

# Monetary Policy and Unemployment

This book pulls together papers presented at a conference in honor of the 1981 Nobel Prize Winner for Economic Science, the late James Tobin. Among the contributors are Masanao Aoki (UCLA), Olivier Blanchard (MIT), Edmund Phelps (Columbia University), Charles Goodhart (LSE), Marco Buti (European Commission), Hiroshi Yoshikawa (Tokyo University and BoJ), Athanasios Orphanides (Fed, US), and Jerome Henry (ECB).

Written in the spirit of the long time Yale Professor, James Tobin, who has held the view that monetary policy is not neutral, this volume provides an analysis of the different economic performances exhibited by the USA, the Euro-area, and Japan in the last decade. Through addressing the potential role monetary policy has on economic growth and unemployment, this book also discusses the new policy rules that, perhaps, should have been and should be used in the future to improve the economic performance of the three regions.

This book will be of great interest to both undergraduate and graduate economic students, academics, and practitioners.

**Willi Semmler** is Professor of Economics at the New School University, New York, and the Center for Empirical Macroeconomics at Bielefeld University.

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The US, Euro-area, and Japan  
*Edited by Willi Semmler*

# **Monetary Policy and Unemployment**

The US, Euro-area, and Japan

**Edited by  
Willi Semmler**



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# 1 Introduction

*Willi Semmler*

## **“Monetary Policy and Unemployment: US, Euro-area and Japan”**

The Economics Department and the Bernard Schwartz Center for Economic Policy Analysis at New School University have hosted a conference on “Monetary Policy and Unemployment in the US, Euro-area and Japan.” The conference, in honor of James Tobin, Nobel Laureate in Economics, has discussed what potential role monetary policy has on economic activity and unemployment reduction in the three currency zones. This event took place on November 22–23, 2002, and was made possible with financial support of the Bernard Schwartz Center for Economic Policy Analysis. The subsequent papers have been presented at the conference. The conference has brought together distinguished macroeconomists from the United States, the Euro-area, and Japan. It has also included practitioners from the Federal Reserve System of the United States, the European Central Bank (ECB), and the European Commission. Some of the macroeconomists included in this volume have made path-breaking contributions to the analysis of the role of monetary policy and unemployment, and the practitioners of monetary policy have brought in their extensive practical experience in effectively implementing the monetary policy. The conference, organized in honor of the late James Tobin, follows up some major themes in his latest work. Encouraged by the work of James Tobin, it is part of an ongoing effort of the Economics Department and the Bernard Schwartz Center for Economic Policy Analysis at New School University to improve our understanding of growth and unemployment in the contemporary world economy. At the conference, there were discussants for each paper, whose work however could not be included in this book because of space limitation. The papers were rewritten after the conference, taking into account the conference discussions and the discussants’ comments.

From the beginning of the 1990s, until the beginning of the year 2000 the US economy went through a considerable boom with annual real growth rate as high as 4–5 percent, low rates of unemployment, and historically very low inflation rates. The other two currency zones, the Euro-area and Japan, also had low inflation rates but suffered from low growth rates and high rates of unemployment: in particular, the Euro-area. The latter two areas did not share the boom with the United States, but they have shared the recession in the years 2001–03.

Academics and politicians have divided opinions on what the real causes of those different performances were and what policies should have been and should be employed to improve the economic performance in those three currency areas.

One view is that the US economy has shown impressively high growth rates in the 1990s because of flexible product, financial, and labor markets, low tax rates, and welfare payments. Consequently, the unemployment rates reached such low levels as 4 percent, in particular in the 1990s. These results have then often been contrasted with the relatively poor performance of European countries and Japan during the same period of time. In Europe, in the same time period, low economic growth has been accompanied by high unemployment rates of up to 10 percent on average. Overregulated product and financial markets, less flexible labor markets, generous welfare programs, expansionary fiscal policies, and high public debt have been seen as the main causes of the weak economic performance of the Euro-area. The policy conclusion is then—one to which many European Central Banks adhered to in the 1990s—that there should be labor market and structural reforms in these regions aimed at enhancing the performance of labor markets. This view emphasized that monetary and fiscal policies should not be implemented before adequate labor market and structural reforms are undertaken.

On the other hand, it has been argued that these regions have historically always shown generous welfare state measures, social security systems, and employment practices that had not affected much economic growth performance in earlier times. In addition, those measures have generated less inequality in the long run. Moreover, supporters of this view are confident that such a strategy will pay off in the long run as the Euro has stabilized now and the increasing potential of large markets in Europe crystallizes. Within this view, the European welfare state, the region's developed infrastructure, and its educated labor force are favorably assessed. A similar optimism is shared for the long run potential growth of the Japanese economy. The view of some observers is that the causes of the weak economic performance in these regions, and particularly in the Euro-area, are found in the tightness of fiscal and monetary policies, which are seen to be an obstacle for growth and job creation.

Another important view sees the problems of European unemployment as arising from structural, in particular nonmonetary factors. Such a structuralist perspective is taken by Edmund Phelps and his coauthors who employ a broader framework to incorporate the role of asset markets and exchange rates. Yet, not only asset prices and exchange rate arrangements are important in their framework, but also business asset investment, expectations and parameter shifts, world interest rates, workers' wealth and entitlements, and tax rates. They also discuss the role of expectations about technical change (and thus productivity growth), confidence in the political climate, and investors' thrust. Many of these forces are not easily measured in empirical studies. However, they are likely to go a long way in explaining differences in growth and labor market performance among the United States, the Euro-area, and Japan. In Japan there are also, as Masanao Aoki, Hiroshi Yoshikawa, and Toshihiro Shimizu argue, other forces that have contributed to the structural problems of the Japanese economy. The main factors

pointed out by Yoshikawa and his coauthors are debt overhang, the increase in deflation pressures, and the increase in uncertainty in the Japanese economy.

James Tobin, in his late papers and talks, has shared the concern of monetary economists on a secular decline of growth rates and rising unemployment in the three currency zones. As concerns monetary policy though he found the non-accelerating inflationary rate of unemployment (NAIRU) a useful economic concept, he was skeptical about what has been called the natural rate of unemployment. He was strongly involved in discussions on the issue of unemployment in those three areas and the entailing policy questions. Among others, it has been in particular the late James Tobin who has pointed to the too tight monetary and fiscal policies, in particular in the Europe-area and Japan, as having caused such an unimpressive growth performance. In the spirit of James Tobin's work this volume intends to elaborate on the earlier views and policy prescriptions by pursuing carefully crafted studies on the labor market and monetary policy in the three currency zones.

In Part I of the book, a more general overview on the trends and problems of economic growth, monetary policy, and unemployment is given by short summary chapters by Olivier Blanchard, Edmund Phelps, and Hiroshi Yoshikawa. They refer in their presentations to all three currency areas—to the United States, the Euro-area, and Japan. One major controversy is to what extent monetary policy has not only short run but also persistent, that is, long run effects on growth and employment. Olivier Blanchard strongly stresses that the NAIRU changes in the long run due to the impact of monetary policy. On the other hand, as Edmund Phelps stresses, there may have been structural, non-monetary factors at work particularly in Europe. A related issue is, whether monetary policy, in Europe but also in Japan, facing the long stagnation of the economy, could have been different from what it actually was. A last issue is, if there are tendencies toward deflation, what role not only monetary but also fiscal policy may play to keep them effective under such circumstances.

In Part II labor market institutions, especially those of the United States and the Euro-area are contrasted and their effects on the performance of the labor market discussed. The view presented here is similar to the earlier first view. Chapters in this part assess the extent to which these institutions have contributed to the differences in the performance of labor markets and persistent unemployment among the two regions. The role of labor market institutions for the long run unemployment in Europe is studied by Olivier Blanchard and Justin Wolfers. David Howell provides a critical evaluation of this view. The macroeconomic research group of the ECB, Alistair Dieppe, Jérôme Henry, and Peter McAdams provide an empirical study on whether the high European unemployment rate can be explained by the natural rate hypothesis or by the hysteresis theory. The effects of monetary policy on the labor market are explored under alternative assumptions on the structure of the labor market in Europe. The study of the causes for the long run stagnation of the Japanese economy and the implications for the labor market, studied by Masanao Aoki, Hiroshi Yoshikawa, and Toshihiro Shimizu is left for Part III of this volume.

Part III extends the framework discussed earlier to incorporate factors other than monetary policy and labor market institutions. The chapters collected here show that also business asset investment, expectations, parameter shifts, real exchange rates, world interest rates, workers' wealth and entitlements, and tax rates and productivity growth are important for the evolution of employment. Edmund Phelps, Hian Teck Hoon, and Gylfi Zoega underline those as important forces behind economic growth and employment. They also discuss the role of confidence in the political climate and investors' thrust. Many of these forces may explain differences in growth and labor market performance between the United States, the Euro-area, and Japan. For Japan, there were, beside the financial market and the debt overhang, as Masanao Aoki, Hiroshi Yoshikawa, and Toshihiro Shimizu argue, other forces that have contributed to the structural problems of the Japanese economy. Among the main factors, as the authors point out, is the increased uncertainty. In a stochastic version of a model with multiple equilibria, they show that the economy got stuck, due to the rise of uncertainty, in a bad equilibrium. In the chapter by Peter Flaschel, Gang Gong, and Willi Semmler, it is shown, using the example of the German economy, that both the dynamics of the economy as well as monetary policy rules are significantly impacted and constrained by the exchange rate system. The core of their model is an estimated open economy price and wage Phillips curve for Germany, which allows evaluating the different monetary policy rules and their success to impact employment and inflation in the open economy context.

In Part IV monetary policy rules and fiscal policy are discussed more specifically. Charles Goodhart describes the institutional changes that, in his opinion, have affected both monetary and fiscal authorities in Europe. He argues that monetary policy has to be considered in the context of fiscal policy and macromonetary policies against asset price movements. There were many constraints to effective monetary policy in the Euro-area such as the lack of reputation of the new ECB, the decentralization of fiscal policies, and the absence of real labor mobility across regions. Recent academic studies have proposed direct inflation targeting as a possible optimum solution for the threat of high inflation. Many of these studies suggest replacing traditional rules, based on the control of money growth, by other rules such as the Taylor Rule. The Taylor Rule sets both output and inflation targeting goals for the monetary authorities, although in practice they mostly emphasize the latter. Chapters by Orphanides and Moreno concentrate on these new monetary policy rules and study the new policy rules in action. The last chapter studies the constraints on fiscal policy. Marco Buti and Paul Van den Noord, by discussing the currently ongoing tax reform as a policy tool in the Euro-area countries, suggest that there may be a trade-off between efficiency and stability in the Euro-area economies. An increase in economic efficiency—through tax cuts and a reduction in public spending—may lead to a rise in the long run instability of the Euro-area economies.

Finally, we want to note that frequently the most important cause for a constrained monetary policy, which was also initially stressed by the Bundesbank and more recently by the ECB, has been seen in the lack of reputation of the

ECB and the threat of high inflation. Yet, as also the chapters in Part I of the volume confirm, there may be considerable risk of deflation rather than inflation in the three currency areas. If this is so, as Olivier Blanchard in his contribution in Part I argues, this appears as a new challenge to monetary as well as fiscal policies in the three currency zones.





## **Part I**

# **Overview**

Unemployment and monetary policy in  
the three currency areas



## 2 Monetary policy and unemployment

*Olivier Blanchard*

I was asked for my thoughts on monetary policy and unemployment. I shall build on the themes developed at this conference, and do my best to be provocative.

1. *Monetary policy can have large and long-lasting effects on real interest rates, and by implication, on activity.* What I mean here is really large, and really long lasting, a decade or more. This conclusion is at odds with much of both the recent empirical work and the recent theoretical work on the topic:

The large empirical literature based on structural vector autoregressions (VARs) suggests that the effect of an innovation in money on activity peaks after a year or so, and is largely gone within 2 or 3 years.

The large theoretical literature based on an equation for inflation derived from Taylor-Calvo foundations gives roughly the same results. A change in money growth has its maximum effect on activity after a year or so, and the effect is again largely gone within 2 or 3 years.

Neither literature is totally convincing.

The type of money shocks whose effects are traced by VAR impulse responses are deviations from normal monetary behavior, and thus (even if identification is convincingly achieved and these are truly deviations, rather than noise) are likely to have different effects from the nondeviation part of policy.

The Taylor-Calvo inflation equations have many merits. They capture something essential, namely the staggering of price and wage decisions. They can be derived from microfoundations. They provide a simple and elegant characterization of the relation between inflation and activity. But, as we all know, they do not fit the data. There is much more inertia in the behavior of inflation than these equations imply.

And, taking a step back, I see the evidence on the relation between monetary policy and real interest rates as speaking very strongly, and very differently. Think of the evolution of *ex ante* real interest rates (use your favorite measure of inflation

expectations to do that; my point is robust to all plausible variations) over the last 30 years in OECD countries:

For most of the 1970s, *ex ante* real rates were very low in most countries. This was due—as a matter of accounting, not in a causal sense—to a large increase in inflation, and a less than one-for-one increase in nominal interest rates. Who can doubt that the evolution of real rates was due to monetary policy? That, faced with an increase in inflation triggered by supply-side shocks, central banks were too slow and too reluctant to increase nominal interest rates, leading to low or even negative real interest rates for a good part of the decade. There may be other interpretations, arguing that the evolution of real interest rates was the result of shifts in investment or saving, and had nothing to do with monetary policy. I have not seen a plausible account along those lines.

For most of the 1980s, *ex ante* real rates were high in most countries. This was due, again as a matter of accounting, to a large increase in nominal interest rates, together with a decrease in the rate of inflation. Again, who can doubt that this evolution was primarily due to monetary policy? In every country, one can trace the sharp increase in interest rates to an explicit change in monetary policy, be it the change under Margaret Thatcher in the United Kingdom in the late 1970s, the Paul Volcker disinflation in the United States in the early 1980s, the competitive disinflation strategy in France a few years later. The case can also be made a contrario: The experience of Germany, with a much more stable monetary policy, and little change in real interest rates, either in the 1970s or the 1980s, reinforces the argument.

Again, there may be plausible nonmonetary accounts for these high real rates (Here, for the sake of internal consistency, I must mention one, that I explored in a paper with Larry Summers in the mid-1980s, in the face of the joint increase in interest rates and stock prices: An increase in anticipated profitability, increasing present values and putting pressure on long real rates. I still believe that this was a relevant factor. But I also believe that much of the evolution of real interest rates in the United States during the decade had to do with monetary policy).

If we accept those two facts, we must reach the conclusion that, while money is eventually neutral, and the Fisher hypothesis holds in the long run, it takes a long time to get there. (This was indeed Milton Friedman's view.) But, if we accept the fact that monetary policy can affect the real interest rate for a decade and perhaps more, then, we must accept, as a matter of logic, that it can affect activity, be it output or unemployment, for a roughly equal time. (Maybe one can think of models where the real rate returns to the natural real rate slowly, but output returns to its natural level faster. The models we use imply that the two should return to their natural level at roughly the same speed.)

In short, monetary policy is potentially much more powerful (although we may not want to use that power) than is often assumed in current debates.

2. *Monetary policy affects both the actual and the natural rate of unemployment.* The first part of the proposition is obviously not controversial. But, studying the evolution of European unemployment, I have become convinced that the second part is also true, that monetary policy can, and does, affect the natural rate of unemployment:

Again for the sake of internal consistency, let me start with a channel I explored, again with Larry Summers, in the late 1980s, namely hysteresis. There, we argued that anything that increased the actual rate of unemployment for sufficiently long—such as, for example, a sustained increase in real interest rates induced by monetary policy—was likely to lead to an increase in the natural rate. Our original explanation, that the goal of those employed was simply to keep their jobs, not create jobs for the unemployed, was too crude. It ignored the pressure that unemployment puts on wages, even when bargaining is only between employed workers and firms. But, even if full hysteresis (a unit root) is unlikely, one can think of many channels, from the unemployed given up search, to the unemployed losing skills, to endogenous changes in labor market institutions, which imply that sustained high unemployment will lead to an increase in the natural rate itself. Sadly, I must admit, I still do not have a good sense today of how important this channel really is.

A much more conventional channel for the effects of real rates on the natural rate is through capital accumulation. Real interest rates affect the cost of capital; the cost of capital affects capital accumulation; the capital stock affects the demand for labor; the demand for labor affects unemployment. For all this to be of relevance for monetary policy, monetary policy must be able to affect real interest rates for a long period of time. But this is the point I just argued earlier was also true.

I believe that this mechanism plays an important role in accounting for the history of unemployment in Europe over the 30 years. Low real interest rates in the 1970s probably partly mitigated the increase in labor costs on profit, limiting the decline in capital accumulation, and thus limiting the increase in the natural rate of unemployment in the 1970s. High real interest rates in the 1980s (and then again, as a result of the German monetary policy response to German reunification, in the early 1990s) had the reverse effect of leading to a larger increase in the natural rate of unemployment during that period. And the decrease in real interest rates since the mid-1990s is probably contributing to the slow decline in unemployment in Europe.

Are there other mechanisms at work? The real business cycle has focused on effects of the real interest rate on labor supply. Ned Phelps has focused on the effects of the real interest rate on the markup of firms. My sense is that interest rate induced movements in the markup may be of relevance, but the capital accumulation channel strikes me as more obvious, and probably more important.

A detour here on an exotic but perhaps important labor supply channel. I have been struck in the recent past by the (so far anecdotal) evidence on the effects of stock market movements on retirement decisions. In an economy in

which most people have defined contribution plans, and in which there is no mandatory retirement age (both conditions are necessary, and are satisfied in the United States), a decrease in the stock market appears to lead many older workers to continue working, so as to maintain their desired level of consumption during retirement. The recent stock market decline has not been due to high interest rates. But the logic would be the same if it had. It may well be that we have moved to an economy in which increases in the interest rate lead to a fall in asset prices, and, in response, an increase in the participation rate of older workers.

A last point here, on the relation between unemployment and inflation. The implication of the earlier argument is that a sustained increase in real interest rates leads first to an increase in the actual unemployment rate (the usual aggregate demand effect) and later, as capital accumulation decreases, to an increase in the natural rate itself. If we think of the pressure on inflation as depending on the difference between the actual and the natural unemployment rates, then, as the natural rate increases, the pressure on inflation from a given unemployment rate will decrease over time. In other words, sustained tight money may have less and less of an effect on inflation over time (the same argument applies if hysteresis, i.e. some effect of the actual rate on the natural rate, is at work).

3. *The ECB failing is in its words, not in its deeds. But words matter very much.* ECB bashing is a popular sport, especially on this side of the ocean. I am not sure it is justified.

The ECB, like many other Central Banks, has adopted inflation targeting (the other pillar,  $M3$ , is mostly for show). Inflation has remained for most of the period above the ECB target, so it is no surprise that the ECB has not embarked on the same kind of drastic interest rate cuts as the Fed over the past few years.

There is, however, an irony to the use of inflation targeting. To noneconomists—that is, to most economic agents, from consumers to firms—inflation targeting as the exclusive goal of Central Bank policy sounds heartless: How can the Central Bank put no weight on output stabilization?

In fact, as we (economists) know, inflation targeting is actually an activist policy, a commitment by the Central Bank to keep output close to its natural level, and so unemployment close to the natural rate: If inflation is kept close to the target, expected inflation will be close to inflation, and so, by the definition of the natural rate—that unemployment rate such that actual and expected inflation are the same—unemployment will be close to the natural rate.

The problem of the ECB is not therefore with the policy it has followed. But it is with the way it has sold it to the public. Its public relations have been dismal.

It has not explained what inflation targeting actually did, how it was as much of a commitment to help Euro economies get out of a recession, as to fight inflation. Worse than that, it has been ambiguous about the symmetry of the target, and thus about its commitment to decrease interest rates if inflation became low. (Compare the rhetoric of the ECB to the careful explanations given by the Central Bank in the United Kingdom. The policies are much more similar than the words.)

The issue is that not only policy, but also public relations matter very much: They shape expectations, which in turn determine spending, and output. Today, in Europe, the private sector feels that it is very much on its own. It is not sure the ECB will help if the slump continues. It is not sure, given the constraints imposed by the Stability and Growth Pact, that fiscal policy can help. I suspect this explains, in part, the pessimism which permeates Europe at this point, and in turn contributes to the current slump. The contrast with US policy could not be stronger.

*4. Europe could easily fall in the liquidity trap.* I worry very much about the liquidity trap. Ten years ago, we thought of this as an exotic case. Japan has shown it could happen.

Japanese economic policy bashing is also a popular sport, and it strikes me also as largely unwarranted. Japanese policy was not that crazy for most of the 1990s. Interest rates were decreased, in retrospect a bit too slowly. Expansionary fiscal policy was used, admittedly with ebbs and flows, but who would not be scared about running such large deficits for so long? The hope was that, with a turnaround in the economy, asset prices would recover, and balance sheets of banks would improve. These hopes did not pan out, but how many of the current critics predicted this outcome in the early 1990s? (A major question is why this fiscal cum money expansion is insufficient to avoid getting into the trap. I do not know the answer.)

I am also unconvinced by a number of recent papers arguing that, under existing policies, this is unlikely to happen elsewhere. I think the same set of events could well happen again. Economies which try to aim for very low inflation (0–2 percent), and put sharp constraints on fiscal policy, are playing with fire.

Let me sketch a scenario on which I put positive probability. The current account of the United States is very large. It is absorbing about 30 percent of non-US world net saving, and this will not last forever. When foreign capital flows slow down (and they will) the current account will have to decrease, the dollar will have to depreciate. And the only currency it can really depreciate against is the Euro. My sense is that macroeconomic policy in the Euro zone is not ready to react to a major appreciation of the Euro. The room for monetary policy is small, the room under current Pact rules for fiscal policy equally limited. The risk of going to the two limits and still being in a recession with deflation strikes me as substantial.

What is there to do? The usual and unsatisfactory response: Europe should not have gotten there in the first place. I believe that a 2 percent inflation target, and the associated 4 or 5 percent nominal interest rate are too low, leaving too little room to decrease interest rates if needed. The second answer is: Beware of analogies. Analogies are only pseudologic, and pseudologic can be dangerous. A really dangerous analogy is “Keep your powder dry.” Central banks should do precisely the opposite: Try by all means to avoid getting into the trap. When close to it, do more rather than less. The third is: Think harder about how to use fiscal policy. This takes me to my last point.

5. *We need to rethink fiscal policy and redesign automatic stabilizers.* Discussions of fiscal policy suffer from schizophrenia:

We all seem happy to accept variations in the budget due to automatic stabilizers. The argument for allowing the automatic stabilizers to operate is indeed a convincing one. They allow for countercyclical fiscal policy, but avoid the dangers of discretionary fiscal policy. Because of their automatic nature, they are more likely to avoid the perverse effects—the negative fiscal multipliers—that appear to characterize some discretionary fiscal expansions.

What automatic stabilizers a country has however, and how strong they are, is entirely based on past decisions that typically gave no weight to output stabilization. A country with a more progressive income tax structure has stronger stabilizers. Was this intended? Almost surely not.

Clearly, if we like automatic stabilizers, we should not be blindly accepting what history left us, but thinking hard instead about how to design the tax/transfer system so as to achieve the optimal degree of optimal automatic stabilization (an argument made recently by Martin Feldstein, that I strongly second). Our profession is nearly silent on this issue, and I believe we can do much better.

Many of the things that monetary policy does could be done by fiscal policy. This will be most useful if the economy is in a liquidity trap, but may be useful even away from it.

This is not to say, fiscal policy can do everything monetary policy can do. Suppose, for example, that you want to decrease the cost of capital. This can be done through expansionary monetary policy. It can also be done through fiscal policy and interest rate subsidies. The problem, however, is that the cost to the budget is likely to be enormous. Suppose you want to decrease the cost of borrowing on mortgages by 1 percent. You can do this through expansionary monetary policy, and a decrease in the appropriate long real rate. While the effect will be initially on flows, refinancing, if sufficiently attractive, will eventually lead to an effect on the whole stock. Or you can do it through a 1 percent tax subsidy for existing mortgages. Mortgages outstanding in the United States at this point are around 6 trillion dollars, so the subsidy will be equal to roughly 60 billion dollars. This is a very large number, and if this is to be a balanced budget, requires a large increase in taxes elsewhere. Much better to leave this to monetary policy. (The size of the transfers between borrowers and lenders are exactly of the same magnitude under monetary policy. But they are stealthy, and do not explicitly involve the budget.)

There are however fiscal policy instruments, which can have a strong effect on spending at a much lower cost to the budget. Conceptually, they are those that lead firms or consumers to shift spending over time, and work through intertemporal substitution. The best known example here is that of the investment tax credit. Starting from an example from Sweden, John Taylor wrote a beautiful Brookings paper 20 years ago, showing how such a cyclical investment tax credit could be



put in place and used to smooth fluctuations. We should explore it again, together with other cyclical tax credits, on consumer durables for example. In the new monetary policy environment, choosing automatic stabilizers optimally, and having a fiscal policy that responds quickly and strongly to movements in activity is a high priority.

### **Acknowledgments**

Remarks made at the Conference “Monetary policy and the labor market. A conference in honor of James Tobin,” held at the New School, November 2002. I thank Francesco Giavazzi and Justin Wolfers for comments.

### 3 Some notes on monetary policy and unemployment

*Edmund Phelps*

Let me start with a few comments on the causes of the tremendous boom in the second half of the 1990s, which certainly occurred in the United States and in a few other economies, but was notable for its absence in most of the largest economies of the European continent. With that interpretation of the boom in hand, I would like to voice some thoughts on monetary matters, in part responding to the provocative comments just made by Olivier Blanchard.

#### **The boom of the second half of the 1990s**

My interpretation of the boom is reflected in Figure 3.1, which, of course, is a highly stylized, almost fanciful depiction of what happened. The real story is no doubt a 100 times more complex.

In the figure we place employment, expressed as 1 minus the unemployment rate,  $u$ , along the horizontal axis, and on the vertical axis we essentially have what in macroeconomics is called Tobin's  $Q$ . Let me, however, decompose Tobin's  $Q$  into its denominator and its numerator. The latter,  $q$ , is the value per unit that firms place on the business assets and, for convenience, I have supposed that the only business asset firms have is the job-ready employee. The employee needs to have special, firm-specific training in order to be effective; so it is costly to train new employees. It is an investment just as buying some bricks and water and shaping them. The denominator is the opportunity cost of this training, which is given by existing employee's productivity  $\Lambda$ .

The downward sloping line in the figure shows the steady value of the business asset taken as a ratio to the productivity of the employees. Thus, it depicts  $Q$  to be a decreasing function of the tightness of the labor market. When the employment rate  $(1 - u)$  is very high, turnover costs are high. Employees quit a lot for greener pastures elsewhere, and that poses high costs to firms, narrowing profit margins and forcing a downward revision in the value they place on having each employee.

The upward sloping curve says, the higher the value that firms put on the employee as a ratio to their productivity, the more ultimately they will accumulate of those employees. The higher the value that firms—the managers, the CEOs, or what not—place on each employee, the higher the steady state level of the employment rate  $(1 - u)$ .

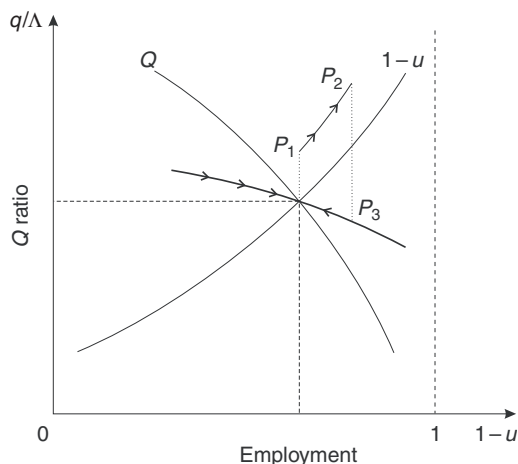


Figure 3.1 Effects of a suddenly and correctly anticipated future productivity shock.

Last, the heavy line is the path that the economy actually takes. It is sort of a glide path, leading to the rest point. In standard macroeconomics, a lot of attention is given to vibrations, up and down, along this path; the economy gets knocked out of the rest point and then goes back to it.

What I now want to talk about, using Figure 3.1 is nineteenth-century style investment booms, prompted by entrepreneurial visions of new investment opportunities. What happens if firms suddenly expect at the present time ( $t_0$ ) that at some specific future date ( $t_1$ ) there is going to be a doubling of the productivity parameter? That is going to mean that in the new steady state,  $q/\Lambda$  will be back to where it was before, so it must be that  $q$  has doubled also. If everybody knows that the assets that they are holding in their possession are going to be worth approximately twice as much by  $t_1$ , this is going to cause an immediate jump in the value placed on these assets now. This is reflected in the figure,  $q$  jumps from its original rest point, precipitating investment in the business asset. The result is a hiring boom and, if everything works out according to the expected scenario—expectations hold firm and they are realized—at  $t_1$  the cumulative near-doubling of  $q$  will actually occur. At that point,  $q$  will be divided by a denominator twice as big, resulting in a jump down of the ratio to point  $P_3$  and then slowly back to where it started.

Things did not work out all that way in the most recent investment boom. Initial expectations were vastly too rosy. What happened then is that, somewhere in the middle of the boom, doubts began to occur that productivity would increase by enough to justify the explosion in business asset values that occurred between 1995 and 2000. When expectations were revised downwards and new expectations were formed of a much lower increase at  $t_1$ , problems arose.

To make it simple, let's assume that in our model no future increase in productivity is now expected whatsoever. With no future shock to productivity any longer expected, you still need to jump back to the saddle path. Now, however, it is a reduction in  $q$ —and not the rise in  $\Lambda$ —that takes the economy there. The reader can insert this case into Figure 3.1. This is precisely what we saw. We saw, at the very time when things were looking the most miraculous, with an unemployment rate down to 3.9 percent, that asset values, as reflected in the stock market, dropped enormously.

For me this development did not reflect well on our economic institutions. In addition, when firms ran into difficulties, some participants behaved very badly. We are learning a lot about how poor some of our corporate governance is. We do not have effectual boards of directors. Nor do we have a financial sector that is doing everything we expected it to do. Partly as a result of this disillusion and outright anger, the CEOs are ducking for cover. This is, perhaps only to some small extent, itself a reason for the declining investment rate of many corporations.

Therefore, in my thinking about the boom, monetary policy did not play a fundamental part in creating the boom. It did not play a fundamental role in ending it either. Nevertheless, there are important questions about monetary policy that have been posed and that I would now like to address.

### **Contemporary monetary policy**

I am not one of those who feel that monetary policy makes no difference, and that nonmonetary models describe everything you ever wanted to know about the economy. For example, I would think that the monetary authorities could give a push to employment, increasing it temporarily until the economy would get back to the original steady state. One reason Central Banks do not constantly do this sort of thing is that they would then lose credibility. Central Banks almost always follow the rule that they are professing. Another drawback is that inflation may increase unacceptably if the Central Bank drives too fast.

Some people understand the logic of that position, but argue that there is something called hysteresis out there. If the Central Bank were to give a temporary boost to the economy, the economy would not go back to the old rest point but to a superior one. The economy would, somehow, be transformed into a healthier, more effective, more dynamic one, with a better rest point than the one it currently has. If this is the case, at least this one time—and perhaps this one time only—the Central Bank ought to step on the gas and increase liquidity. Some of the best economists in the country have been quite taken with this idea of hysteresis. I myself looked at hysteresis in 1972, having learnt the word from Paul Samuelson. I argued then that hysteresis is an important cause of depression, and that it gives a tragic note to an unnecessary depression because out of that depression there are all sorts of permanent hurts.

However, is it true that out of a depression comes a permanent worsening of the equilibrium or natural rate of unemployment? There is still disagreement on that point. There is a paper by Gylfi Zoega and Mario Bianchi, which casts

considerable doubt on the empirical importance of hysteresis. There is also a recent paper by David Papell in the Review of Economics and Statistics—about a year or two ago that looks at 17, 18, or 19 OECD countries over three or four decades. On the whole he finds little evidence of hysteresis.

Is then nothing to be said for monetary stimulus? Some people say that there is nothing basically wrong with the American economy. The natural rate of interest has fallen, and what we need is a corresponding fall in interest rates; if we get that reduction in interest rates, we will move back to normal levels of employment once more. Unless and until we get that further reduction in interest rates, we are going to be stuck in this quasi-depressed state, which seems depressed to us after the accelerating boom although it is better than anything we had in the 1980s. I am inclined to agree that the Central Bank must avoid doing harm. True, we had a tremendous loosening of monetary policy, we had a big drop of interest rates—good job by Alan Greenspan, it was a little late but he did it—but maybe it is not enough. Maybe we are going to suffer a further downturn of employment because we did not get the monetary policy quite right. However, the jury is still out on that one; reasonable people can disagree.

I do not agree with the claim or assumption that the unemployment rate of 3.9 percent that we had before was normal, and that what we have now, with an unemployment rate of 5.7 percent, is something abnormal. A percentage of 5.7 seems like normalcy. It is not good enough for me; I am sure it is not good enough for you, but it is normalcy. If we want to change that normalcy, we have to do some brain surgery on the economy—I do not think that monetary policy can get us back to 3.9 percent.

I would like to add one note about Europe. Many people say that, while monetary policy cannot be convicted of primary responsibility for the present volume of unemployment in the United States, in Europe monetary policy is demonstrably, visibly too tight. They argue that if the European Central Bank were to cut interest rates by anything like the amount that Alan Greenspan and the Federal Reserve cut them here, then Europe would soon be in much, much better shape.

Again, just as I am inclined toward a fundamentally nonmonetary interpretation of the recent boom and retreat, it seems to me that there are good nonmonetary reasons for the downturn that is occurring in Europe. It is true that they did not make all the bad investments that we did, they only made some of them, but they made some beauties—some very bad investments in 3G telecommunications for example. Moreover, many of the tremendous increases in capacity created by American corporations have marred what, otherwise, would had been good opportunities for Europeans. Europeans just missed the boat; and the fact that the United States overdid it and overbuilt in several areas, may have hurt Europe on balance. Maybe that is why Europe has, to its surprise, suffered a downturn even if it did not have an upturn to show for it.

# 4 The long stagnation of the Japanese economy during the 1990s and macroeconomic policies

*Hiroshi Yoshikawa*

It is useful to begin with some comments on the Japanese growth record in the postwar era. Aoki, Yoshikawa and Shimizu show it in Figure 9.1 of Chapter 9 in this volume. During the 1950s and 1960s, the average growth rate was 10 percent; it was an era of high growth. The average growth rate went down to 4 percent in the 1970s and 1980s. During the 1990s, the average is only 1 percent.

I presented the model that Professor Aoki and I are working on to explain the long stagnation during the 1990s. Now I would like to introduce you to several alternative explanations of the fall in the rate of growth. Obviously, everybody in Japan is interested in why this happened. Of course, there are always cyclical ups and downs. Thus even in the lost decade, there was an expansionary phase during 1995 and 1996, but most people are interested in the long run problem, namely why the economy has stagnated for so long.

A popular argument is demography. As you must know, in Japan aging proceeds very rapidly. To my knowledge, the speed of Japan's aging is comparable only to that of Italy and Spain. The working population is expected to decline by 0.6 percent per year for the next 20 years. It is interesting to think what kind of growth theory you have when the natural rate of growth,  $n$ , is negative. Anyway, many people argue that, given these circumstances, 1 percent growth may be the most we can hope for; that 1 percent is the potential or natural growth rate. I do not subscribe to this argument, but it is very popular.

Also recently, Fumio Hayashi, my friend and colleague at the University of Tokyo, and Edward Prescott, the champion of real business cycle theory, wrote a paper on Japan explaining the long stagnation from a real business cycle perspective. Basically, they claimed that this stagnation was due to stagnant total factor productivity. I am not ready to buy this argument, either and I think that we need to find other explanations.

Monetary policy and the credit crunch had clearly something to do with the poor performance of the Japanese economy. You must know that bad loans are a very serious and much discussed problem in Japan. Bad loans have contributed to the very poor performance of the economy. This again is a very popular argument and I have shown earlier, the growth rates of the monetary base, broadly defined, money growth, and bank lending. The monetary base is recently growing

by 35 percent per year, but money is growing only by 2 percent per year and bank lending by  $-2$  percent. Many people, including people at the Bank of Japan (BOJ), argue that this record is due to bad loans, and that the banking system is not working. Hayashi and Prescott, by the way, dismiss this kind of argument, and believe that money has little to do with the poor performance of the Japanese economy.

Let me now go on to the discussion of monetary policy. As I explained our problem is that (short-term) interest rate fell to zero-bound. In this “liquidity trap,” what would be the transmission mechanism of further monetary expansion. One popular channel is the expected inflation rate. To me, the transmission mechanism based on the exchange rate seems more promising. While the evidence is not very strong, it appears that there is some correlation with some lag between the exchange rate and deflation. When the exchange rate depreciates, deflation seems to stop; when the exchange rate appreciates, deflation worsens. Thus, many of us living in Japan are looking forward to a depreciation of the yen to cure the problem of deflation.

Going back to the interest rate, which is zero, a very heated discussion in Japan is, what the BOJ can do now. As I have said earlier, a popular argument is that the BOJ can still be expansionary by putting more money in the economy and thus generating inflationary expectations. In this case, even if the nominal interest rate is zero, the expected real interest rate will decline and will encourage investment. Most of the people at the BOJ, however, do not like this argument. I am not defending the BOJ here, but I am also very skeptical. Many economists here in the United States seem to think that the BOJ is afraid of hyperinflation. That would be nonsense, of course, because now we are having deflation. The issue seems to lie elsewhere, however.

The people who favor monetary expansion which is supposed to generate inflationary expectations seem to have the following logic in mind. First of all, there is only one road to inflation. We should use it now and when inflation comes to 2 or 3 percent we just stop. This is what the Central Bank can always do. However, there may be actually two different roads to inflation; in other words, the road to 2 or 3 percent mild inflation and the road to hyperinflation may be different. Let’s recall the episodes of hyperinflation in history. None of them started with sudden extraordinary monetary expansion initiated by Central Bank. Most of them had real causes such as war. A gigantic real shock such as war leads to monetary accommodations and thus to hyperinflation. You need a great real shock in the first place, but at the same time, it is also true that monetary accommodations are necessary to cause hyperinflation. It is in this sense that inflation is a monetary phenomenon, as economists like to say. In history no hyperinflation occurred because a Central Bank was foolish enough not to stop gradually increasing inflation, however.

The mild inflation is a wholly different matter. It is rather difficult for the Central Bank to generate 2 or 3 percent inflation by simply putting more money into the economy. I am not quite sure whether mild inflation can be reasonably called a monetary phenomenon. I would prefer the logic of the Phillips curve.

To summarize, the channel of inflationary expectations leading to the reduction of the expected real interest rate and a recovery of investment seems less promising to me than the transmission mechanism based on the depreciation of the exchange rate. But here comes the problem of international relations, because for Japan it is not easy to depreciate the yen without the consent of Washington. Exchange rates are surely not easy to handle, but, if possible, Japan should depreciate the yen, for a while, say to ¥130 or 140 per dollar. Jeff Sachs has suggested ¥180 and we would certainly welcome it.

Finally, let me make a comment on fiscal policy. Here the scope is very limited because debt outstanding is 140 percent relative to GDP. Still many of us think that the type of tax cut that Professor Blanchard proposed in his presentation—tax cuts that would push investment such as the investment tax credit—appears to be promising. In fact, probably within the next month, the Japanese government will announce a tax cut of this kind.



## **Part II**

# **Labor market institutions and unemployment**



# 5 The role of shocks and institutions in the rise of European unemployment

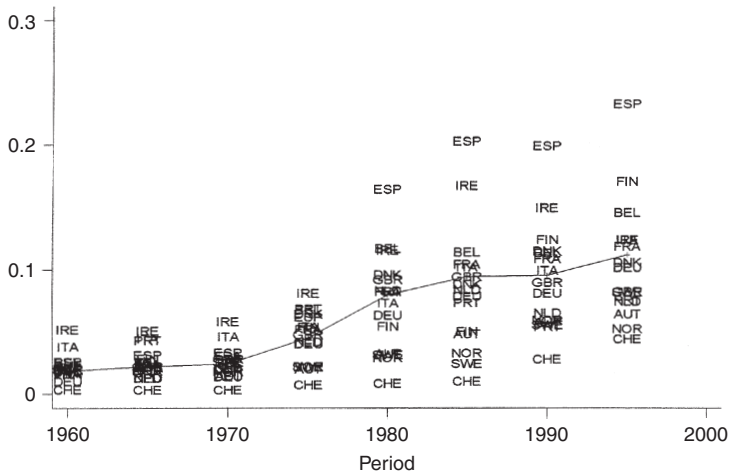
## The aggregate evidence

*Olivier Blanchard and Justin Wolfers*

Figure 5.1 shows the evolution of unemployment in Europe since 1960. The figure plots average unemployment rates over 5-year intervals, starting in 1960, both for the OECD-Europe as a whole (the line) and for 15 individual OECD-Europe countries.<sup>1</sup> It shows the increase in the overall unemployment rate, from 1.7 percent in the early 1960s to 11.0 percent in the mid-1990s, together with the large dispersion in unemployment rates across countries, from 4.0 percent in Switzerland to more than 20 percent in Spain in the mid-1990s.

Explanations for these evolutions fall into three classes:

- Explanations that focus on the role of adverse economic shocks. Adverse shocks can indeed increase the unemployment rate, at least for some time. And there are many plausible candidates for such adverse shocks over the last 30 years. As unemployment started rising in the 1970s, the focus was on oil price increases and the total factor productivity (TFP) growth slowdown. Since then, the evolution of the real interest rate, and other shifts in labor demand have been added to the list. Explanations based solely on shocks run, however, into a major empirical problem. Shocks can potentially explain the general increase in unemployment over time. But, as we shall see, they do not differ enough across countries to explain the cross-country variation so evident in Figure 5.1.
- Explanations that focus on the role of adverse labor market institutions. Labor market institutions affect the nature of unemployment, and some can indeed potentially generate a high unemployment rate. With the persistence of high unemployment now for more than two decades, explanations based on adverse institutions (“labor market rigidities”) have become steadily more popular. Explanations based solely on institutions also run, however, into a major empirical problem: many of these institutions were already present when unemployment was low (and similar across countries), and, while many became less employment-friendly in the 1970s, the movement since then has been mostly in the opposite direction. Thus, while labor market institutions can potentially explain cross-country differences today, they do not appear able to explain the general evolution of unemployment over time.



*Figure 5.1* Unemployment Rate, E15.

Note

Line links average unemployment rate for the E15. Mnemonics are listed in Note 1.

- Explanations that focus on the interaction of adverse shocks with adverse market institutions. Some institutions may affect the impact of shocks on unemployment. For example, better coordination in bargaining may lead to a faster adjustment of real wages to a slowdown in productivity growth. Some institutions may affect the persistence of unemployment in response to shocks. For example, if labor market institutions lead to a labor market with long unemployment duration, adverse shocks are more likely to lead some of the unemployed to become disenfranchised, reducing the pressure of unemployment on wages, thereby slowing, and possibly even halting the return to lower unemployment. It is easy to see what makes this third class of explanations attractive. It has the potential to explain not only the increase in unemployment over time (through adverse shocks), but also the heterogeneity of unemployment evolutions (through the interaction of the shocks with different labor market institutions).

In an earlier work (Blanchard 1999), we took stock of the underlying alternative theories. We looked at whether and how different shocks and different institutions may affect the unemployment rate. We looked at the channels through which shocks and institutions might interact. This led us to argue in favor of the third class of explanations. In this chapter, we look at the aggregate empirical evidence more formally, at the role of shocks, institutions, and interactions, in accounting for the evolution of European unemployment.

To do so, we look at the data through two panel data specifications. In the first, we assume unobservable but common shocks across countries. In the second, we

construct and use country-specific time series for a number of shocks. In both specifications, we allow for an interaction between shocks and institutions: The effect of a given shock on unemployment is allowed to depend on the set of labor market institutions of the country.

We see the results as surprisingly (at least given our priors) good: specifications that allow for shocks, institutions, and interactions can account both for much of the rise and much of the heterogeneity in the evolution of unemployment in Europe. The magnitudes of the effects of the shocks on unemployment are plausible. The magnitudes of the effects of institutions are equally so. And their interactions explain much of the difference across countries.

These results notwithstanding, three caveats are in order. First, the results are preliminary. In many cases, we do not have time series for institutions, and the series we have may not be very good. Second, the results are typically weaker when we allow for time-varying, rather than time-invariant, measures for institutions. This gives some reasons to worry. Last, the fact that the specifications fit the data does not prove that the underlying theories are right; just that they are not obviously inconsistent with the aggregate data.

We believe we are the first to analyze the panel data evidence looking simultaneously at shocks, institutions, and interactions. But we build on a large number of previous studies. Bruno and Sachs (1985) were among the first to emphasize both shocks and institutions in the initial rise in unemployment. An empirical attempt to explain UK unemployment as a result of shocks, institutions, and interactions was presented by Layard *et al.* (1991) in their book on unemployment. Two recent influential studies are by Phelps (1994) and by Nickell (1997). We differ mostly from Phelps by allowing for institutions, and for interactions. We differ mostly from Nickell by allowing for observable shocks, and by having a panel data dimension going back to the 1960s. Our results are partly consistent with those of Phelps with respect to shocks, and largely consistent with those of Nickell with respect to institutions.

Our chapter is organized as follows: The first section looks at shocks, both across countries and over time. The second section does the same for institutions. The third section discusses potential interactions between shocks and institutions. The fourth section reports the results of estimation under the assumption of unobservable but common shocks across countries. The fifth section reports the results of estimation using country-specific time series for shocks. The final section concludes.<sup>2</sup>

## **Shocks**

Three shocks appear to have played an important role in the increase in European unemployment. (This short declarative sentence conveys more certainty than is justified. Caveats follow.)

### ***The decline in TFP growth***

Starting in the early 1970s, Europe suffered a large decrease in the underlying rate of TFP growth. This is shown in Figure 5.2.<sup>3</sup> The two lines in Figure 5.2(a) give the

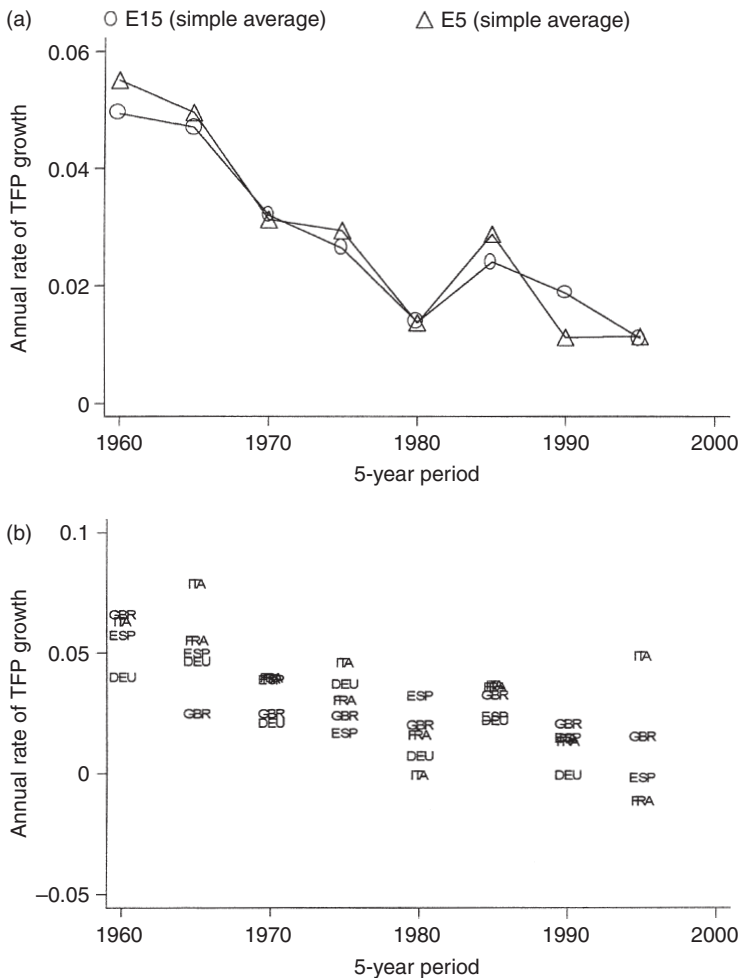


Figure 5.2 TFP Growth (a) E15 and E5; (b) E5.

evolution of the average rate of TFP growth for the 15 countries of OECD-Europe (E15 in what follows) and for the five largest European countries, France, Germany, Italy, Spain, and the United Kingdom (E5). To give a sense of the heterogeneity across countries, Figure 5.2(b) gives the evolution of TFP growth in each of the E5 countries. (Showing all 15 countries would clutter the figure but yield similar conclusion.) TFP growth which had been close to 5 percent in the 1960s decreased to 3 percent in the first half of the 1970s, and to 2 percent in the second half of the 1970s. It has remained around 2 percent since then. The decline has affected countries in roughly similar fashion.<sup>4</sup>

The decrease in TFP growth was initially partially hidden by the large increase in the relative price of oil and other raw materials. Thus, much of the focus of the initial research (e.g. Bruno and Sachs (1985)) was on this increase in relative prices rather than on the slowdown in TFP growth. In retrospect, the slowdown in TFP growth from its unusually high level in the first 30 years after Second World War was surely the most important shock of the period.<sup>5</sup>

There is no question that a slowdown in TFP growth can lead to a higher equilibrium unemployment rate for some time (we prefer to use “equilibrium rate” rather than “natural rate,” but the meaning is the same). All that is needed is that it takes some time for workers and firms to adjust expectations to the new lower underlying rate, leading to wage growth in excess of productivity growth for some time. Can the effects of such a slowdown on unemployment be permanent? Theory suggests that the answer, to a first approximation, is no. Once expectations have adjusted, the effect on unemployment should mostly go away. There lies the first puzzle of European unemployment. The initial shock is clearly identified. But, after more than 20 years, it is hard to believe that its effects are not largely gone. So, what accounts for today’s high unemployment? There is much less agreement here, but two other shocks appear relevant.

### ***The real interest rate***

Figure 5.3(a) gives the evolution of the average real interest rate for both the E15 and the E5. Figure 5.3(b) gives the real interest rate for each of the E5 countries.<sup>6</sup>

Figure 5.3 shows that, both for the E15 and E5 countries, the real rate turned from positive in the 1960s to sharply negative in the second half of the 1970s, and then to large and positive in the 1980s and the 1990s. For some countries, the decline in the 1970s was nearly as dramatic as the ensuing increase. Figure 5.3(b) shows how the real rate in Spain went down from 2 percent in the 1960s to –5 percent in the mid-1970s, back to 5 percent in the 1980s and the 1990s. For others, such as Germany, the real rate has remained much more stable.

Why might such changes in the real interest rate affect the equilibrium unemployment rate?<sup>7</sup> Because they are likely to affect capital accumulation, and so, at a given wage (and thus a given ratio of employment to capital), to shift labor demand. Are the effects on unemployment likely to be permanent? Theory is largely agnostic here. Again, a plausible answer is that long run effects, if present, are likely to be small.

It is clear from Figure 5.3 that the pattern of interest rates may help explain why unemployment kept increasing in the 1980s, even as the effects of lower TFP growth on unemployment were—presumably—declining. This suggests that, had real interest rates been stable, unemployment would have been higher in the 1970s, and lower in the 1980s. Put another way, the low real interest rates of the 1970s delayed some of the increase in unemployment by a decade or so. The higher real interest rates since the early 1980s may help explain why unemployment has remained high in the 1980s and the 1990s.

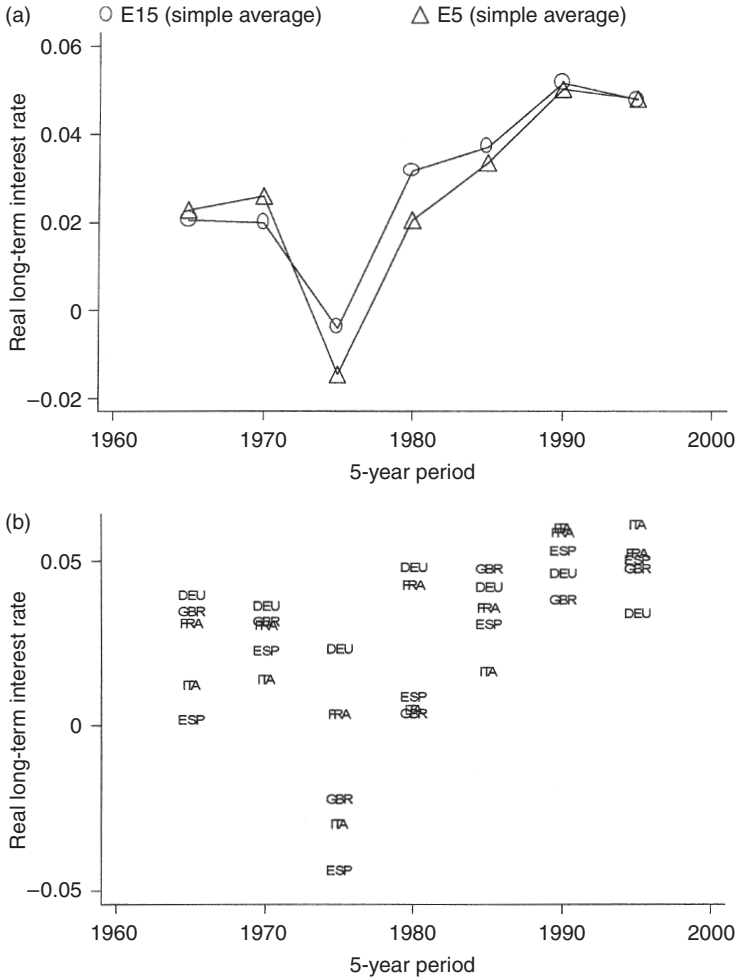


Figure 5.3 Real interest rate. (a) E15 and E5; (b) E5.

**Shifts in labor demand**

Figure 5.4 gives the evolution of the log of the labor share for both the E15 and the E5 (normalized to equal zero in 1960). For both groups of countries, the evolution of the share is quite striking. After increasing in the 1970s, the labor share started decreasing in 1980s and the decline has continued since then. For the E5, the labor share is now 10 percent lower than it was in 1960; for the E15, it is 8 percent lower.

Why look at the evolution of the labor share? Suppose that technology were characterized by a Cobb-Douglas production function, both in the short and the



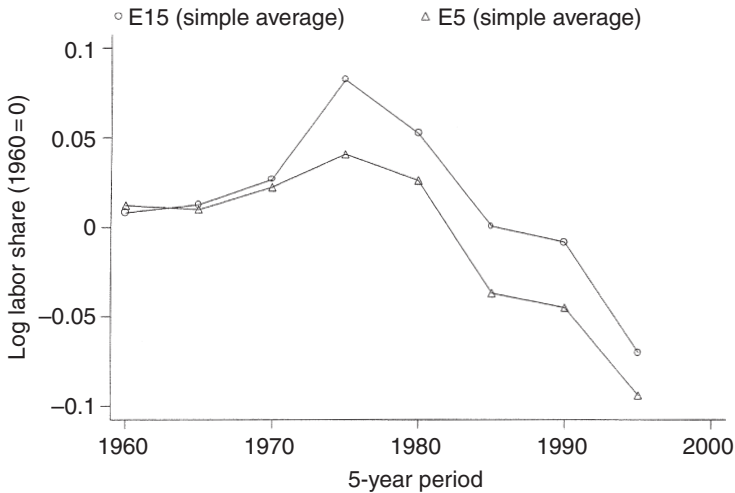


Figure 5.4 Log labor share, E15 and E5.

long run. The decrease in the share since the 1980s would then reflect either technological bias away from labor—a decrease in the coefficient on labor in the production function—or a decrease in the wage relative to the marginal product of labor. In either case, the implication would be an adverse shift in labor demand and thus a potential source of unemployment in the 1980s and 1990s.<sup>8</sup>

The elasticity of substitution may be equal to one in the long run, but is surely less than one in the short run. In that case, movements in the share will also reflect the dynamic response of factor proportions to factor prices. Indeed, much of the increase in the labor share in the 1970s surely reflects the effects of the increase in the real wage relative to TFP growth together with a low short run elasticity of substitution, and some of the decrease since then reflects the adjustment of proportions over time. In Blanchard (1997), we argued, however, that more has been at work than the adjustment of factor proportions to factor prices, and that the large decline in the share reflects a genuine adverse shift in labor demand.

We shall use the measure of the shift in labor demand constructed in that earlier article. This measure can be thought of as the log of the labor share purged of the effects of factor prices on the share in the presence of a low elasticity of substitution in the short run. Figure 5.5(a) plots the evolution of this measure of the labor demand shift for both the E5 and the E15. Figure 5.5(b) plots the evolution of the measure for each of the E5 countries. Both figures, (a) and (b) of Figure 5.5 show how the adjustment eliminates much of the increase and subsequent unwinding in the share in the 1970s (visible in Figure 5.4). Figure 5.5(a) shows little movement in the measure until the mid-1980s, with a strong decrease thereafter. Figure 5.5(b) shows the sharp difference between the United Kingdom where, if anything the shift has been positive

(the underlying labor share has remained roughly constant) and countries such as Spain or France (where the adverse shift has exceeded 10 percent).<sup>9</sup>

Such an adverse shift in labor demand can clearly lead to higher equilibrium unemployment for some time. Its dynamic effects, however, are quite different from those of the two shocks we looked at earlier. Think for example of the shift as coming from a reduction in labor hoarding by firms—one of the interpretations suggested in Blanchard (1997). As firms get rid of redundant workers, the result will be a decrease in employment, and so an increase in unemployment. Thus, such a shift has the potential to explain why unemployment has remained high in many countries in the 1990s. But the decrease in labor hoarding also leads to higher profit, which in turn should lead, over time, to capital accumulation and

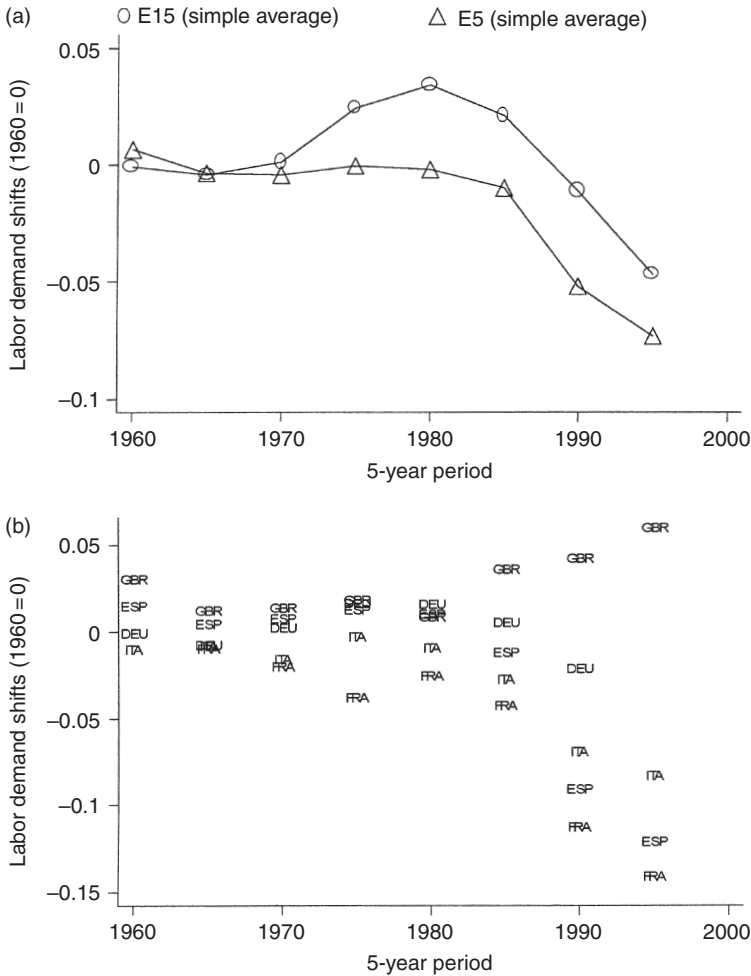


Figure 5.5 Labor demand shifts (a) E15 and E5; (b) E5.

higher employment. This is a relevant point to keep in mind when one thinks about the future. If it is the case that such a shift is indeed responsible for some of the unemployment of the 1990s, then this suggests a brighter future, as the favorable effects start dominating and lead to an increase in employment over time.

### ***Equilibrium vs actual unemployment***

We have focused so far on factors that affect equilibrium unemployment. There is no question however that part of the evolution of unemployment in Europe comes from the deviation of actual unemployment from equilibrium unemployment.

In environments of low to medium inflation, the change in inflation is likely to be a good signal of where equilibrium unemployment is relative to actual unemployment. Decreasing inflation is likely to reflect an unemployment rate above the equilibrium rate; increasing inflation reflects the reverse. Figure 5.6(a) shows the evolution of the change in inflation for the E5 and the E15. Figure 5.6(b) shows the evolution of the change in inflation for each of the E5.<sup>10</sup> The change in inflation was positive in the 1970s, suggesting an actual unemployment rate below the equilibrium rate. The change in inflation has been negative since then, suggesting the equilibrium rate has been lower than the actual rate. In other words, macroeconomic policy probably delayed some of the increase in unemployment from the 1970s to the 1980s. And, as inflation is still slowly declining, actual unemployment probably exceeds equilibrium unemployment at this point. By how much is difficult to say: the relation between the change in inflation and the deviation of unemployment from its equilibrium may well be different at very low inflation.

Two caveats as we end this section. First, what we have taken as “shocks” are at best proximate causes, and should be traced to deeper causes. This is particularly clear for real interest rates and labor demand shifts. Second, there may well have been other shocks, from increased turbulence (although the quantitative evidence on this is not very supportive), to shifts in the relative demand for skilled and unskilled workers (although, on this point as well, the evidence for Europe is mixed). (See, e.g. Nickell and Bell (1994).) We have not explored their role here.

To conclude: This section suggests the following story. Europe was hit with major adverse shocks in the 1970s, not only oil price increases, but also, and more importantly, a large and sustained decrease in TFP growth. Unemployment increased, but the adverse impact was initially softened both by lower real interest rates and an expansionary macroeconomic policy leading to less of an increase in actual than in equilibrium unemployment. As the effect of the adverse shocks of the 1970s receded, higher interest rates and tight macroeconomic policy contributed to higher equilibrium and actual unemployment in the 1980s. Finally, adverse labor demand shifts can potentially account for why unemployment has remained high in the 1990s. Thus, shocks appear to have the potential to explain the broad evolution of European unemployment. But, at least to the naked eye, differences in the evolution of unemployment across countries seem difficult to trace back to differences in shocks.

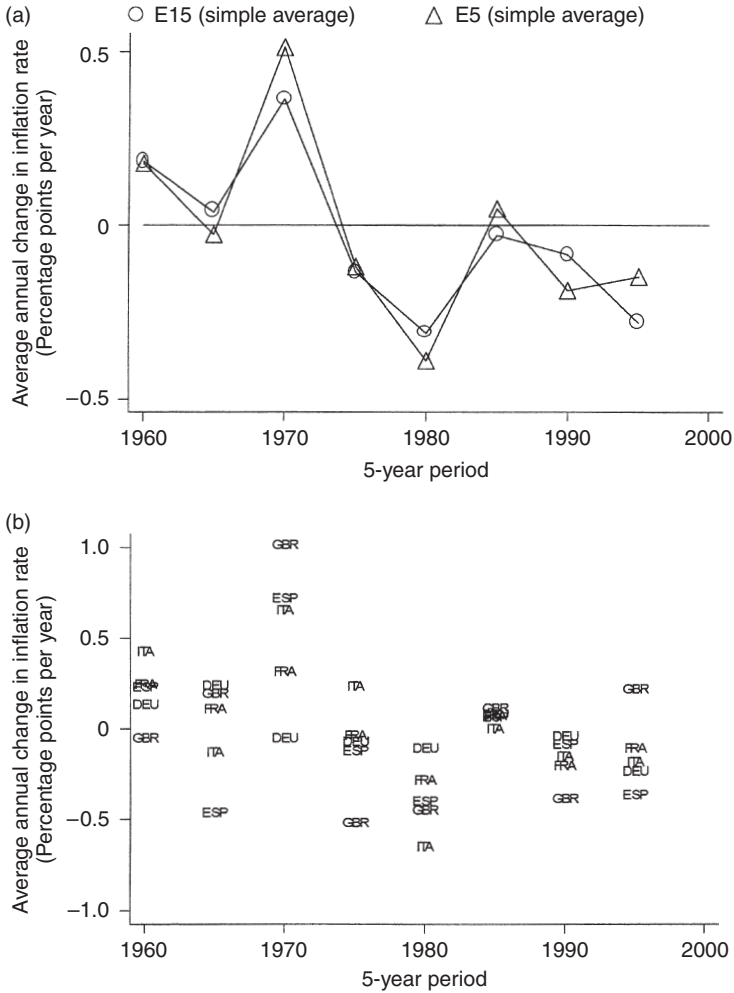


Figure 5.6 Change in inflation rate (a) E15 and E5; (b) E5.

## Institutions

While in the 1970s the discussion of the rise of unemployment focused primarily on shocks, the persistence of high unemployment for another two decades has led to a shift in focus from shocks to labor market institutions. Indeed, many discussions of European unemployment ignore shocks altogether, and focus exclusively on “labor market rigidities.” What typically follows is a long list of so-called “rigidities,” from strong unions, to high payroll taxes, to minimum wages, to generous unemployment insurance, to high employment protection, and so on.

We have learned however from theory that things are more complicated. Some of the so-called rigidities may represent rough institutional corrections for other distortions in the labor market. Some institutions may be bad for productivity, for output, and for welfare, but may not lead to an increase in unemployment. A short summary of the large literature—a literature largely triggered by the rise in European unemployment—goes as follows:<sup>11</sup>

- Some labor market institutions increase the equilibrium unemployment rate. First among them is the unemployment insurance system. More generous insurance increases unemployment through two separate channels: The first, and the focus of most microeconomic empirical work, is lower search intensity. The second is the effect on the bargained wage at a given rate of unemployment. Both combine to increase equilibrium unemployment duration, and, by implication, the equilibrium unemployment rate.<sup>12</sup>
- Some labor market institutions change the nature of unemployment, but have an ambiguous effect on the equilibrium unemployment rate. This is the case for employment protection. Employment protection both decreases the flows of workers through the labor market, and increases the duration of unemployment. This makes for a more stagnant labor market, with a higher proportion of long-term unemployed. But the effect of lower flows and higher duration on the equilibrium rate itself is ambiguous.
- Some labor market institutions may not have much effect either on the rate or on the nature of unemployment. Their incidence may be mainly on the wage, not on unemployment. This is the case for many of the components of the so-called “tax wedge.” Some of these components are really not taxes, but rather payments for health benefits, or retirement: the effect of these components on unemployment should be small. As to the tax component, what matters is how taxes affect the ratio of after-tax unemployment benefits to after-tax wages. Taxes, which by their nature apply equally on the unemployed and the employed, such as consumption or income taxes, are likely to be roughly neutral. And if the unemployment insurance system tries to achieve a stable relation of unemployment benefits to after-tax wages—a reasonable assumption—even payroll taxes may not matter very much.

Turning to the evidence, the two relevant questions are: How much do labor market institutions vary across countries? And how have they evolved over time?

Thanks to work by the OECD and by a large number of researchers, we have fairly good answers to the first question. The state of knowledge has recently been summarized by Nickell (1997) and Nickell and Layard (1998).<sup>13</sup> In much of what we do later, we shall use the data for institutions put together by Nickell and described in those two articles. For the moment, suffice it to say that, based on the measures which have been constructed for various labor market institutions, and the cross-section evidence: (1) there is substantial heterogeneity across European countries and (2) this heterogeneity appears to have the potential to explain differences in unemployment rates across

countries *today*: countries with high unemployment rates typically have less employment-friendly institutions.

This raises the second question, the evolution of institutions over time. The basic question is a simple one. Have European labor market institutions become steadily worse since the early 1970s (in which case explanations based solely on institutions can potentially explain the evolution of unemployment)? Or do they in fact date back much further, to a time when unemployment was still low (in which case explanations based solely on institutions face a major puzzle)? The question is simple, but the answer is not.

Time series for at least part of the period and a subset of countries have been put together for some institutions—replacement rates, unionization, the tax wedge—by the OECD and other researchers. But, in general, our knowledge of the evolution of institutions is rather limited. We shall look here at two institutions only, unemployment insurance, and employment protection.

- The OECD has constructed a measure of the replacement rate for each country, every 2 years, going back to 1961. The measure is an average of the replacement rates for different categories of workers, different family situations, and different durations of unemployment. Each replacement rate is constructed as the ratio of pre-tax social insurance and social assistance benefits to the pre-tax wage. Figure 5.7(a) gives the evolution of this measure of the replacement rate, for each 5-year period, for each of the E5 countries. The figure clearly shows the different evolutions across countries. In Germany, France, and the United Kingdom the replacement rate was relatively high to start with; it has increased a bit in France, decreased a bit in Germany, decreased a bit more in the United Kingdom. In Spain and Italy the replacement rate was very low at the start. It increased in the 1960s in Spain, and only more recently in Italy. Both are now at levels comparable to other countries. In short, there is no simple common trend.

The OECD measure is a summary measure of the replacement rate, and in some ways, not a very attractive one. It gives equal weight to the replacement rate in year 1 of an unemployment spell, to the average replacement rate in years 2 and 3, and to the average replacement rate for years 4 and 5; but given the exit rate from unemployment, the generosity of benefits in years 4 and 5 for example is clearly less important for the determination of unemployment than the generosity of unemployment in year 1. Figure 5.7(b) provides a different angle by showing the *maximum* replacement rate over all categories and all durations of unemployment for each country and each subperiod. What clearly comes out is how this rate increased until the late 1970s, and how (except for Italy, which has converged from a low maximum replacement rate to the European average) it has decreased since then. In other words, the worst excesses have been largely eliminated. This may be more important than changes in the average replacement rate.

- Putting together series on employment protection is difficult. We have taken a first step by constructing series based on recent work by the OECD (see OECD

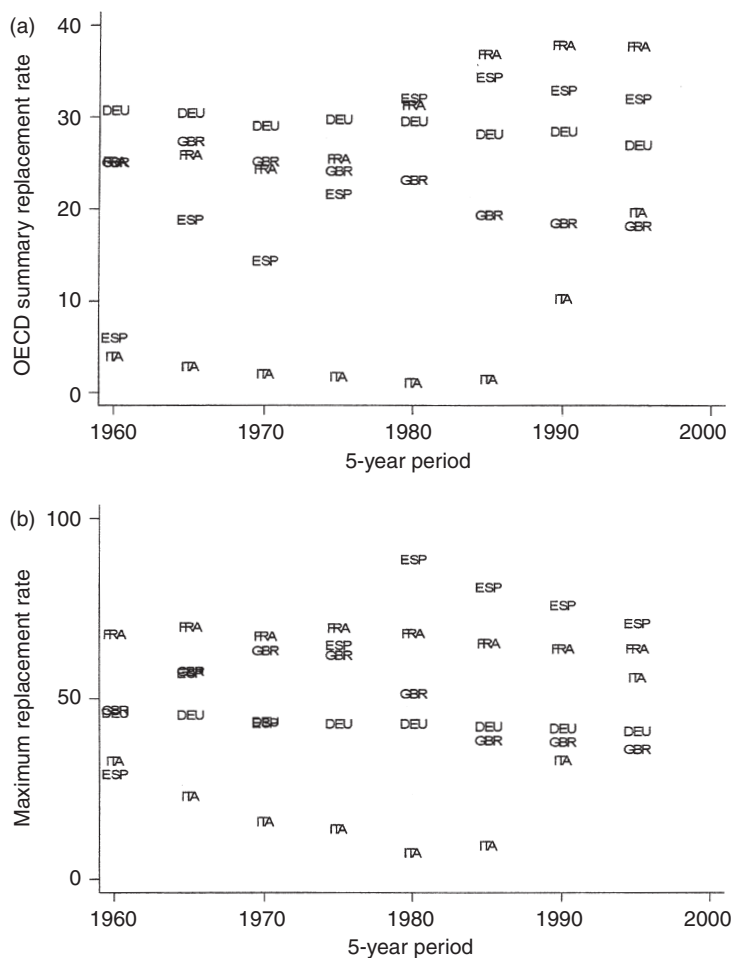


Figure 5.7 Replacement Rates, E5: (a) OECD; (b) Maximum.

(1999)), as well as on earlier work by Lazear (1990). Details of construction are given in the appendix. There are a number of reasons why these series are at best rough approximations to the evolution of employment protection. In particular, the OECD data, which we use to construct the measures from 1985 on, are based on a much broader set of dimensions of employment protection than the Lazear series (notice period and severance pay for a blue collar worker with 10 years seniority), which we use to construct the series before 1985.

This caveat notwithstanding, Figure 5.8 shows the evolution of the employment protection index for the E5 countries since 1960. (The figure for the E15 would be harder to read, but yield similar conclusions.) Note again the diversity of evolutions, and the lack of a simple answer.

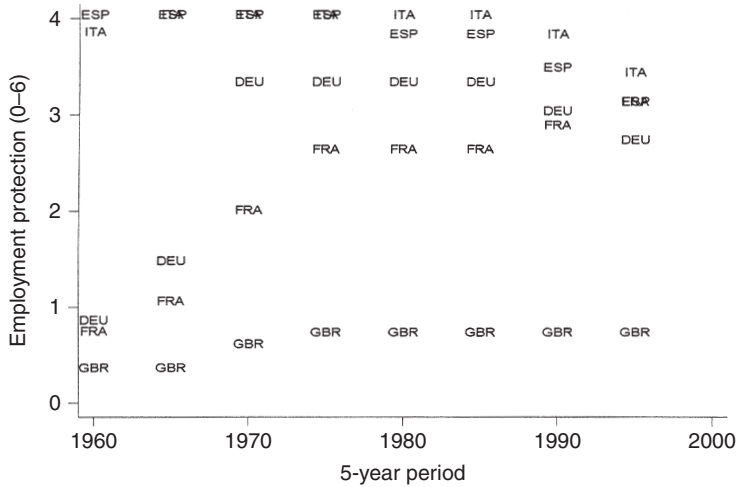


Figure 5.8 Constructed employment protection index, E5.

Spain and Italy appear to have had high employment protection throughout. Employment protection in Spain was high even under Franco, before unemployment increased. In both countries, employment protection has decreased since the mid-1980s—in Spain, largely because of the development of fixed term contracts rather than the weakening of protection for workers on indefinite contracts. In France and Germany, employment protection was low to start with, then increased in the late 1960s and early 1970s, and has been roughly stable since then.<sup>14</sup>

To conclude: There is enough heterogeneity in labor market institutions within Europe to explain potentially, differences in unemployment rates today. As to the evolution of institutions over time, it is clear that neither the view that labor market institutions have been stable through time, nor the view that labor market rigidities are a recent development are right. Some countries have had these institutions for a long time, others have acquired them more recently. There clearly was an increase in employment-unfriendly institutions in the late 1960s and early 1970s. Since then, there appears to have been a small but steady decline.

## Interactions

Our review of facts makes clear why it is tempting to look for explanations of the rise of European unemployment based on the interaction of shocks and institutions: Adverse shocks can potentially explain the general increase in unemployment. Differences in institutions can potentially explain differences in outcomes across countries. This is indeed the direction that has been explored in much of the recent research on unemployment. This section gives a brief assessment of the current state of knowledge.<sup>15</sup>



One can think of labor market institutions as shaping the effects of shocks on unemployment in two ways. First, they can affect the impact of shocks on unemployment. Second, they can affect the persistence of unemployment in response to shocks.

Most of the initial research explored the first direction, focusing on how the nature and the details of collective bargaining might determine the response of unemployment to various shocks.<sup>16</sup> It pointed, for example, to the importance of indexation clauses in labor contracts. It also pointed to the potential importance of the level and the structure of collective bargaining: it might be easier, for example, to achieve a slowdown in wage growth in response to a slowdown in productivity growth if bargaining takes place at the national rather than the firm or sectoral level—where aggregate trends may be less well perceived and understood, and coordination of the slowdown may be more difficult to achieve.

As unemployment remained high, the research shifted to how labor market institutions might also explain the persistence of unemployment in response to shocks.<sup>17</sup> The general idea is as follows. Take an adverse shock which leads to higher unemployment. The normal adjustment mechanism is then for unemployment to put downward pressure on wages until unemployment has returned to normal. To the extent that some labor market institutions reduce the effect of unemployment on wages, they will increase the persistence of unemployment in response to shocks. Research has identified a number of such channels. Here is a nonexhaustive list:

- A rise in unemployment typically comes with higher unemployment duration (rather than higher flows in and out of unemployment). If some of the unemployed remain unemployed for a long time, they may either stop searching or lose skills. Indeed, the two factors reinforce each other: if firms perceive the long-term unemployed as more risky, they may be reluctant to hire them, decreasing the incentives of the long-term unemployed to search for a job. But if they are not actively searching or employable, these unemployed workers become irrelevant to wage formation. Firms do not consider them as competition. Employed workers do not see them as competition. The pressure of unemployment on wages decreases, and unemployment becomes more persistent. Layard and Nickell (1987) were the first to point to the potential macroeconomic relevance of such duration dependence.

Why should institutions matter in this context? It is because of their effect on the average duration of unemployment. A well documented fact about European labor markets is that, probably because of institutions such as more generous benefits and employment protection, a given unemployment rate is associated with much longer duration than in the United States.<sup>18</sup> And the longer the average duration of unemployment to begin with, the more likely the effects mentioned earlier are to play an important role. If an increase in the unemployment rate from 5 to 10 percent is associated with an increase in unemployment duration from 3 to 6 months, few of the unemployed will become long-term unemployed. If instead, the same increase in the unemployment rate implies an increase in duration from 1 to 2 years, then disenfranchising effects are much more likely to be important.

- Higher unemployment falls unevenly on different groups in the labor market. In most countries, higher unemployment tends to fall disproportionately on the youngest workers and the less educated.

Labor market institutions affect the composition of the unemployed, thus affecting the effects of unemployment back on wages. For example, a high minimum wage can both increase the effect of adverse shocks on the unemployment rate of the less-educated workers, and—because the minimum wage is fixed—reduce the effect of unemployment on wages. Collective bargaining, to the extent that it reflects primarily the preferences and the labor market prospects of prime-age workers, may also lead to little response of wages to youth unemployment, and thus lead to more persistence in unemployment.

- Higher unemployment may lead to a change in norms—an argument developed in particular by Wilson (1987) in the context of urban poverty in the United States, and by Lindbeck in the context of European unemployment (e.g. Lindbeck (1995)). As long as unemployment is low, workers may be largely ignorant of the rules governing unemployment insurance, or there may be a stigma attached to being unemployed. After a period of high unemployment, ignorance is likely to disappear; attitudes vis-à-vis unemployment are likely to change. Thus, countries with a more generous welfare system may end up with higher unemployment, even when the shocks are gone.

Other channels have been explored as well: Sargent and Ljungqvist (1995) have explored the effect of unemployment insurance rules on the relation between “turbulence” shocks and equilibrium unemployment. Mortensen and Pissarides (1999) have explored the effect of unemployment insurance and employment protection on the relation between relative demand shifts and equilibrium unemployment. Our understanding of the specific channels and their empirical relevance remains rather primitive. This is still very much work in progress, and there is a need for substantially more theoretical and empirical work. Nevertheless, the general thrust is sufficiently clear for us to explore the potential role of interactions in explaining the evolution of unemployment. This is what we do in the rest of the chapter.

### **Common unobservable shocks and interactions**

In looking more formally at the data, we proceed in two steps. In this section, we treat shocks as unobservable, but common across countries—in effect we treat them as time effects. In the next, we treat shocks as observable and country-specific.

Our first specification in this section relies on the set of time invariant measures of institutions used by Nickell (1997).<sup>19</sup> The specification we use is the following:

$$u_{it} = c_i + d_t \left( 1 + \sum_j b_j X_{jt} \right) + e_{it} \quad (1)$$

where  $i$  is a country index,  $t$  a (5-year) period index, and  $j$  an institution index. The dependent variable,  $u_{it}$ , is the unemployment rate in country  $i$  in period  $t$ .

$c_i$  is the country effect for country  $i$ .  $d_t$  is the time effect for period  $t$ .  $X_{ij}$  is the value of institution  $j$  in country  $i$  (in this first specification, we do not allow for time variation in institutions, so there is no index  $t$ ). The specification allows for the effects of the common time effects on unemployment to depend on the specific set of labor market institutions of a country. This dependence is captured by the parameters  $b_j$ .

The specification of (1) is clearly more a description of the data than the outcome of a tightly specified theory of interactions. It does not distinguish in particular between the effects of institutions on the impact or on the persistence of shocks on unemployment. But it captures the basic hypothesis that, given the same shocks, countries with worse institutions will experience higher unemployment.

We estimate this equation using data from 20 countries—the E15 countries listed and examined earlier, plus the United States, Canada, New Zealand, Australia, and Japan. (These countries are clearly important controls for any story about European unemployment.) There seems to be little point in looking at year-to-year movements in institutions or in shocks unless one wants to learn more about dynamic effects, and this would take us too far. So, as in earlier figures, we divide time into eight 5-year periods, from 1960–64 to 1995+.

Following Nickell, we use measures for eight “labor market institutions” (the reader is referred to Nickell (1997) for more details):

- Three are measures of different dimensions of the unemployment insurance system: the replacement rate ( $RR$ ), the number of years over which unemployment benefits are paid ( $Ben$ ), and a measure of active labor market policies ( $ALMP$ ).
- One is a measure of employment protection ( $EP$ ).
- One is a measure of the tax wedge ( $Tax$ ).
- The last three measure aspects of collective bargaining: union contract coverage ( $Cov$ ), union density ( $Den$ ), and (union and employer) coordination of bargaining ( $Coor$ ).

The results of estimation of (1) (by nonlinear least squares) are presented in Table 5.1. All the measures of labor market institutions are defined so that an increase in the measure is expected to increase the effect of an adverse shock on unemployment: the expected sign of each  $b_j$  is positive.<sup>20</sup> Also, all measures of institutions are constructed as deviations from the cross-country mean; this way the time effects gives the evolution of unemployment for a country with mean values for all eight institutions.

The results of Table 5.1 are surprisingly strong (relative to our priors). The estimated equation gives the following description of the data:

- Estimated time effects account for an increase in the unemployment rate equal to 7.3 percent. That is, the equation implies that, if a country had had mean values for all eight institutions, its unemployment rate would have grown by 7.3 percent over the period.

Table 5.1 Time effects interacted with fixed institutions

|                               | (1)<br>Coefficients | (2)<br>Range of<br>independent<br>variable |      | (3)<br>Implied range of<br>effect of shock<br>(mean = 1) |      |
|-------------------------------|---------------------|--|------|--|------|
| Time effects*                 | 7.3%                |  |      |  |      |
| <i>RR</i>                     | 0.017 (5.1)         | -46.3                                      | 32.6 | 0.21   | 1.55 |
| <i>Ben</i>                    | 0.206 (4.9)         | -2.0                                       | 1.6  | 0.60   | 1.33 |
| <i>ALMP</i>                   | 0.017 (3.0)         | -47.2                                      | 9.5  | 0.20   | 1.16 |
| <i>EP</i>                     | 0.045 (3.1)         | -9.5                                       | 9.5  | 0.58   | 1.42 |
| <i>Tax</i>                    | 0.018 (3.2)         | -17.8                                      | 22.2 | 0.68   | 1.40 |
| <i>Cov</i>                    | 0.098 (0.6)         | -1.7                                       | 0.3  | 0.83   | 1.03 |
| <i>Den</i>                    | 0.009 (2.1)         | -30.4                                      | 39.6 | 0.73   | 1.36 |
| <i>Coor</i>                   | 0.304 (5.1)         | -2.0                                       | 2.0  | 0.40   | 1.60 |
| Country effects ( <i>CE</i> ) | Yes                 |  |      |  |      |
| $\bar{R}^2$                   | 0.863               |  |      |  |      |

Note

\* Estimated time effect for 1995+ minus estimated time effect for 1960–64; Column (1): regression results, *t*-statistics in parentheses; Number of observations: 159.

- Coefficients on all eight institutions have the predicted sign: Higher *RRs*, longer duration of *Ben*, higher *EP*, a higher *Tax*, higher *Cov* and *Den*, lead to a larger effect of shocks on unemployment. *ALMP* and *Coor* lead to a smaller effect (remember our sign convention in defining each institution).

All coefficients, except for the union coverage variable, are statistically significant.<sup>21</sup>

To give a sense of magnitudes, column (2) gives the range for each institutional measure (recall that these are deviations from the cross-country mean). Column (3) then shows the effect of a given shock for the lowest and highest value of the corresponding institution. The way to read the column is as follows. Take three countries, each with mean values for all institutions except one—say, employment protection (line 5). Take an adverse shock which would raise unemployment by 1 percentage point in the country with the mean value of employment protection. Then, the same shock will have an effect of only 0.58 percentage point in the country with the lowest employment protection, but an effect of 1.42 percentage point in the country with the highest employment protection. The conclusion one should draw from column (3) is, given the existing variation in labor market institutions, the range of the effects of institutions on the impact of a given shock on unemployment is roughly similar across institutions.

- Not only are the coefficients on institutions plausible, but the model does a good job of explaining the differential evolution of unemployment rates across countries. Figure 5.9 plots the change in the actual and the fitted unemployment rates from 1965–69 to 1995+. The fit is quite good. Interactions between common shocks and different institutions can account

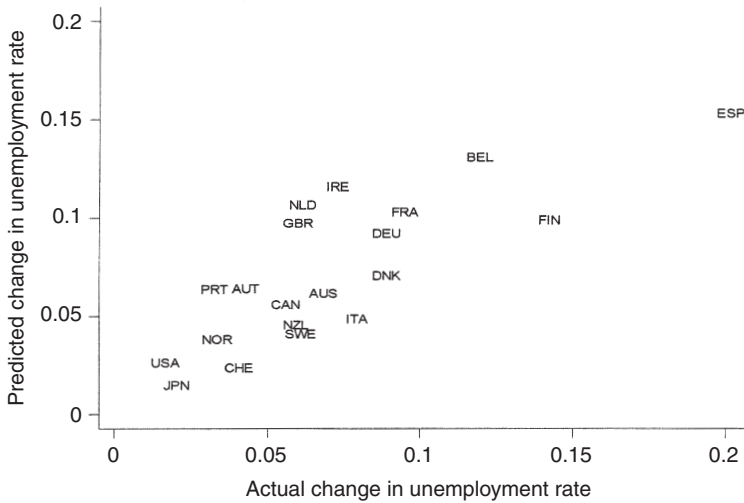


Figure 5.9 Actual and predicted change in  $u$ , 1995+ over 1965–69.

for much of the actual difference in the evolution of unemployment rates across countries. (Recall that a pure time effect model with no interactions would predict no variation in predicted unemployment rates across countries: all the points would lie on a horizontal line.)

- Another way of thinking about these results is as follows. Consider a model with unobservable shocks and unobservable institutions—equivalently a model with time, country, and interacted time and country effects:

$$u_{it} = c_i + d_t(1 + b_i) + e_{it} \quad (1')$$

- Equation (1) can then be thought of as imposing the restriction that  $b_i$  be a linear function of country  $i$ 's institutions:  $b_i = \sum X_{ij} b_j$ . This raises the question of how much better we would do if we did not impose this restriction and estimated (1') instead. One way to answer the question is to look at two  $\bar{R}^2$ s. The  $\bar{R}^2$  from estimation of (1') is 0.903, compared to 0.863 in Table 5.1. The  $\bar{R}^2$  from a second stage regression of the estimated  $\hat{b}_i$  on labor market institutions  $X_{ij}$ s is 0.57. We read these results as saying that (1) the statistical description of the evolution of unemployment as the result between shocks and institutions has the potential to give a good description of the data (as reflected in the first stage  $\bar{R}^2$ ), and that (2) labor market institutions do a good job of explaining country interaction effects (as reflected in the second stage  $\bar{R}^2$ ).

In short, (1) gives a good description of the heterogeneity of unemployment evolutions, as the result of interactions between shocks and institutions. These results are indeed consistent with the two cross-sections estimated by Nickell, and

show that his results are robust both to the use of a longer time period and the introduction of country effects.<sup>22</sup>

One must worry however that these results are in part the result of research Darwinism. The measures used by Nickell have all been constructed *ex-post facto*, by researchers who were not unaware of unemployment developments. When constructing a measure of employment protection for Spain, it is hard to forget that unemployment in Spain is very high. ... Also, given the complexity in measuring institutions, measures which do well in explaining unemployment have survived better than those that did not. Thus, in the rest of this section, we look at robustness.

### ***Dropping institutions, countries, or country fixed effects***

To give a sense of robustness with respect to the set of institutions, column (1) in Table 5.2 reports the results of eight separate regressions, each regression allowing interactions with only one of the eight measures for institutions. When introduced on their own three measures are highly significant: *Ben*, *EP*, and *Cov* (which is insignificant in the multivariate specification). In contrast, the *RR*, which is highly significant in the multivariate specification, is insignificant when introduced alone. Another strategy is to see what happens when we drop one institution at a time. The results (not reported) indicate that the coefficients reported in Table 5.1 are robust to such a variation.

Table 5.2 Time effects interacted with fixed institutions: alternative specifications

|              | (1)<br><i>Institutions<br/>entered<br/>individually</i> | (2)<br><i>No country<br/>effects</i> |
|--------------|---|--------------------------------------|
| Time effects |   | 7.1%                                 |
| <i>RR</i>    | 0.004 (1.0)   | 0.017 (4.1)                          |
| <i>Ben</i>   | 0.268 (6.6)   | 0.213 (4.1)                          |
| <i>ALMP</i>  | 0.007 (1.4)   | 0.017 (2.4)                          |
| <i>EP</i>    | 0.043 (4.0)   | 0.049 (2.8)                          |
| <i>Tax</i>   | 0.012 (2.2)   | 0.017 (2.4)                          |
| <i>Cov</i>   | 0.532 (4.9)   | 0.049 (0.2)                          |
| <i>Den</i>   | -0.002 (-0.5)   | 0.009 (1.8)                          |
| <i>Coor</i>  | 0.048 (1.1)   | 0.301 (4.3)                          |
| <i>CE</i>    | Yes   | No                                   |
| $\bar{R}^2$  |   | 0.797                                |

Note

Column (1): each coefficient is estimated using a different regression, allowing interactions between the time effects and the specific institution variable.

Column (2): Levels of institutional measures entered, but coefficients not reported.

Number of observations: 159.

Second, we look at robustness with respect to the set of countries. In general, dropping one country at a time makes little difference to the results (not reported here). The only exception is the importance of Spain in determining the coefficient on *EP*. When dropping Spain, the coefficient on *EP* goes from 0.045 in Table 5.1 to 0.015.

Third, we look at robustness with respect to the treatment of country effects. Column (2) in Table 5.2 reports the results of estimation of (1), replacing country effects by the set of (time invariant) measures of labor market institutions for each country. That is, it imposes the constraint that all differences in unemployment rates be explained by differences in institutions; such a constraint is surely too strong, but it is worth seeing how it affects the results. Only the coefficients on interactions are reported in column (2). They are roughly the same as in Table 5.1. The coefficients on the levels of the labor market institutions (not reported) are typically insignificant. The fit is significantly worse than in Table 5.1.

### **Looking at alternative measures of institutions**

Table 5.3 looks at the implications of using alternative measures for some of the institutions. This is the work-in-progress part of our chapter. Our goal is eventually

Table 5.3 Time effects interacted with institutions: alternative measures

|                   | (1)<br><i>Alternative<br/>RRs</i> | (2)<br><i>Time-varying<br/>RRs</i> | (3)<br><i>Alternative<br/>EP</i> | (4)<br><i>Time-varying<br/>EP</i> |
|-------------------|-----------------------------------|------------------------------------|----------------------------------|-----------------------------------|
| Time effects      | 7.3%                              | 6.2%                               | 7.3%                             | 7.1%                              |
| (N) <i>RR</i>     |                                   |                                    | 0.017 (5.2)                      | 0.017 (4.7)                       |
| (N) <i>Ben</i>    |                                   |                                    | 0.238 (5.6)                      | 0.205 (4.4)                       |
| (Alt) <i>RR1</i>  | 0.009 (2.6)                       | 0.007 (2.0)                        |                                  |                                   |
| (Alt) <i>RR25</i> | 0.009 (1.4)                       | 0.019 (2.7)                        |                                  |                                   |
| (N) <i>ALMP</i>   | 0.014 (1.6)                       | 0.005 (0.5)                        | 0.019 (3.2)                      | 0.017 (2.6)                       |
| (N) <i>EP</i>     | 0.024 (1.4)                       | 0.032 (1.7)                        |                                  |                                   |
| (Alt) <i>EP</i>   |                                   |                                    | 0.294 (4.3)                      | 0.167 (2.2)                       |
| (N) <i>Tax</i>    | 0.016 (2.4)                       | 0.015 (2.1)                        | 0.019 (3.5)                      | 0.021 (3.7)                       |
| (N) <i>Cov</i>    | 0.413 (2.1)                       | 0.395 (1.9)                        | 0.085 (0.5)                      | 0.287 (1.8)                       |
| (N) <i>Dens</i>   | 0.004 (0.8)                       | 0.000 (0.0)                        | 0.010 (2.5)                      | 0.008 (1.7)                       |
| (N) <i>Coor</i>   | 0.272 (4.9)                       | 0.325 (4.5)                        | 0.392 (6.5)                      | 0.361 (5.3)                       |
| <i>CE</i>         | Yes                               | Yes                                | Yes                              | Yes                               |
| $\bar{R}^2$       | 0.824                             | 0.831                              | 0.872                            | 0.857                             |

Note

(N) means Nickell measure.

Column (1): estimation using time-invariant values of *RR1* and *RR25*, equal to their average values for 1985–89.

Column (2): estimation using the time series for *RR1* and *RR25*.

Column (3): estimation using the value of *EP* for the late 1980s.

Column (4): estimation using the time series for *EP*.

Number of observations: 159.

to construct time series for all eight institutions. So far, we have done so only for *RRs* and for *EP*. Columns (1) and (2) report our results using alternative measures for *RRs*. Columns (3) and (4) report our results using alternative measures for *EP*.

Using the OECD database on *RRs* for each country since 1961, we construct an alternative set of measures for the generosity of unemployment insurance. The first measure, *RR1*, is the *RR* during the first year of an unemployment spell, averaged over all categories. The second, *RR25*, is the average *RR* during years 2 to 5 of an unemployment spell, averaged over all categories.

Column (1) shows the results of estimation using time-invariant values for *RR1* and *RR25*. For comparisons with the results using Nickell's measures which apply to the late 1980s and early 1990s, we use the mean value of the two *RRs* for the period 1985–89. Measures for the other six institutions are the same as in Table 5.1. The fit is a bit worse than in Table 5.1. The two *RRs* are both individually significant, and jointly highly significant. Coefficients on the other labor market institutions are often less significant than in Table 5.1. In particular, the coefficient on *EP* is smaller, and less significant.

Column (2) shows the results of estimation using time-varying measures for *RR1* and *RR25*. Relative to column (1), the fit, measured by  $\bar{R}^2$ , is marginally improved (but is still worse than in Table 5.1). The part of the increase in unemployment due to time effects decreases from 7.3 to 6.2 percent. Coefficients on labor market institutions are largely the same as in column (1).

Columns (3) and (4) use the index of employment protection discussed under "Institutions". In contrast to the Nickell index, which is a ranking of countries and thus ranges from 1 to 20, this index is a cardinal index, ranging theoretically from 0 to 6, empirically from 0 to about 4. Thus, in comparing coefficients to those obtained using the Nickell specification, keep in mind that the coefficients should be about five times larger to generate the same effect on unemployment.

Column (3) shows the results of estimation using time-invariant values of the index, equal to its value for 1985–89. The results are very similar to Table 5.1.  $\bar{R}^2$  is a little higher. The effect of *EP* is similar in magnitude to that in Table 5.1 (i.e. the coefficient is about five times larger), and highly significant.

Column (4) shows the results of estimation using the time-varying values of the employment protection index. Allowing for time variation does not improve the results:  $\bar{R}^2$  is slightly lower. The coefficient on the employment protection index decreases by nearly half and becomes less significant. These results can be read in three ways. First, the effects of employment protection are indeed less strong than suggested by previous regressions using time-invariant measures. Second, the time series we have constructed for employment protection are not very reliable; as we discussed in "Institutions", we are worried about the evolution of the index in the early part of the sample. Third, our earlier and apparently stronger results come in fact from reverse causality. Under this interpretation, the rise in unemployment has led over time to more employment protection, which is why there is a close relation between employment protection at the end of the sample and unemployment. But employment protection has little effect on unemployment, which is why the relation is weaker when using time series. Given the lack of strong evidence about



the presence of a strong and reliable feedback from unemployment to institutions, we are skeptical; but we cannot exclude this interpretation.

To conclude: a model with common unobservable shocks and interactions with institutions provides a good description of the evolution of unemployment rates across time and countries. The description appears reasonably robust—although less so with respect to time variation in institutions. This conclusion leaves open the issue of what these shocks might have been, and whether they have indeed been similar across countries. For this reason, we now turn to a specification based on observable shocks.

### Country-specific observable shocks, and interactions

The benchmark specification we use in this section is the following:

$$u_{it} = c_i + \left( \sum_k Y_{kit} a_k \right) \left( 1 + \sum_j X_{ij} b_j \right) + e_{it} \quad (2)$$

where the notation is the same as before, but the unobservable common shocks under “Interactions” are now replaced by a set of country-specific shocks;  $Y_{kit}$  denotes shock  $k$  for country  $i$  in period  $t$ .<sup>23</sup> Again our benchmark relies on time-invariant measures of institutions, thus the lack of an index  $t$  for  $X$ . Later on, we look at results allowing for time variation for institutions.

Following the discussion in “Institutions”, we consider three sources of shocks and construct three variables for each country and each period. They are the rate of TFP growth, the real rate of interest, and the labor demand shift measure, respectively. We enter them as levels, but, given the presence of country dummies in the regression, they can be thought of as deviations from country averages—or from their 1960 values. To make it easy to read the tables, each variable is measured so that an increase is expected to increase unemployment initially; therefore the original measure of TFP growth is multiplied by  $-1$ . Due to some missing data for some countries, the panel is (slightly) unbalanced. Also, one observation requires special treatment. As discussed in Blanchard (1997), the Portuguese revolution was associated with a large permanent increase in the measured labor share (20 percent of GDP)—without a corresponding increase in unemployment. While this evolution is interesting in its own right, we have decided to ignore it by allowing for a dummy for Portugal, from 1960 to 1974.<sup>24</sup>

The natural first question is: Ignoring differences in institutions across countries, how much of the evolutions of unemployment across time and countries can be explained by our three shocks? Table 5.4 and Figure 5.10 answer the question.

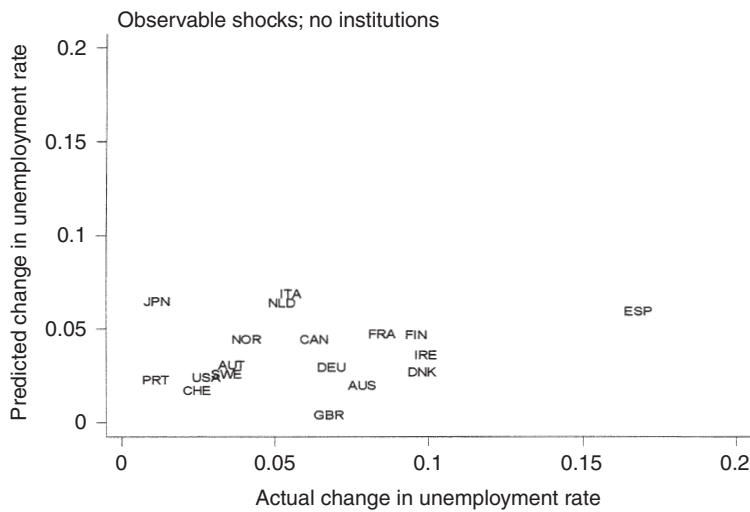
Column (1) in Table 5.4 presents regressions of the unemployment rate on the three shocks, leaving institutions out. Two of the three shocks (TFP growth, and the real interest rate) are significant. A decrease in TFP growth of 3 percentage points, as has happened in many countries, translates into an increase in the unemployment rate of about 1.5 percent. An increase in the real interest rate of 5 percentage points leads to an increase in the unemployment rate of 3 percent.

Table 5.4 Shocks only

| Dependent var | (1)<br><i>u</i> | (2)<br><i>u</i> * sacrifice<br>ratio = 0.2 | (3)<br><i>u</i> * sacrifice<br>ratio = 4.0 |
|---------------|-----------------|--|--|
| TFP growth    | 0.47 (3.1)      | 0.36 (2.6)                                 | 0.25 (1.7)                                 |
| Real rate     | 0.67 (5.6)      | 0.63 (6.1)                                 | 0.63 (6.1)                                 |
| LD shift      | 0.07 (1.1)      | 0.08 (1.5)                                 | 0.09 (1.7)                                 |
| CE            | Yes             | Yes  | Yes  |
| $\bar{R}^2$   | 0.566           | 0.590                                      | 0.584                                      |

Note

Number of observations: 131.

Figure 5.10 Actual and predicted change in *u*, 1965–69 to 1990–94.

A decrease in the adjusted labor share of 10 percentage points, such as happened in France and Spain since the mid-1980s, leads to an increase in the unemployment rate of about 1 percent. So, these shocks appear indeed to explain part of the evolution of the unemployment rate across time and countries.

Do differences in the magnitude of shocks explain the cross-country heterogeneity in unemployment increases? The answer, as shown in Figure 5.10, is no. The figure plots the change in fitted unemployment against the change in actual unemployment from 1965–69 to 1990–94 (this is the longest time span for which data are available for all countries). The relation is positive, but poor. The Netherlands and Spain have the same predicted increase in unemployment, yet very different outcomes. In short, the heterogeneity of shocks cannot account for much of the heterogeneity of unemployment evolutions.

Columns (2) and (3) in Table 5.4 present a rough attempt to adjust unemployment for deviations of actual from equilibrium unemployment. We start from the assumption that the following “Phillips curve” relation holds between the change in inflation, the actual and the equilibrium rate of unemployment:

$$\Delta\pi_{it} = -a(u_{it} - u_{it}^*)$$

We then construct “equilibrium unemployment” as  $u_{it}^* = u_{it} + (1/a)\Delta\pi_{it}$ ;  $1/a$  is often called the sacrifice ratio. Estimates of  $a$  for Europe for annual data typically range from 0.25 to 0.50.<sup>25</sup> Column (2) constructs  $u^*$  using a sacrifice ratio of 2.0; column (3) does the same using a ratio of 4.0.<sup>26</sup> The fit in columns (2) and (3) is better than in column (1)—the dependent variable is not the same however. The effects of each of the three shock variables are roughly similar.

Table 5.5 presents the results of the specification that allows for both shocks and interactions with institutions. Column (1) presents the results from estimating the benchmark specification (2).

All three variables measuring shocks are now very significant. The effects of TFP growth and the labor demand shift are larger than in Table 5.4, the effects of the real interest rate slightly smaller. A decrease in TFP growth of 3 percentage points translates into an increase in the unemployment rate of about 2 percent. An increase in the real interest rate of 5 percentage points leads to an increase in the unemployment rate of 2.5 Percent. A decrease in the adjusted labor share of 10 percentage points leads to an increase in the unemployment rate of about 2 percent.

Table 5.5 Shocks interacted with fixed institutions

|             | (1)<br><i>Benchmark<br/>equation</i> |        | (2)<br><i>Institutions<br/>entered<br/>individually</i> |        | (3)<br><i>u* sacrifice<br/>ratio = 2.0</i> |        |
|-------------|--------------------------------------|--------|---|--------|--|--------|
| TFP growth  | 0.71                                 | (5.0)  |   |        | 0.58                                       | (4.5)  |
| Real rate   | 0.47                                 | (5.1)  |   |        | 0.49                                       | (5.7)  |
| LD shift    | 0.19                                 | (2.7)  |   |        | 0.15                                       | (2.4)  |
| <i>RR</i>   | 0.025                                | (3.7)  | 0.013   | (2.4)  | 0.025                                      | (3.7)  |
| <i>Ben</i>  | 0.267                                | (3.0)  | 0.203   | (2.3)  | 0.313                                      | (3.3)  |
| <i>ALMP</i> | 0.028                                | (1.4)  | -0.009  | (-0.7) | 0.033                                      | (1.6)  |
| <i>EP</i>   | 0.095                                | (2.7)  | 0.047   | (2.7)  | 0.090                                      | (2.6)  |
| <i>Tax</i>  | 0.033                                | (2.4)  | 0.026   | (2.6)  | 0.037                                      | (2.6)  |
| <i>Cov</i>  | -0.501                               | (-1.1) | 0.639   | (3.0)  | -0.466                                     | (-1.0) |
| <i>Den</i>  | 0.033                                | (3.2)  | -0.002  | (-0.3) | 0.033                                      | (2.8)  |
| <i>Coor</i> | 0.414                                | (2.9)  | -0.039  | (-0.4) | 0.439                                      | (2.9)  |
| <i>CE</i>   | Yes                                  |        | Yes   |        | Yes  |        |
| $\bar{R}^2$ | 0.674                                |        |   |        | 0.702                                      |        |

Note

Number of observations: 131.

Coefficients on seven of eight institutions have the expected sign. Only *Cov* is negative, but insignificant. The most significant coefficients are on the *RR*, the *Ben*, *Den*, and *Coor*. Except for *Cov*, the pattern of coefficients is the same as in Table 5.1 (estimated with unobservable shocks), up to a factor of proportionality greater than one. That is, they are in general 1.5 to 2 times larger than in Table 5.1. The mechanical explanation is that the observable shocks explain less of the general increase in unemployment, and the interactions must therefore explain more. The  $\bar{R}^2$  is much lower than in Table 5.1: despite the fact that they can differ across countries, the three observable shocks do not do as good a job as the set of eight time effects in Table 5.1.

The specification does a good job of explaining differences in unemployment evolutions across countries. This is shown in Figure 5.11, which plots the change in fitted unemployment against the change in actual unemployment, from 1965–69 to 1990–94. The fit is quite good; clearly much better than in Figure 5.10, if not quite as good as in Figure 5.9. Figure 5.12 gives another way of looking at fit, by plotting the actual and fitted unemployment rate for each of the 20 countries over time. The visual impression is one of a good fit in nearly all cases. (To facilitate comparison of unemployment rates across countries, the vertical scale is the same for all countries. The drawback is that it is harder to assess the fit for each country.)

Column (2) looks at the effects of entering institutions one at a time. The conclusions are largely similar to those in the previous section. In particular, *Cov* is very significant on its own, but not in combination with other institutions. Column (3) replaces actual by equilibrium unemployment, assuming a sacrifice ratio of 2.0. The fit is better, but the results are otherwise very similar.

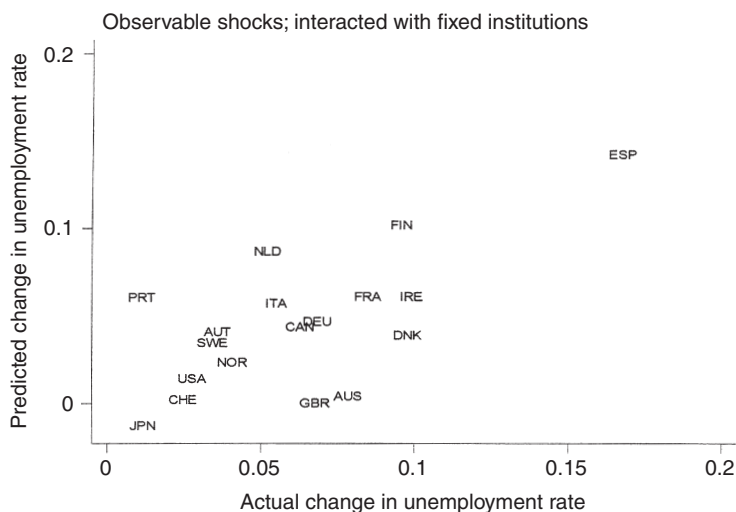


Figure 5.11 Actual and predicted change in  $u$ , 1965–69 to 1990–94.



Table 5.6 Shocks interacted with institutions—alternative measures of institutions

|                   | (1)<br><i>Alternative<br/>RRs</i> | (2)<br><i>Time-varying<br/>RRs</i> | (3)<br><i>Alternative<br/>EP</i> | (4)<br><i>Time-varying<br/>EP</i> |
|-------------------|-----------------------------------|------------------------------------|----------------------------------|-----------------------------------|
| TFP growth        | 0.57 (3.7)                        | 0.54 (3.6)                         | 0.61 (4.2)                       | 0.65 (4.3)                        |
| Real rate         | 0.50 (4.6)                        | 0.51 (4.8)                         | 0.49 (4.9)                       | 0.51 (5.2)                        |
| LD shift          | 0.18 (2.1)                        | 0.17 (2.2)                         | 0.17 (2.3)                       | 0.17 (2.2)                        |
| (N) <i>RR</i>     |                                   |                                    | 0.022 (2.9)                      | 0.020 (3.0)                       |
| (N) <i>Ben</i>    |                                   |                                    | 0.199 (2.1)                      | 0.157 (2.0)                       |
| (Alt) <i>RR1</i>  | 0.014 (1.8)                       | 0.008 (1.1)                        |                                  |                                   |
| (Alt) <i>RR25</i> | 0.006 (0.4)                       | 0.013 (0.9)                        |                                  |                                   |
| (N) <i>ALMP</i>   | 0.014 (0.6)                       | 0.001 (0.0)                        | 0.017 (0.8)                      | 0.008 (0.4)                       |
| (N) <i>EP</i>     | 0.051 (1.1)                       | 0.049 (1.1)                        |                                  |                                   |
| (Alt) <i>EP</i>   |                                   |                                    | 0.224 (1.3)                      | 0.083 (1.1)                       |
| (N) <i>Tax</i>    | 0.023 (1.5)                       | 0.018 (1.1)                        | 0.037 (2.4)                      | 0.032 (2.3)                       |
| (N) <i>Cov</i>    | 0.087 (0.2)                       | 0.213 (0.5)                        | 0.186 (0.6)                      | 0.394 (1.5)                       |
| (N) <i>Dens</i>   | 0.020 (1.7)                       | 0.013 (1.1)                        | 0.026 (2.1)                      | 0.020 (2.0)                       |
| (N) <i>Coor</i>   | 0.341 (2.3)                       | 0.285 (1.9)                        | 0.524 (2.8)                      | 0.458 (2.9)                       |
| <i>CE</i>         | Yes                               | Yes                                | Yes                              | Yes                               |
| $\overline{R}^2$  | 0.624                             | 0.618                              | 0.656                            | 0.654                             |

Table 5.6 looks at alternative measures of institutions. Its structure is the same as that of Table 5.3. Columns (1) and (2) look at the effects of using the two alternative measures of replacement rates using OECD data. Column (1) uses a time-invariant value equal to the average for 1985–89; column (2) uses the time series. Columns (3) and (4) do the same for employment protection. The table suggests two conclusions, both worrisome: Replacing the Nickell measures by alternative, but time-invariant measures, substantially decreases the  $\overline{R}^2$ . Going from the time-invariant to the time-varying measures further decreases the fit. The coefficients on institutions remain consistently positive, but are typically smaller than in Table 5.5, and less significant. These results lead to the same discussion as in “Interactions”: Luck, or data mining, when the standard set of measures is used? Poor time series for institutions, interacting here with the fact that we are looking at their product with time-varying and also imperfectly measured shocks? Or reverse causality (although the fact that the deterioration of fit happens when replacing one time-invariant measure by another is not supportive of this hypothesis).

To conclude, one can indeed give a good account of the evolution of unemployment across countries and times by relying on observable shocks and interactions with labor market institutions. The fact that the results are weaker when using time-varying institutions is worrying. But, again, the results strike us as surprisingly good overall.

## Conclusions

We see our results as preliminary. We see our dynamic specification of the effects of shocks as much too crude. We still need to construct and introduce time series

for some labor market institutions. We worry about the endogeneity of labor market institutions. Nevertheless, we believe that the results so far suggest that an account of the evolution of unemployment based on the interaction of shocks and institutions can do a good job of fitting the evolution of European unemployment, both over time and across countries.

If our account is correct, one can be mildly optimistic about the future of European unemployment. The effects of some of the adverse shocks should go away. The real interest rate is likely to be lower in the future than in the recent past. The dynamic effects of what we have identified as adverse labor demand shifts should eventually prove favorable to employment. Institutions are also slowly becoming employment-friendly. Our results suggest that the more favorable macroeconomic environment and the improvement in institutions should lead to a substantial decline in unemployment.

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## Notes

- 1 The eight time periods are 1960–64 to 1990–94, and 1995+ (typically 1995–96.) The 15 countries included in OECD-Europe are Austria (AUT), Belgium (BEL), Denmark (DNK), Finland (FIN), France (FRA), Germany (DEU), Ireland (IRE), Italy (ITA), the Netherlands (NLD), Norway (NOR), Portugal (PRT), Spain (ESP), Sweden (SWE), Switzerland (CHE), and the United Kingdom (GBR). Left out are Greece, Iceland, and Luxembourg, for which we could not construct time series for all the explanatory variables used later in the chapter. The unemployment rates are the rates according to national definitions, rather than standardized rates—which typically do not exist back to 1960. (For the period when both unemployment rates exist, using one or the other makes little difference.) Also, while the figures only show what has happened in Europe, the regressions we run later look at all available OECD countries; they include, in addition to Europe, the United States (USA), Canada (CAN), Australia (AUS), New Zealand (NZL), and Japan (JPN).
- 2 We shall use the existence of the earlier work as an excuse for keeping our discussion of theoretical issues, and of relevant references, to a minimum.
- 3 We first construct the rate of TFP growth for each year and each country. We do so by computing the Solow residual for the business sector, and then dividing it by the labor share in the sector. Under the assumption of Harrod neutral technological progress—the assumption that allows for steady state growth—this is the right measure of technological

- progress, and gives the rate at which real wages can grow along the balanced growth path. We then take averages for each 5-year period, for each country. E5 and E15 are constructed as simple (unweighted) averages of TFP growth over countries.
- 4 Note that, in contrast to the other observations which are based on five yearly observations, the observation for 1995 is typically based on only one year (1995) or two years (1995 and 1996). Thus, one year can make a lot of difference. This is the case for Italy in this figure.
  - 5 An early article on that theme is Grubb *et al.* (1982).
  - 6 We first compute the real interest rate for each year and each country, as the nominal long rate on government bonds minus a 5-year average of lagged inflation. We then take averages for each 5-year period.
  - 7 The focus here is on the effects on the equilibrium unemployment rate. Changes in the real interest rate also affect the deviation of actual unemployment from the equilibrium rate. We focus on that effect later.
  - 8 Let  $Y = N^\alpha K^{1-\alpha}$ . Let the ratio of the wage to the marginal produce of labor  $w/Y_n \equiv \mu$ .  $\mu$  is equal to 1 under perfect competition in both goods and labor markets, but may differ from 1 otherwise. Then the share of labor  $\alpha = a\mu$ . A decrease in  $\alpha$  reflects a decrease in  $a$  or a decrease in  $\mu$ . Also labor demand can be written as  $\log N = \log Y - \log w + \log \alpha$ . A decrease in  $\log \alpha$  leads to an equal decrease in  $\log N$  given output and the wage. This is why we look at the log share.
  - 9 This distinction between Anglo-Saxon and Continental countries is discussed in Blanchard (1997). The differences in evolutions reflects divergence rather than convergence of the share in levels: For the last period (1995+), the labor share in the business sector was 62 percent for France and Spain, vs 70 percent for the United Kingdom and 67 percent for the United States. (The caveat about the dangers of comparing share levels across countries applies.)
  - 10 We first construct the change in inflation (using the business sector GDP deflator for each year and each country. We then take the average for each 5-year period.
  - 11 A longer discussion is given in our earlier work. A nice theoretical discussion is given by Mortensen and Pissarides (1998). A wider ranging presentation of both theory and facts is given by Nickell and Layard (1998).
  - 12 The steady state unemployment rate is equal to unemployment duration times the flow into unemployment as a ratio to the labor force. Unemployment benefits increase duration, and leave the flow roughly unchanged, increasing the unemployment rate.
  - 13 In addition to the references in these two articles: For a recent comparison of various measures of unemployment insurance, see Salomaki and Munzi (1999). For a recent comparison of measures of employment protection, see OECD (1999), chapter 2.
  - 14 Informal evidence suggests that employment protection was high in France even in the 1960s. Again, this is not reflected in the Lazear measure, and by implication, not reflected in our measure either. This may be an issue for other countries as well.
  - 15 Again, see our earlier work for references, and discussion.
  - 16 This was indeed one of the main themes of Bruno and Sachs (1985).
  - 17 This was the motivation behind the admittedly crude “hysteresis model” of unemployment in Blanchard and Summers (1986). Research since then has shown that while full hysteresis (permanent effects of shocks) is unlikely, institutions can lead to high persistence.
  - 18 See for example, the comparison of the labor markets in Portugal and the United States in Blanchard and Portugal (1999).
  - 19 Nickell gives values for these institutions for both 1983–88, and 1989–94. We use the average of the two.
  - 20 Thus, we multiply the original Nickell measures of active labor market policies and of coordination by  $-1$ . We take the expected effect of employment protection to be that more employment protection leads to a larger effect of adverse shocks on unemployment, and the expected effect of coordination that more coordination reduces the effects of adverse shocks on unemployment.



- 21 The  $t$ -statistics are computed under the assumption of iid residuals. The residuals show however both spatial and serial correlation, and adjusted  $t$ -statistics would probably be lower.
- 22 There are however some differences between estimated coefficients. In particular: employment protection is significant here, not in Nickell. Union contract coverage is not significant here, but is significant in Nickell.
- 23 Most theories predict that the interaction of institutions and shocks may be different for different shocks. But allowing for different interactions between each shock and each institutions struck us as asking too much from our limited data set (131 data points for the regressions in this section).
- 24 The difference between macro and labor panel data regressions is that, in macro, each data point is intimately known by the researcher...
- 25 If our approach to measuring the equilibrium unemployment rate is right however, then most existing estimates of  $a$ , which rely on a much rougher measure of equilibrium unemployment, are not right. We did not take up the task of estimating  $a$  in this chapter.
- 26 In doing so, we are implicitly assuming that the sacrifice ratio is not related to institutions. This is probably incorrect.

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## 6 Labor market institutions and unemployment in Europe

A comment on Blanchard and Wolfers

*David R. Howell*

The statistical examination of the links between labor market institutions and unemployment across developed countries is a relatively recent development, pioneered by Stephen Nickell and his colleagues (Layard *et al.* 1991; Nickell and Bell 1995; Nickell and Layard 1997). Chapter 5 by Blanchard and Wolfers in this volume, previously published as an NBER working paper in 1999 and in the *Economic Journal* in 2000, has been a hugely influential contribution in what might be termed the second generation of research on this question. It focuses on the interaction of macroeconomic shocks and institutions, expands the time period, and adds time-varying measures of institutions. But most importantly it is cautious—persistently checking the initial results with various robustness tests and questioning the meaningfulness of the regression results given the quality and potential endogeneity of the key institutional measures. I will begin with a brief overview of what may be termed the “first generation” studies, followed by short comments on the Blanchard–Wolfers contribution, and then will turn to more recent work that challenges the mainstream view that cross-country regression research confirms a central role for labor market institutions in the explanation for Europe’s high unemployment in the 1980s and 1990s.

### **The first generation**

A hallmark of the classical thinking attacked by Keynes in the 1930s was that wage rigidity must explain persistent high unemployment. Sensible economic policy would then consist of promoting labor market flexibility, which in turn would entail—according to the general view—attacking those labor market institutions designed to shelter workers from the harshest effects of the competitive marketplace. But it is notable that it was not until the late 1980s that leading economists began to carefully explore the statistical links between “employment-unfriendly” labor market institutions and the cross-country pattern of unemployment for developed (OECD) countries. The explanation for this apparent anomaly is easily found—until the 1970s, countries rich in strong, highly “unfriendly” institutions, such as labor unions, unemployment benefit systems, and employment protection laws, were consistently outperforming the more



institutions had strong “good” effects: according to Nickell’s results, bargaining coordination and active labor market policies both tended to *reduce* unemployment. In sharp contrast to another paper in the same symposium, which argued that labor market rigidities alone accounted for high European unemployment (Siebert 1997), Nickell’s (1997) conclusion was cautious: “the broad-brush analysis that says that European unemployment is high because European labor markets are too ‘rigid’ is too vague and probably misleading.”

### **Blanchard and Wolfers**

With the late 1990s, a number of empirical studies appeared that improved upon Nickell’s original institutional measures, added others, changed the time period covered, and experimented with the specification and econometric method (see Baker *et al.* 2002, for a detailed review of this literature). The high water mark of this second generation was, in this author’s view, the Blanchard–Wolfers chapter that appears in this volume. Building on Blanchard’s earlier work, this chapter shifts the focus from simple institution effects to the interaction of institutions with macroeconomic shocks, represented by the slowdown in total factor productivity (TFP) growth, trends in long-term real interest rates, and shifts in labor demand. Blanchard and Wolfers argue that labor market institutions may produce higher unemployment by limiting the ability of labor markets to respond to adverse shocks. This helps explain why the same institutions were not employment-unfriendly in previous decades.

Their study is also distinguished by a much longer time period (eight 5-year periods from 1960–96; the last 2 years are treated as a full period), and while it relies heavily on Nickell’s institutional measures, it also employs alternative, OECD-generated measures of benefit replacement rates and employment protection laws that vary over time. The substantial skepticism with which Blanchard and Wolfers treat their results offers a striking contrast to much of this cross-country regression literature (again, see Baker *et al.* 2002). Along with numerous robustness tests, the authors challenge the inadvertent bias that may creep into the generation of the variables themselves.

One must worry however that these results are in part the result of research Darwinism. The measures used by Nickell have all been constructed *ex-post facto*, by researchers who were not unaware of unemployment developments. When constructing a measure of employment protection for Spain, it is hard to forget that unemployment in Spain is very high...Also, given the complexity in measuring institutions, measures which do well in explaining unemployment have survived better than those that did not.

(Blanchard and Wolfers 2000: C22)

Using Nickell’s (1997) time-invariant measures of institutions (the average for 1983–88 and 1989–94) and accounting for time and country effects, Blanchard and Wolfers get results for the entire 1960–96 period that are similar to Nickell’s for the late 1980s and early 1990s. But, the authors point out that the results are

quite sensitive to the specification. Indeed, it appears that the use of alternative, arguably much superior OECD-generated measures of unemployment benefit replacement rates and the severity of employment protection laws worsens the results. Referring to Table 5.6, they write that “The table suggests two conclusions, both worrisome: replacing the Nickell measures by alternative, but time invariant measures, substantially decreases the  $R^2$ . Going from the time invariant to the time varying measures further decreases the fit.” Nevertheless, on balance they conclude that “the results strike us as surprisingly good overall”—institutions traditionally viewed to be employment-unfriendly are found to be statistically associated with higher unemployment across countries.

### **Recent research**

Blanchard and Wolfers’ emphasis on the importance of the *interaction* of macroshocks and institutions follows from their view that “while labor market institutions can potentially explain cross-country differences today, they do not appear able to explain the general evolution of unemployment over time” (2000: C2). In a recent study that relies on annual data for the 1960–92 period, Nickell and colleagues (2002) directly take up the challenge. As they put it, “our aim is to see how far it is possible to defend the proposition that the dramatic long term shifts in unemployment seen in the OECD countries over the period from the 1960s to the 1990s can be explained simply by changes in labor market institutions in the same period” (Nickell *et al.* 2002: 1). This represents a striking shift from Nickell’s relatively cautious 1997 assessment. The new paper concludes that the data support their proposition: “broad movements in unemployment across the OECD can be explained by shifts in labor market institutions.”

But there is reason for considerable skepticism about such a conclusion. First, it might be noted that the Nickell *et al.* results appear far more fragile than the authors suggest. As Baker *et al.* point out, Nickell *et al.* put out 2001 and 2002 versions of the paper (the latter published as Nickell *et al.* 2003<sup>1</sup>), and the main difference seems to be that the more recent one extends the data from 1992–95. This change appears to have quite large effects.<sup>2</sup> The fact that the inclusion of three additional years (from 31 to 34 years in the time series) leads to substantial changes in the regression results—suggesting entirely different conclusions about the effects of key institutional measures—would appear to raise serious questions about the robustness of their findings. Of course, this fragility is exactly what Blanchard and Wolfers found and expressed so much concern about.

Along the same lines, alternative tests using the same data suggest far less impressive results. In his “Comment” on the Nickell *et al.* study, Fitoussi runs separate country tests on their data and concludes that “What is striking is the weak, to say the least, explanatory power of the institutional variables, especially those considered as being the more important, namely, the benefit replacement rate and employment protection...” (Fitoussi 2003: 434). Fitoussi’s conclusion is unequivocal: “Until now, there has been no convincing evidence that labor market institutions are responsible for the high level of unemployment in Continental

Europe or for the disappointing macroeconomic performances for Europe during the 1990s” (p. 434).

The same conclusion is reached in a new study by Baker *et al.* (2002). One of the distinctive features of the “second generation” literature has been the improvement in the quality of the institutional measures (recall Blanchard and Wolfers’ warning about “research Darwinism”). As a first test of the robustness of Nickell’s influential study (1997), Baker *et al.* simply use the Nickell *et al.* data in a specification that closely resembles that of Nickell (1997). Baker *et al.* (2002) find that,

Using the Nickell *et al.* (2001) data in the Nickell (1997) regression produces results that differ markedly from those obtained in the original study. In Nickell (1997), seven of the eight institutional variables had the correct sign and were statistically significant at standard levels. The only exception was the employment protection variable, which was close to zero and not statistically significant. Using the Nickell *et al.* (2001) data, however, three of the six institutional variables have the wrong sign (employment protection, union density, and the tax wedge) and none are statistically significant.

(Baker *et al.* 2002: 114)

Just as Blanchard and Wolfers found, the use of more recently constructed (and presumably better) measures of the “employment-unfriendly” institutions produces notably worse results. Indeed, Nickell’s 1997 results entirely disappear with the better Nickell *et al.* data. The Baker *et al.* study runs a number of tests of the full 1960–99 period, using measures drawn from the OECD (personal communication), Blanchard and Wolfers (2000), Belot and Van Ours (2000), and Nickell *et al.* (2002), and consistently find weak and even wrong signed results for the key measures—unemployment benefits, employment protection, and union coverage. Indeed, they find that, comparing the results before and after the mid-1980s, “if anything the results for the more recent period offer even weaker support for the deregulationist position than does the 1960–84 period.”

## **Assessment**

The first generation empirical work on labor market institutions and unemployment, exemplified by Nickell (1997), has spawned a large literature which has utilized better (often time-varying) measures of institutions and increasingly sophisticated estimation methods. Given the direct implications for public policy, getting the effects right is particularly important. Blanchard and Wolfers’ chapter not only advanced this research, but was distinguished by a concern over the quality of the data and fragility of their results, a concern that appears to be strongly confirmed by recent research. Their healthy skepticism is not particularly characteristic of this research literature, which may be the result of a bias towards confirmation, stemming from the dominance of classical thinking (rigidities must explain persistent high unemployment).

The alternative perspective is one that stresses the ability of capitalism to thrive under a variety of institutional arrangements (Freeman 2000; Hall and

Soskice 2001). It is notable that the European unemployment crisis appears concentrated in just the 1985–99 period, and for many countries (Denmark, the Netherlands, Sweden, Germany, and so on) only for a portion of that decade and a half. Figure 6.1 shows a recent, strong downward convergence in unemployment rates, one that has taken place without radical reform of the European welfare state—by any measure, northern European countries have maintained a dramatically stronger welfare state than the United States (see Howell 2004). Indeed, by 2002, the United States again had an unemployment rate above the median of these 19 major OECD countries.

The conventional wisdom, that employment-unfriendly labor market institutions are the source of the relatively recent crisis in unemployment in much of Europe, needs to be put in a larger perspective, one nicely put by Fitoussi in his comment on the Nickell *et al.* chapter:

If we had followed conventional wisdom in each decade we would have recommended that every country in the world adopt the French institutional model in the 1960s, the Japanese one in the 1970s, the German one in the 1980s, and the U.S. one in the 1990s.

(Fitoussi 2003: 437)

As the American “roaring nineties” come to an end, it is time for a more balanced view of the role of labor market institutions and, following Blanchard and Wolfers’ example, a less confirmatory approach to the cross-country research on unemployment.

## Notes

- 1 Actually, it appears that the new results (through 1995) are published in table 13 of Nickell *et al.* (2003) with a heading that mistakenly reads 1961–92 instead of 1961–95.
- 2 In the 2001 version, the employment protection legislation variable was highly significant in all three of the published unemployment regressions (table 13) and quite large in its economic impact. In contrast, the coefficient of this variable in the regressions in the more recent version is not close to being significant. The additional 3 years also seems to have a substantial affect on the impact of other variables. In the 2002 version, the effect of higher taxes is more than 30 percent lower, the effect of coordination is nearly 40 percent lower, and the effect of benefit duration is cut by more than 50 percent. The additional 3 years of data also now make the coefficient of the interest rate variable significant. It had been very close to zero and not close to significant in the earlier regressions. In the EPOP regressions in the earlier version, only the replacement rate and benefit duration variables were found to have significant negative effects and the employment tax variable was not close to being significant.

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# 7 Labor market dynamics in the Euro-area

## A model-based sensitivity analysis

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### Introduction

The literature relating movements in unemployment and activity distinguishes between three main hypotheses. The first—the *natural rate* hypothesis—states that, although output-gap fluctuations generate cyclical movements in unemployment, in the long run, unemployment reverts back to equilibrium. This equilibrium is determined by deep, structural factors such as taxation, work incentives, unionization, social preferences etc. The second hypothesis—*Hysteresis*—suggests that unemployment has no such equilibrium-reversion properties: due to institutional and labor market rigidities, cyclical fluctuations can have permanent effects on the level of unemployment. There are two coexisting approaches to this hypothesis, one simply implying that unemployment is characterized as a nonstationary, unit-root process. The other one emphasizes the possible nonlinearity involved in the formation of the equilibrium unemployment, the complexity of which is not simply captured by a unit-root process.<sup>1</sup> In the former case, the unemployment follows a random walk, reflecting all types of shocks cumulated over history; in the latter, unemployment may be affected solely by shocks of large magnitude, moreover in an asymmetric way.

Focusing on the statistical aspects of the issue, a number of studies have examined unemployment persistence among OECD countries: for example, Arestis and Mariscal (1999), Bianchi and Zoega (1998), Brunello (1990), Jaeger and Parkinson (1994), Song and Wu (1997). Results are, however, often mixed. Broadly, one might say that in many cases, the unit-root case cannot be rejected; however, when unemployment is examined in a multicountry panel context or where there is some control for structural breaks, a unit root is more often rejected. Accordingly, some consensus seems to appear on the empirical validity of the so-called *partial Hysteresis* assumption—Layard *et al.* (1991)—that is, heavily persistent but equilibrium-reverting unemployment, albeit with slow speed of adjustment.<sup>2</sup>

A consensus has therefore emerged, whereby the Euro-area is characterized, when compared to the United States, not only by high unemployment but also, and more problematically, by an unusually high degree of unemployment persistence. This is argued to pose a problem for (Euro-area) macroeconomic policy-makers. If unemployment has a unit root, stabilization policy becomes

complicated, in so far as it must continuously and exactly aim at offsetting any adverse shocks likely to affect equilibrium unemployment. Even if unemployment were merely strongly persistent, problems for stabilization policy would arise since it would be impossible, in the face of shocks, to avoid periods of protracted high unemployment. Eventually, unemployment may well in time revert back to equilibrium, but the adjustment period would then involve substantial welfare loss for agents, which may create pressures to deviate from medium-term stability-oriented policies. One additional theoretical possibility is that at extremes of unemployment, the labor market adjustment process (e.g. the elasticity of wages with respect to unemployment) might flatten considerably; thus resulting in what could be called *local* Hysteresis effects. In such cases, policy-makers would hardly be comforted by the notion of eventual equilibrium-reversion. They would inevitably however face the issue of how to avoid “unemployment traps,”<sup>3</sup> that is, extremes of unemployment that once entered may be difficult to depart from.

The relation between labor market variables and policy is however not straightforward. Policy-makers (especially those in charge of monetary policy) are rarely considered to target labor market variables as such (e.g. the unemployment or vacancy rate). We have already suggested that equilibrium unemployment is invariant to the cycle (i.e. there is no long run trade-off between inflation and activity) and determined by structural, institutional, and behavioral characteristics in the economy. These will, at best, be slow to change and, most likely, not amenable to short run stabilization policy. However, while it is not inconceivable that policy-makers could take cyclical unemployment into account when setting policy, this seems rarely considered. Notwithstanding, given the success of the output gap as an argument in, for example, the Taylor rule, it should be borne in mind that there is a mapping between the output gap and the unemployment gap, labor share, etc. Traditionally, this relation has rested on the so-called Okun’s law connecting cyclical movements in output and unemployment.<sup>4</sup> More recently, in the context of “New Keynesian” Phillips curves literature, output-gap measures have been directly related to measures of real marginal costs and thus, in turn, wage pressures and productivity.<sup>5</sup> Consequently, irrespective of whether monetary policy-makers explicitly take into account labor market variables (such as unemployment), there will be a clear connection to labor market conditions in terms of instruments used. Moreover, some Central Banks—the US Federal Reserve is but one example—have statutory growth objectives.<sup>6</sup>

Two additional elements have to be considered, in relation to the interaction between labor market structure and the type of policy conducted. First, the transmission mechanism of policy may be affected by the labor market structure prevailing, so that the dynamic response of the economy to a given policy move may widely differ across labor market configurations. Second, there is a wide range of possible policies that could be employed—in particular on the monetary side—so that the dynamics of unemployment in a labor market structure will also vary with the type of policy implemented.

We address such issues based on simulations carried out with an estimated macroeconometric model for the Euro-area (the Area Wide Model (AWM),

Fagan *et al.* 2001). The model is characterized by a well-pinned down, unique equilibrium unemployment rate but with relatively slow convergence dynamics. We want to check the sensitivity of this property to changes to both the labor market configuration and the postulated monetary policy. This is done using both deterministic and stochastic simulations. The first set of results, documenting the impact of a monetary policy shock, allows us to assess how monetary policy transmission is affected by the various assumptions, and see how the dynamics of unemployment can vary depending on both the labor market structure and the assumed policy. The second set of simulations provides us with a number of summary statistics on variables of interest such as unemployment and inflation. The whole exercise is conducted first with the standard model version, to provide a benchmark consistent with the estimated parameters. A similar exercise is then carried out allowing for a stronger wage response to unemployment and for a higher sensitivity of employment to real wages. In turn, a specifically adverse configuration is analyzed, where, due to imposed asymmetries in the Phillips curve, high unemployment results in lower wage responses than those estimated. Such a feature could put the economy in a situation where unemployment remains well beyond its long run equilibrium value for a protracted period. We then analyze the performance of alternative specifications of the Taylor rule, under all envisaged labor market configurations.

A final point to be borne in mind is that the AWM—unlike many models used in this class of exercises—is relatively large and nonlinear. Such features are attractive in so far as they furnish us with a better grasp of the higher moments of the variables of interest and the potential for the economy to get caught in traps which by their very definition are asymmetric and nonlinear. The computational burden of solving these kinds of models under such configurations is more than compensated by the insight they give to (monetary) stabilization policy under often highly nonstandard labor market features.

Several papers have examined the sensitivity to and performance of monetary policy rules to different hypotheses on unemployment determination, Phillips-curve specification, capacity constraints—*inter alia*, Evans (1986), Turner (1995), and Clarke *et al.* (2001). Our study both complements those and extends them. First, we examine both the deterministic and stochastic environment in evaluating labor market outcomes and policy rules. Second, in evaluating our results, we consider metrics associated with the *full* distributional path of key variables. This turns out to be very important and highly instructive. Finally, we focus on the Euro-area. Thus, to sum up, our approach is thus very much an encompassing one, allowing for a multiplicity of possible labor market adjustment mechanisms and policy-rule settings.

There are however two important caveats, regarding the scope of this study. First, this chapter is not about how monetary-policy makers might compensate for labor market deficiencies. The dominant view in macroeconomics remains the division between the real and nominal sides of the economy. Monetary policy controls the latter and indeed provides the nominal anchor to long run inflation and inflation expectations. While credible and well-designed monetary policy

rules may have an effect on the variability (and dynamics) of unemployment around its natural rate or output around potential, they cannot affect the long run of these variables since these are driven by more fundamental aspects—for example, work incentives, institutional and labor market rigidities, savings rate, demographics, natural resources, etc. Second, the chapter does not focus on *optimal* monetary policy. This is deliberate. We consider the contribution of this chapter to be the analysis of the interaction between policy and labor market dynamics, rather than trying to identify an optimal policy rule. This is also the reason why we have not addressed the issues relating to whether the monetary policy maker could engage in a process of learning the true parameters governing the economy.

Finally, let us try to put our work in the appropriate context with respect to the title of this meeting and its accompanying volume—*Monetary Policy and the Labor Market in the U.S., the Euro-area and Japan: A Conference in Honor of James Tobin*. Although Tobin's contribution to economics touched many different fields, the concerns of both this volume and our chapter ranked high. First, consider stabilization policy. Tobin famously engaged in a lively debate with Milton Friedman in the 1960s and 1970s on the effectiveness of (and interest elasticities from) fiscal and monetary policy. Friedman believed the stabilizing features of the economy so strong, and the informational requirements of activist policy-maker so onerous that anything other than noncontingent policy rules were unrealistic. However, he did not deny the long and variable lags of monetary policy, state-contingent rules (such as Taylor rules) did nevertheless—as Buitier (2003: F608) comments—“provide a reasonable summary of Tobin's practical monetary policy prescriptions.” This prescription was largely based on his view that market failures—such as periods of prolonged unemployment—were sufficiently probabilistic and policy-makers sufficiently informed and credible, that feedback rules could be welfare-enhancing over passive rules (like Friedman's fixed-money growth rule). The second concern was unemployment dynamics. Tobin considered that much of the case against stabilization policy resulted from an overemphasis on natural-rate reasoning.<sup>7</sup> Tobin's case against the natural rate rested on the existence of a temporary floor on the rate of decline in nominal wages in excess of supply markets—with this floor being exogenous to past (or anticipated) wage dynamics as well as to the actual amount of excess supply. This constraint will only cease to bind if high unemployment persists over a protracted period. These features, as we shall see, are very much aspects of our modeling strategy in this chapter. Notably, while the model employed here—like most models in its class—embodies no long run trade-off, we nevertheless allow for sufficient and persistent departures from that natural rate (essentially intertemporal path-dependency in unemployment) such as to capture many of Tobin's underlying themes (e.g. nonlinearity and threshold effects in the wage-price-employment nexus).

The chapter proceeds as follows. We first consider the stylized facts of Euro-area unemployment. We then describe the AWM and the nature of our exercises. The following two sections contain our deterministic and stochastic simulation results respectively. Conclusions are reported in the final section.

## Stylized facts of Euro-area unemployment dynamics

In this section, we briefly highlight the stylized facts of Euro-area unemployment and labor market dynamics, in descriptive terms, first, but also with a view to providing benchmark estimates for a number of key parameters for the Euro-area on the basis of which some structural change analysis could be conducted.

### *Descriptive overview*

One of the notable aspects in that regard lies with international comparisons—for example, McMorrow (1996). As we can see (Figure 7.1) from 1983 onwards, Euro-area unemployment has exceeded that of the United States and Japan. Japan's unemployment has remained unusually low by comparison, reflecting its better growth performance and specialized labor market features such as labor hoarding and implicit contracts (Brunello 1990; Lincoln 2001). The United States has been between the Japan and Euro-area extremes with an unemployment rate anchored around 6 percent. In the Euro-area, however, unemployment accelerated upwards appreciably, apparently after the first and second oil shocks. As we can see (Table 7.1), it has witnessed not only the highest average unemployment rate but also the most variable one. For illustrative purposes, Table 7.1 also gives estimates of Stock's (1991) 90 percent confidence interval around the largest autoregressive unit root in the unemployment rate—as can be seen, all unemployment rates have autoregressive values that straddle unit-root territory. In the case of the United States, the central estimate of the largest autoregressive root is

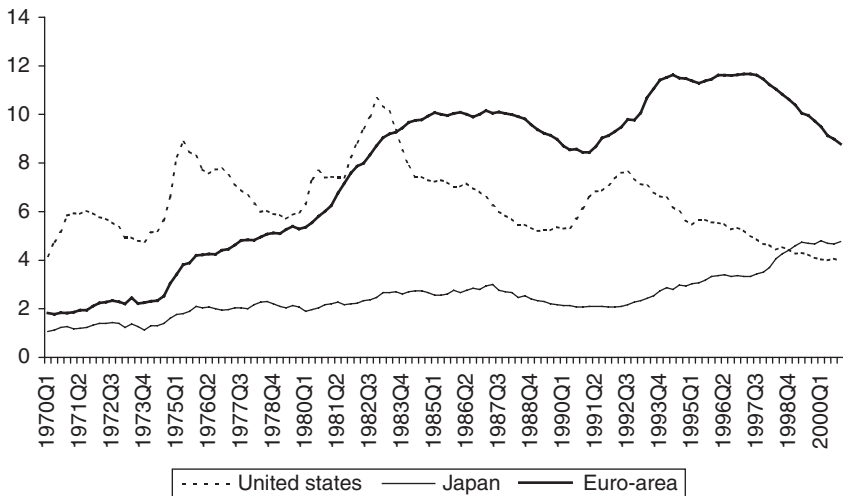


Figure 7.1 The dynamics of unemployment rates (1970–2000).

Table 7.1 Descriptive statistics for the unemployment rate (1970–2000)

|  | <i>United States</i>    | <i>Japan</i>            | <i>Euro-area</i>        |
|--|-------------------------|-------------------------|-------------------------|
| Mean   | 6.34                    | 2.48                    | 7.64                    |
| St. Dev.   | 1.43                    | 0.89                    | 3.28                    |
| Max.   | 10.67                   | 4.80                    | 11.68                   |
| Min.   | 3.97                    | 1.07                    | 1.77                    |
| Skewness   | 0.67370<br>[0.00250]    | 0.91732<br>[0.00003]    | -0.54573<br>[0.01425]   |
| Kurtosis   | 0.36241<br>[0.42331]    | 0.77894<br>[0.08526]    | -1.16572<br>[0.01001]   |
| Normality  | 10.05855<br>[0.00654]   | 20.52554<br>[0.00003]   | 13.17586<br>[0.00137]   |
| Stock's (1991)<br>measure of<br>persistence <sup>1,2</sup> | 0.819<br>(0.627, 1.045) | 1.044<br>(1.026, 1.078) | 1.048<br>(1.031, 1.082) |

Source: OECD, ECB.

Notes

1 Based on ADF regression:  $y_t = \mu_0 + \mu_1 t + \alpha y_{t-1} + \sum_{j=1}^k \alpha_j^* \Delta y_{t-j}$ , where  $k = 1$ .

2 Figures in ()s are 90 percent confidence intervals.  
 $p$ -values are in []s.

below one (0.819) while in the two other countries, only unit values appear—this may be the result of not controlling for structural breaks.

McAdam and Mestre (2002) document a number of further “stylized facts” at the Euro-area level, which are relevant to our discussion, for example, in terms of persistence of the various series of interests but also of the relation between unemployment and nominal/real variables. As can be seen (Table 7.2), the price level, unit labor costs, the mark-up, nominal wages, and the unemployment rate are all countercyclical; others are pro-cyclical.<sup>8</sup> Unemployment therefore is the only real magnitude, which has cyclical features similar to those of nominal series. On the other hand, series that appear to be leading the output cycle are only nominal ones, such as the price level, unit labor costs, and nominal wages whereas inflation, real wages, employment, and unemployment are lagging indicators. Finally, all series are highly persistent as judged by their AR (1) values, but unemployment as well as employment appear more sluggish than productivity and real wages, as if the latter two were adjusting to cyclical developments to a larger extent than the former two.

Much attention has been devoted to explain the relatively poor record for Euro-area employment and job creation. Typical themes in this debate being differences in the adoption of new technologies (*new economy*) (Temple 2002); shifts in rents reflecting changes in union bargaining and technology biases (Blanchard 1997; Bentolila and Saint-Paul 1998); differences in product-market regulations (Jean and Nicoletti 2001); the interaction between shocks and national institutions (Blanchard and Wolfers 2002), etc. Finally, Morgan and Mourougane (2001) offer

Table 7.2 Euro-area historical stylized facts

|                          | <i>St. dev.</i> | <i>St. dev.</i><br><i>ratio</i> | <i>AR(1)</i> | <i>t</i> - 4 | <i>t</i> - 3 | <i>t</i> - 2 | <i>t</i> - 1 | <i>t</i> | <i>t</i> + 1 | <i>t</i> + 2 | <i>t</i> + 3 | <i>t</i> + 4 |
|--------------------------|-----------------|---------------------------------|--------------|--------------|--------------|--------------|--------------|----------|--------------|--------------|--------------|--------------|
| Real GDP                 | 1.027           | 1.000                           | 0.834        | 0.137        | 0.365        | 0.623        | 0.839        | 1.000    | 0.839        | 0.623        | 0.365        | 0.137        |
| Price level              | 1.196           | 1.164                           | 0.955        | -0.669       | -0.713       | -0.680       | -0.591       | -0.453   | -0.279       | -0.119       | 0.011        | 0.109        |
| Unit labor costs         | 0.014           | 0.014                           | 0.900        | -0.589       | -0.676       | -0.725       | -0.696       | -0.605   | -0.365       | -0.121       | 0.117        | 0.288        |
| Mark-up                  | 0.862           | 0.839                           | 0.794        | -0.285       | -0.389       | -0.505       | -0.554       | -0.548   | -0.319       | -0.078       | 0.184        | 0.38         |
| Nominal wages            | 1.074           | 1.045                           | 0.866        | -0.635       | -0.644       | -0.586       | -0.462       | -0.265   | -0.138       | -0.009       | 0.12         | 0.205        |
| Real (Producer)<br>wages | 0.664           | 0.646                           | 0.678        | -0.132       | -0.100       | -0.039       | 0.046        | 0.195    | 0.165        | 0.159        | 0.198        | 0.223        |
| Real consumer<br>wages   | 0.834           | 0.811                           | 0.737        | 0.167        | 0.190        | 0.207        | 0.245        | 0.321    | 0.235        | 0.171        | 0.151        | 0.123        |
| Labor Productivity       | 0.719           | 0.700                           | 0.705        | 0.228        | 0.379        | 0.563        | 0.69         | 0.799    | 0.512        | 0.226        | -0.051       | -0.26        |
| Employment               | 0.621           | 0.604                           | 0.928        | -0.018       | 0.173        | 0.375        | 0.577        | 0.72     | 0.787        | 0.765        | 0.659        | 0.503        |
| Unemployment             | 0.344           | 0.335                           | 0.913        | -0.094       | -0.234       | -0.398       | -0.585       | -0.734   | -0.799       | -0.76        | -0.645       | -0.471       |

Source: Abbreviated from McAdam and Mestre (2002).

Notes

Sample for all series is 1970Q1 to 1999Q4. We first log each series, then use the difference between the logged series and its *HP* filter to derive the associated moments and cross-correlations:  $y - HP(y)$ .



a comprehensive overview of the effect of structural and institutional factors on the labor markets of the major EU countries.

While the standard interpretation—see our earlier cited references—is that European labor markets are subject to institutional features that slows their responsiveness down compared to the United States, it should be pointed out that econometrically pinning down the wage-price-employment nexus is a difficult task. For instance, to take one important illustration, while standard (as opposed to “New”) Phillips curves fit the data robustly, their recent forecasting performance appears to have weakened (e.g. Anderson and Wascher 2000). This might reflect such things as measurement errors in output-gap estimates (Orphanides *et al.* 2000); *new economy* effects or, the failure of backward-looking expectations to capture improved policy credibility. The evidence of whether European labor markets are chronically slower to adjust than, say, US ones is therefore mixed and not clear-cut. For instance, Chagny *et al.* (2002) estimate standard wages equations and find generally that the absolute value of the elasticity of wages with respect to unemployment is higher in the United States (i.e. a more flexible labor market); there are signs that France has an even higher elasticity.

Notwithstanding the uncertainty on such parameter values, it seems useful to review the estimates we will employ as benchmark parameters in the subsequent steps of the exercise. In what follows, we provide details in particular on the long run unemployment rate as well as the behavioral equations for employment and wages.

### ***An estimate of the Euro-area Nairu***

The Euro-area Nairu (the non-accelerating inflationary rate of unemployment) referred to here is computed as suggested by Fabiani and Mestre (2002), namely following the Gordon (1997) approach. They consider a number of additional estimation methods and models and, in general, find that a Nairu can be identified that is relatively robust to changes in the underlying models. The Nairu that they identify is imposed on the AWM as an exogenous but time-varying component. The resulting time series for the Nairu is on Figure 7.2, starting from low values around 3 percent in the early 1970s and increasing almost continuously between 1973 and the late 1980s. Thereafter, it stabilizes at a value under 9 percent, with a small additional increase around 1993, which the recent decrease has not fully offset. In the following exercise, no particular assumption is made regarding further exogenous changes that could drive the Nairu—the long run value is fixed at 9.1 percent. Exercises to vary the Nairu are possible in the model, but the default case is to keep the Nairu fixed, equal to its baseline value in history, to a constant value out-of-sample.<sup>9</sup>

### ***An estimated employment equation***

The specification employed for the employment equation of the AWM is solved from the inversion of the (Cobb-Douglas) production function—from this static

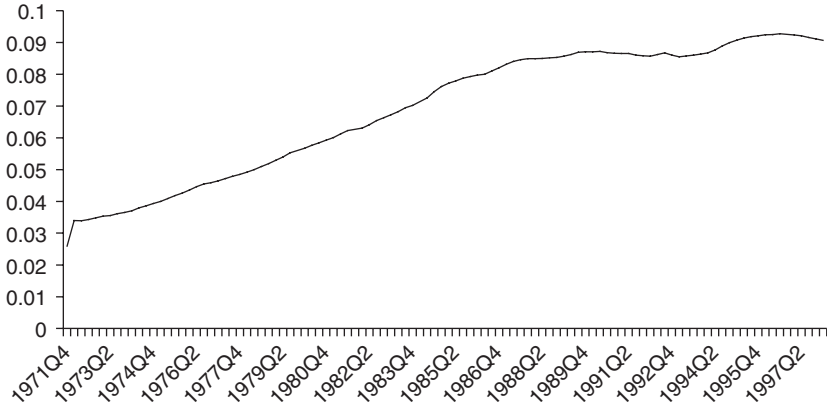


Figure 7.2 Trend unemployment rate.

expression, there is a dynamic equivalent.<sup>10</sup> The resulting estimated ECM equation is the following:

$$\begin{aligned} \Delta \text{LOG}(LNN) = & 0.69 * \text{DLNNS} + 0.18 * \Delta \text{LOG}(YEAR) - 0.12 * \Delta \text{LOG}(WRNA) \\ & - 0.13 * \Delta \text{LOG}(WRNA)_{-1} - 0.081 * [\text{LOG}(LNN) - (\text{LOG}(YEAR) \\ & - \beta * \text{LOG}(KSR) - \text{LOG}(TFT)) / (1 - \beta)]_{-1} + \text{dummies} \end{aligned}$$

where  $LNN$ : Total employment (including self-employed);  $DLNNS$ : a parameter set equal to trend labor force growth;  $\Delta \text{LOG}(WRNA)$ : real (product) wage growth minus trend productivity growth  $KSR$ : Total capital stock;  $TFT$ : Trend total factor productivity—labor augmenting, HP filtered Solow residual;  $\Delta \text{LOG}(YEAR)$ : Real GDP growth minus trend productivity growth;  $\beta$ : Capital-share parameter in the Cobb-Douglas production function (= 0.41).

An interesting feature of this equation is that it incorporates some significant impact of real wage on the dynamics of employment, with an elasticity of about 0.25. One of our experiments will incorporate a scenario where this response is twice as strong, with a view to mimicking a more flexible labor market.<sup>11</sup>

### ***An estimated equation for wage determination***

$$\begin{aligned} \Delta \text{LOG}(WRN/PCD/LPROD) \\ = & 0.2 * [\text{INFT} - \Delta \text{LOG}(PCD)] \\ & + 0.27 * \Delta \text{LOG}(WRN/PCD/LPROD)_{-4} \\ & - 0.92 * \Delta^2 \text{LOG}(PCD) - 0.57 * \Delta^2 \text{LOG}(PCD)_{-1} \end{aligned}$$

$$\begin{aligned}
& - 0.47*\Delta^2\text{LOG}(PCD)_{-2} - 0.33*\Delta^2\text{LOG}(PCD)_{-3} \\
& - 0.56*\Delta^2\text{LOG}(LPROD) - 0.46*\Delta^2\text{LOG}(LPROD)_{-1} \\
& - 0.40*\Delta^2\text{LOG}(LPROD)_{-2} - 0.26*\Delta^2\text{LOG}(LPROD)_{-3} \\
& - 0.015*\text{LOG}(URX/URT)_{-1} + 0.10*\text{LOG}((1 - \beta)*YFD/ULT)_{-1} \\
& + \text{dummies}
\end{aligned}$$

where *LPROD*: Labor productivity; *PCD*: Consumption deflator; *ULC*: Unit labor costs; *ULT*: Trend unit labor costs; *URT*: Trend unemployment rate; *URX*: Unemployment rate; *WRN*: Average compensation per head; *WIN*: Compensation to employees; *YER*: GDP real; *YFD*: GDP deflator at factor cost; *INFT*: Inflation expectations—set equal to steady-state inflation, also enters the Taylor rule.

Wages are modeled as a Phillips curve in levels, with wage growth depending on productivity, current and lagged inflation—in terms of consumer prices—and the deviation of unemployment from its structural level (the Nairu). Since dynamic homogeneity holds, the long run Phillips curve is vertical. As in Chagny *et al.* (2002) who provide estimates of wage equations for a number of large OECD countries, we focus on the wage equation within a system also comprising a price equation, that is, we do not take the price–price Phillips curve approach (see e.g. Turner and Seghezza 1999, as an illustration of the latter, also on OECD countries). The price formation is taken as given, identifying therefore the wage equation as embedding most of the labor market features, whereas the price equation is assumed to relate to goods market features.

Short run dynamics also include a calibrated term in expected inflation. This expectations term may be viewed as a crude proxy for forward-looking behavior (inflation expectations being set exogenously) such as the one modeled in Clarida *et al.* (1998) or Gerlach and Svensson (2000). Having both this term and the similar one entering the price equation equal to 0.2 yields similar full model simulation results as the configuration in which either the wage or price-setting curve includes an expectation term with a 0.8 coefficient, which comes close to available estimates from the reduced form approach.

On the basis of the equation mentioned in the preceding paragraph, two key parameters can be identified, first the one pinning down the response of (real) wages to employment, second the extent to which wage formation incorporates exogenous inflation expectations—in line with the steady-state value, in turn equal to the Central Bank objective—or model-consistent forward-looking ones. In terms of structural change affecting behavior, shifts in these two parameters seem worth examining.

## The experimental framework

In this section, we clarify how the sensitivity analysis is to be conducted, that is, using a model of the economy, with both estimated and calibrated equations, both fitting the data and reflecting long run “well-behaved” structure, allowing for

changes in the earlier mentioned parameters—real wage effects on employment, real rigidity and inflation expectations in wage formation. In addition, there is a need for both deterministic and stochastic simulations to capture the “average” response that may differ from the deterministic one (see e.g. Clark *et al.* 1997).

### ***The AWM structure—an overview***

The AWM model structure is standard, built on an aggregate demand/aggregate supply framework, with a well-defined long run classical supply-side equilibrium and a vertical long-run Phillips curve, with an exogenous Nairu.<sup>12</sup> The steady-state real interest rates pins down the capital to output ratio, via the marginal productivity optimality condition of the firm. Since labor force is given in the long run, steady-state output is then equal to the production function outcome with a zero unemployment gap, that is, with no deviation from the Nairu. In that equilibrium, all real variables grow at the same rate as potential output, real wages grow in line with long run labor productivity, and relative prices are constant, in particular the real exchange rate.<sup>13</sup> The model also takes into account stock-flow consistency, so that, for example, households’ wealth (comprising total capital stock, public debt, and net foreign assets) is also determined in GDP points at steady state. With the steady-state public debt, ratio pinned down by a fiscal rule and the steady-state capital stock determined by the marginal productivity condition, this relation pins down the steady-state ratio of net foreign assets to GDP.

In the short run, since nominal variables do not immediately adjust to their steady-state values, the model has some Keynesian features, whereby output is given by the sum of demand components. The resulting departure from equilibrium in both the goods and labor markets exerts influence on short run price and wage developments, via an output gap and an unemployment gap term, respectively.

The convergence to the long run is ensured by the responses of policies to deviations from equilibrium. A number of alternative options can be used in the AWM (as well as in other models). In a standard configuration, fiscal policy is modeled as a change in direct tax rates responding to deviation from an objective that can be formulated in terms of, for example, a fiscal deficit to GDP ratio. Monetary policy in turn can be assumed to follow a standard rule—such as the Taylor rule—whereby the Central Bank responds to deviation from some inflation objective and to the output gap (which can be interpreted as an indicator of future inflationary pressures). Irrespective of their precise specification, both types of policy reactions are necessary for the model to reach its steady-state balanced growth path.

An additional important feature of the model is the possibility to pin down the nominal equilibrium in a number of alternative ways. Since the earlier mentioned equilibrium is defined in real terms or relative prices only, a nominal anchor has to be specified, which can be done, for example, via a Taylor rule, determining the steady-state inflation rate, and therefore, the price level path, depending on the initial conditions for the price level.

In total, the AWM comprises 89 equations, of which 15 are behavioral—which still makes it a fairly tractable tool. Box 7.1 provides an overview of the main

**Supply side**

$$I \equiv \Delta K + \delta K_{-1} \quad (1)$$

$$\beta Y/K = r + \delta \quad (2)$$

$$y_{pot} \equiv \beta k + (1 - \beta)(\bar{l} + Trend) \quad (3)$$

$$O_{gap} \equiv Y/Y_{pot} \quad (4)$$

$$\Delta l = -\lambda \cdot \Delta(w - p) - \lambda_1 \cdot (l - y_{pot}^{-1}(k))_{-1} \quad (5)$$

$$U \equiv (\bar{L} - L)/\bar{L} \quad (6)$$

$$\begin{aligned} \Delta w = \Delta p + \Delta Trend - \omega \cdot u \\ - \omega_1 \cdot (w - p - Trend - \ln(1 - \beta))_{-1} \end{aligned} \quad (7)$$

$$\begin{aligned} \Delta p = \Delta w + \Delta Trend - \pi \cdot O_{gap} \\ - \pi_1 \cdot (p - w + Trend - \ln(1 - \beta))_{-1} \end{aligned} \quad (8)$$

**Demand side**

$$Y \equiv C + I + \bar{G} + X - M \quad (9)$$

$$\Delta c = \gamma \Delta y - \gamma_1 \cdot r - \gamma_2 \cdot (c - \gamma_3 \cdot y_d - (1 - \gamma_3) \cdot a)_{-1} \quad (10)$$

$$Y_d \equiv W \cdot L(1 - t) \quad (11)$$

$$dY \equiv t \cdot Y - \bar{G} \quad (12)$$

$$\Delta A \equiv X - M + dY + I - \delta K_{-1} \quad (13)$$

$$x = \bar{y}_w - \xi(p - e - \bar{p}_w) \quad (14)$$

$$m = y + \mu(p - e - \bar{p}_w) \quad (15)$$

Note

*I*: Investment; *K*: Capital;  $y_{pot}$ : Potential output;  $O_{gap}$ : Output gap; *l*: Labor; *U*: Unemployment rate; *w*: Wages; *p*: Prices; *Y*: GDP; *c*: Consumption;  $y_d$ : disposable income; *d*: Deficit in GDP percentage points; *A*: Wealth accumulation; *X*: Exports; *m*: Imports.

$\delta$  depreciation rate,  $\beta$  long run capital income share, equal to the elasticity of capital in the production function, *r* real interest rate—defined as the difference between the monetary policy interest rate and inflation.

*Trend* labor augmenting total factor productivity, *t* direct tax rate—defined by the fiscal policy rule, aiming at stabilizing the fiscal deficit ratio to GDP, *e* nominal exchange rate—defined by a (forward-looking) UIP condition.

Variables in italics are in logarithms, a bar denotes exogenous variables such as  $\bar{L}$  labor supply,  $\bar{G}$  public spending,  $\bar{Y}_w$  world demand,  $\bar{P}_w$  world prices. Symbols: = is used for econometric equations and  $\equiv$  for accounting identities.  $\lambda$ ,  $\omega$ ,  $\pi$ ,  $\gamma$ ,  $\xi$ ,  $\mu$  are coefficients.

All econometric equations in the AWM are specified as ECMs, while in this Box, for simplification purposes, only those equations with specific short run features are presented with their dynamics (e.g. for prices).

equations in the model, in a simplified version comprising seven econometric relations (missing equations are mostly related to additional deflators). The main elements in the supply-side of the AWM are, first, equation (2), which links the long run capital to output ratio, to the real interest rate augmented by the depreciation rate (as proxy for the user cost). Investment obtains via the accounting identity (1). Inverting the Cobb-Douglas production function, equation (3), labor demand can be derived as in equation (5)—with some short run negative impact of the real wages. The marginal productivity condition on labor appears in the long run of the wage equation (7), with, in addition, some Phillips curve impact of the unemployment rate—as defined by equation (6). The price behavior is based on a standard mark-up on Unit Labor Cost expression (see equation (7)), the mark-up increasing with the output gap defined by equation (4). It should be noted that inflation terms in both wages and prices can be rewritten in terms of a weighted average of past and expected future inflation, as in Gerlach and Svensson (2000) (see Fagan *et al.* 2001). These expectational terms can alternatively be set exogenous (e.g. equal to the inflation objective in the Taylor rule) or fully model-consistent.

As to the demand-side, GDP has five components, of which public spending is exogenous in real terms (see equation (9)). The consumption equation (10) can be interpreted as a backward-looking version of a standard theoretical consumption function with some habit formation term. Consumption is proportional to income supplemented with financial wealth, with moreover an intertemporal substitution effect, hence the real interest rate term. There is moreover in the short run a proxy for liquidity constraints, captured by changes in income. Disposable income, defined by equation (11), is equal to wage income net of taxes (transfers are also considered in the full model framework). Equation (13) describes the accumulation of households' wealth, which increases with the trade balance, public deficit and investment net of capital depreciation. Public deficit is given by equation (12), which is expressed in GDP points, to reflect the possible endogeneity of the direct tax rate via a fiscal rule based on a deficit ratio target. Finally equations (13) and (14) show the specification of the exports and imports, both being assumed to respond with unit elasticity to the corresponding demand, conditional on competitiveness developments.

A particular aspect of the model is that it comprises a number of indicators for prices and costs, namely the following full system of deflators:

- GDP (factor cost) deflator *YFD*
- GDP (Market Prices deflator, i.e. including indirect taxes) *YED*
- Average whole-economy earnings *WRN* (compensation per head)
- Consumer Expenditure Deflator *PCD*—average import + output prices
- *HICP*—bridge equation from the latter price, specific effect of oil
- Import and Export Deflators—*MTD* and *XTD*—intra vs extra Euro-area variables
- The investment deflator—*ITD*—weighted average of import and output prices.

The system mentioned in the preceding paragraph has also to be supplemented with closure rules and a UIP (forward-looking) condition to be closed. For

illustrative purposes, the model can therefore be further approximated by a simple 4-equation deviation from steady state one comprising the UIP exchange rate condition ( $e$ ), a Taylor rule for the nominal interest rate ( $r$ ), an aggregate demand curve ( $y$ ) and a Phillips curve for inflation ( $\pi$ ):

$$\begin{aligned} E(\Delta e_{t+1}) &= r \\ r &= \pi + \frac{\pi}{2} + \frac{y}{2} \\ y &= -\alpha(r - \pi) \\ \pi &= \beta(\Delta e) + \gamma y + \text{Shock}. \end{aligned}$$

The system can be solved, for example, for the change in the exchange rate ( $e$ )—in this simple case, the only forward-looking variable, as in the standard version of the AWM—the dynamics of which then are found to satisfy:

$$\begin{aligned} E(\Delta e_{t+1}) &= \lambda(\Delta e_t + \text{Shock}/\beta) \\ \text{where } \lambda &= \frac{\beta(\alpha + 3)}{\alpha + 2 + \alpha\gamma} \end{aligned}$$

The system clearly displays saddle-path stability with a unitary unstable root and the stable root given by  $\lambda$ . Thus, as standard, there is an initial overshoot of the nominal exchange rate for a given monetary policy change, and a reversion to base whose dynamics are driven by the value of the stable root and by an amount which is a function of the whole sequence of shocks (in this model, that shock derives purely from the inflation equation: a cost-push shock in normal parlance). This simple exercise demonstrates important aspects of our system. After the initial saddle-path jump, the reversion to baseline will be a function of parameters such as those measuring the Phillips curve slope,  $\gamma$ , the imported inflation pass through,  $\beta$ , and also the respective weights of inflation and output gap in the postulated Taylor rule—assumed earlier to take their standard values. In practice, however, the dynamics of the AWM are much richer. Hence there is the need for more complete exercises. Nevertheless this simple model highlights the key role of parameters such as the slopes of both the IS and the Phillips curves as well as the pass through of the exchange rate to prices in defining core dynamics of the system.

### ***Three labor market configurations***

As already indicated, both deterministic and stochastic simulations will be conducted with three alternative sets of parameters and specifications for the labor market equations, namely the earlier mentioned employment and (real) wage equations.

First, we look at the *Base* case, namely the standard version of the AWM is to be used as an already largely documented benchmark—simulation results have been reported and assessed by, for example, Dieppe and Henry (2002) who present simulation results for a number of shocks under alternative monetary policy rules or McAdam and Morgan (2001) who give a systematic comparative assessment of the model responses to a normalized interest shock.

Second, we investigate the impact of a so-called *Flexible* case, in which both the real wage term in the employment equation and the Phillips curve term in wages are multiplied by a similar factor (two) to reflect the idea that, in line with conventional wisdom, such elasticities should be much higher than those estimated to date for the Euro-area, in the event where the labor market would be more flexible, with both labor demand more sensitive to real wages and real wages more responsive to unemployment (Poret *et al.* 1989 took a similar approach when looking at the impact of deregulation in goods and labor market in the OECD countries, by running counterfactual simulations giving to European economies elasticities similar to those estimated for the United States).

Third, we define a nonlinear configuration, which will be referred to as *Hysteresis* thereafter. As documented in a number of empirical papers, there are signs of non-linearities in the process underlying the Nairu, such as asymmetric impact of shocks of different size or threshold effects (see e.g. Bianchi and Zoega 1998; Akram 1998; Røed 1997; León-Ledesma and McAdam 2002). The particular type of configuration we want to investigate builds on the smooth transition models, see, for example, Teräsvirta (1994); this allows us to functionally endogenize the elasticity of wages with respect to unemployment, without however affecting *ex ante* the long run behavior of the model.<sup>14</sup> In our application, we choose the following logistic specification:

$$\gamma(u) = (0.75 - 0.5) \frac{-0.014}{-0.5 + 0.75 \exp((URX - URT)/URT)}$$

With such a specification, the long run Nairu is unchanged although in the short- to medium run, the first derivative of inflation with respect to unemployment is no longer a constant but a function of the unemployment level itself, so that for a sizeable number of periods, unemployment could possibly widely differ from its steady-state value. With the earlier mentioned formulation, the elasticity  $\gamma$  is exactly equal to its point estimate ( $-0.0147$ ) in the case where actual and long run unemployment rates ( $URX$  and  $URT$ , respectively) are equal. There is, however, some increasing divergence from this value as the unemployment deviation from its steady-state value increases. For illustration, the elasticity is at  $-0.0086$  for  $URX = 11$  percent and at  $-0.0382$  for  $URX = 7$  percent. An additional non linearity then appears when comparing the elasticity from its central point value to that taken on these two extremes, with a stronger impact of lower unemployment on the elasticity than what is observed for higher unemployment.<sup>15</sup>



### Monetary policy environments

In common with many other macromodels, the AWM includes a Taylor rule to operationalize monetary policy. Taylor rules have a number of advantages. First, they are empirically well-founded and second, in the theoretical literature on policy rules, they are often considered well micro-founded, being a good approximation to the true welfare function and an approximation to optimized rule. Against that, there is the problem of the often-cited unreliability of real-time output gap estimates,<sup>16</sup> and the need to know the steady-state rate of interest, which can be highly model-dependent and highly uncertain. (See the discussions in Taylor 1999; Gali 2001.)

The generalized Taylor rule is given by:

$$\begin{aligned} i_t = & \rho i_{t-1} + (1 - \rho)[r^* + E_t(\pi_{t+\theta})] + \alpha E_t(\pi_{t+\theta} - \pi^T) \\ & + \beta E_t(\tilde{y}_{t+k}) \end{aligned}$$

Where  $\rho$  is a smoothing parameter,  $r^*$  is the steady-state real rate of interest,  $\pi_t$  is the contemporaneous inflation rate with target  $\pi^T$ ,  $\tilde{y}_t$  is the contemporaneous real output gap,  $\alpha$ ,  $\beta$  are parameters defining the feedback from, respectively, inflation and output-gap targets to the nominal interest rate,  $i$ , and  $E$  defines the expectations operator. The integer parameters  $\theta$ ,  $k$  define the policy-maker's planning horizon. Typical configuration include:  $\theta = k = 0$  (i.e. an *outcome-based* rule), or a *forecast-based* rule for  $\theta > 0$ ,  $k \geq 0$ . In our exercises, we consider the following parameter variations to be of interest:  $\alpha$ ,  $\beta$ ,  $\rho$ ,  $\theta$ .<sup>17</sup> Invariably, however, we assume  $\alpha \in (1, \alpha^{\text{Max}}]$  in line with the so-called *Taylor Principle*, which states that if inflation rises then nominal interest rates will rise further to stabilize the economy (i.e. real interest rate increases).<sup>18</sup>

More specifically, the conducted set of experiments is based on the following range of parameters and specifications for the Taylor rule (all in all eight cases):

First we use the “Standard” configuration, namely a standard Taylor rule, with the usual parameters on both its arguments. This has to be considered as a benchmark in terms of simulation results, although it can be argued that this constitutes only a poor proxy to actual monetary policy decision-making. The “Standard” case then reads (using recent traditional AWM variable names, Fagan *et al.* 2001):

$$STN = 150(INF - INFT)4 + 50 \ln \mathcal{Y}_{gap} + STN_{stst}$$

where  $INF$  is the quarterly change in inflation (hence the factor four),  $INFT$  the baseline inflation,  $\mathcal{Y}_{gap}$  the output gap and  $STN_{stst}$  the steady-state value of the short-term nominal interest rate.

Second, we use an inflation forecast-based Taylor rule (FL case), with model-consistent expectations—as done in either Quest (see, Roeger and In't Veld 1997) or Multimod (described in Laxton *et al.* 1998). Such an interest-rate setting equation can be derived from the previous Taylor rule, which can be rearranged as:

$$STN = 150(INF_{+4} - INFT) 4 + 50 \ln \mathcal{Y}_{gap} + STN_{stst}$$

Third, we experiment with a range of parameters capturing four different degrees of “aggressiveness,” in terms of the response to observed inflation (IF cases):

$$STN = (100 + 50/F)(INF - INFT)4 + 50F \ln Y_{gap} + STN_{sst}$$

In all cases, the weight of inflation beyond unity is divided by a factor  $F$  by which the weight of output is multiplied—leaving the nominal short-term unchanged at steady state. Experiments have been conducted with factors 0.25, 0.5, 2, and 4. The standard Taylor rule corresponds to a factor one.

Fourth, we introduce some interest rate smoothing (IS case), with at each point in time the short-term rates equal to 50 percent of the Base case and 50 percent of the last quarter value.<sup>19</sup>

$$STN = 0.5[150(INF - INFT)4 + 50 \ln Y_{gap} + STN_{sst}] + 0.5STN_{-1}$$

Finally, we combine the Taylor rule configuration with one in which wage formation is influenced by model-consistent forward-looking expectations jointly, that is, not only pinned down by the (exogenous) steady-state inflation. This case—denoted *EX*—is equivalent to assume that agents form their expectations less in line with the inflation target but more with the actual developments in future inflation, hence the idea to consider as an experiment related to monetary policy environment rather than to the labor market as such. This is achieved by substituting an inflation term comprising 50 percent of forward-looking inflation and 50 percent of inflation target to the *INFT* term in the original wage equation.

### **The deterministic responses to a monetary policy shock<sup>20</sup>**

In order to better assess how the various envisaged modifications to the structure of the model affect its behavior, in particular regarding the interaction between the policy regime and the dynamics of unemployment, we document the response of the modeled economy to a monetary policy shock under the various configurations proposed. This will shed light on how the transmission mechanisms are affected, but will also provide a first idea of how persistent unemployment may be according to the hypotheses made on the labor market and the policy behavior.

The monetary policy experiment is based on a temporary 100 basis point upward shock to the short-term interest rate, the latter remaining exogenous for 1-year period after which the corresponding interest-rate setting equation is switched back on. It should be stressed that the suggested simulations and analysis includes endogenous—albeit delayed—fiscal policy responses, whereas in Fagan *et al.* (2001), the monetary policy experiment was performed with no further policy responses after the initial shock to interest rates.

Irrespective of the simulation environment—which should mostly affect the magnitude of the effects but not the qualitative response—the expected impact of

the shock is a directly negative impact on domestic demand components. Investment (cost of capital effect), consumption (intertemporal substitution) as well as inventories (cost of capital effect) would be reduced. This effect could be strengthened by accelerator effects on investment and inventory accumulation combined with a Keynesian multiplier effect on consumption. As the exchange rate is endogenous, the increase in the interest rates would also result in an appreciation of the currency dampening exports—although the overall impact on trade contribution may remain uncertain, given the depressing impact on imports of the domestic demand slowdown. Once both fiscal and monetary policies become expansionary, the economy should converge back to equilibrium, with inflation back to baseline and a closed output gap—that is, GDP in line with its baseline value, given the type of shock considered which leaves supply unchanged.

In the AWM, the overall response of activity to the shock is, as expected, temporary, being not significant at a 10-year horizon (see Figures 7.3–7.6). The maximum impact on the GDP level is reached after about 1 year and is almost the same for all cases. The impact on GDP growth peaks at about  $-0.3$  percentage points the first year, being maximal after two or three quarters. In all cases, inventories contribute more strongly to the slowdown in the first quarter, investment and then private consumption playing a stronger role afterwards.<sup>21</sup>

As regards inflation, the maximum impact occurs much later than for GDP, that is, in the course of the fifth year in general. In all cases, the resulting deviation from baseline inflation is of a similar magnitude, with values around  $-0.1$  in annual terms, with marked oscillations for about 10 years before inflation returns to its baseline value.

In comparative terms, the impact of an increase in the relative weight of the inflation term in the Taylor rule can be seen quite clearly, with a stronger and more cyclical response of both unemployment and inflation as the weight of the latter is increased. Effectiveness of monetary policy in the short- to medium run—as measured by, for example, the inflation response over the four years following the shock—seems in this backward-looking environment to have therefore a counterpart in terms of increased medium-term volatility around the baseline.

As to the comparison across different dynamic configurations of the AWM, a striking contrast seems to appear between the interest smoothing case and the case where we have model-consistent expectations in wages, to the extent that the latter delivers a strongly negative response of inflation with, however, a much milder impact on unemployment. The other configurations—Base case, forward-looking inflation in the rule—fall in between these two extremes.

Across labor market regimes, the difference between the Base case and the Flexible one is not very marked (the latter resulting into less marked fluctuations), whereas quite clearly the Hysteresis case results in much stronger responses, in spite of the somewhat small change implemented. In particular, the dynamics of the resulting unemployment rate become particularly cyclical, almost close to unstable—the whole model, however, remains well-behaved since both the inflation and the output gaps return to their baseline level eventually, after, however, about 20 years of substantial volatility. Interestingly enough the picture

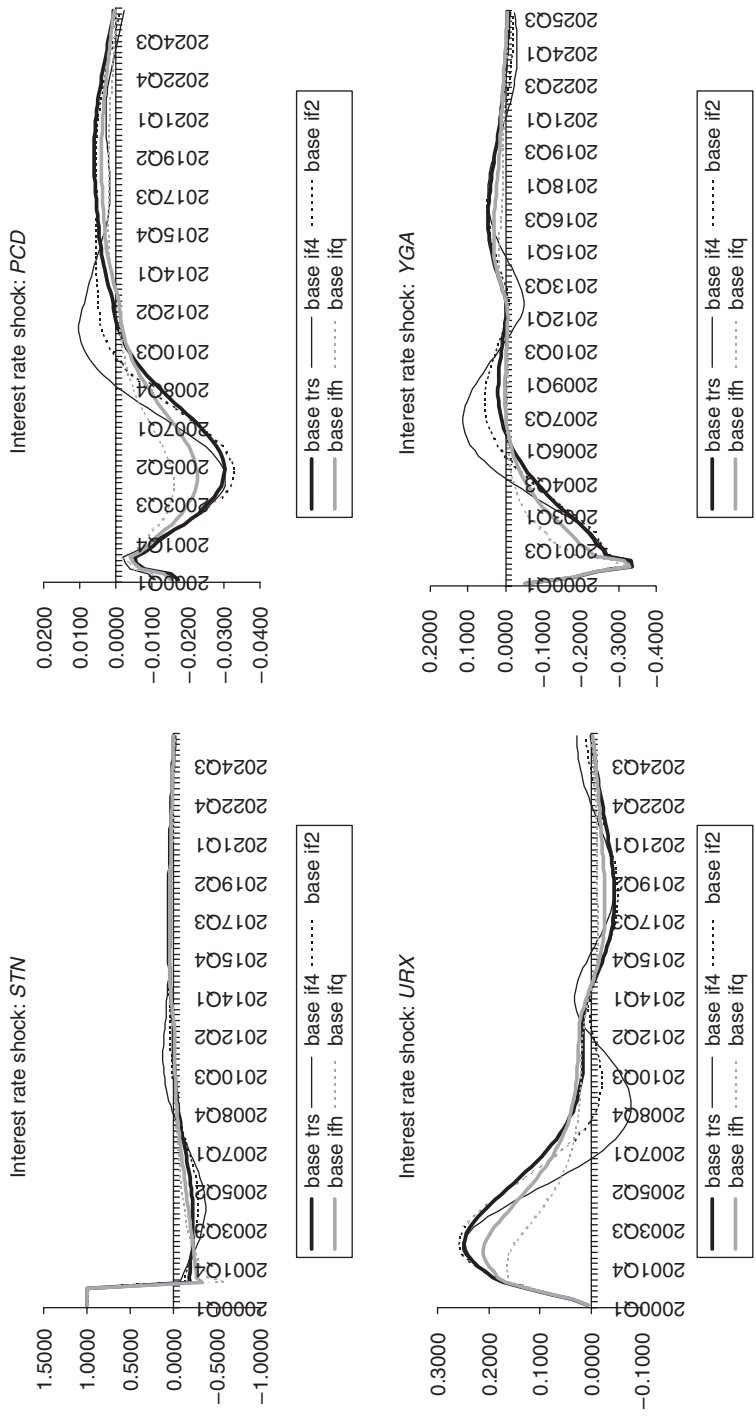


Figure 7.3 Temporary shock to interest rates, different weight on inflation in the Taylor rule.

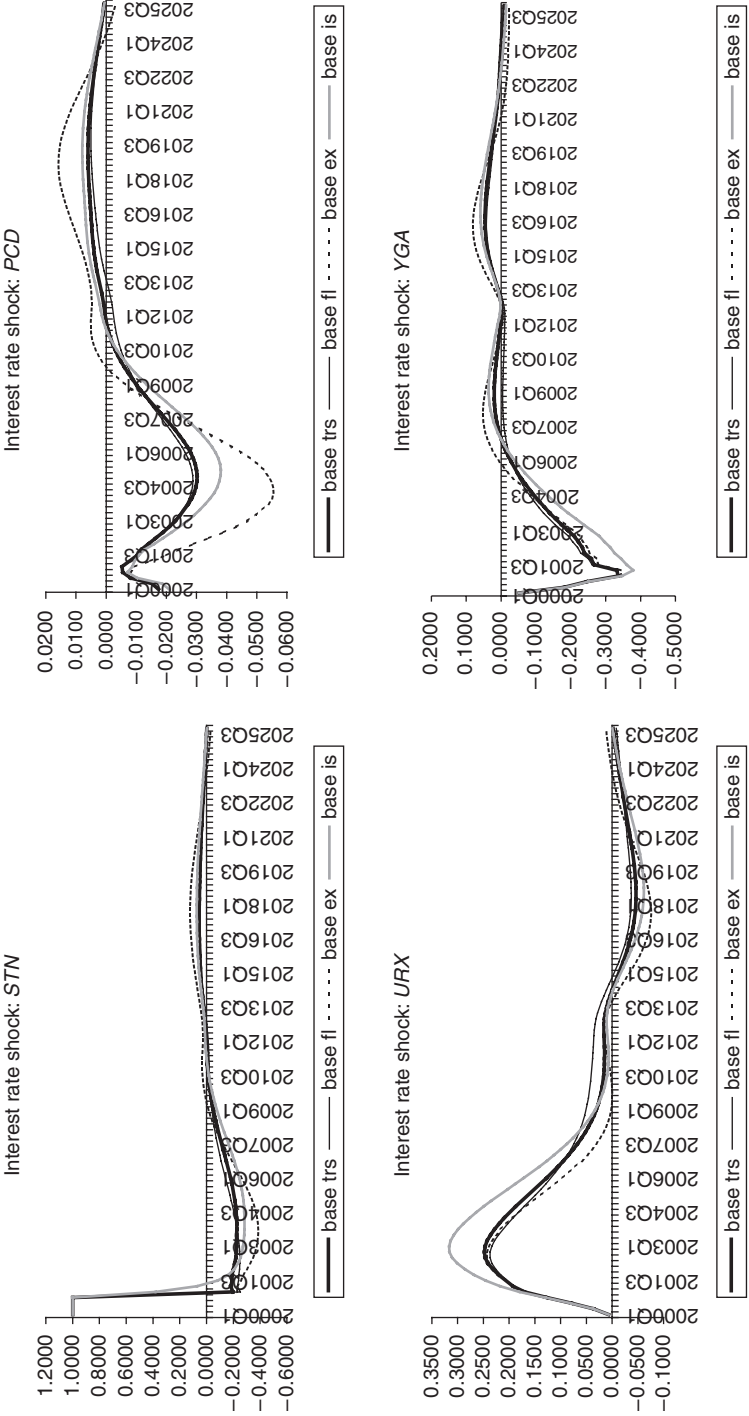


Figure 7.4 Temporary shock to interest rates, regimes with endogenous expectation and smoothing.

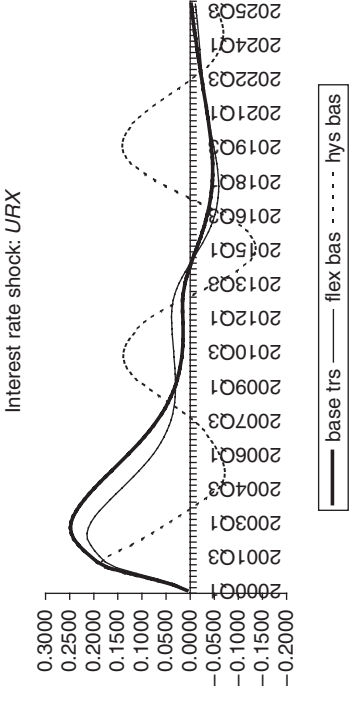
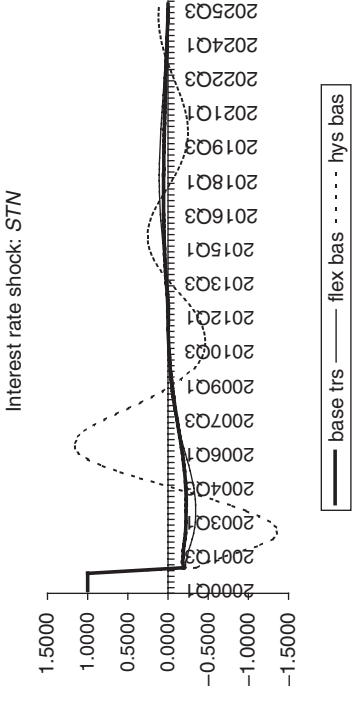
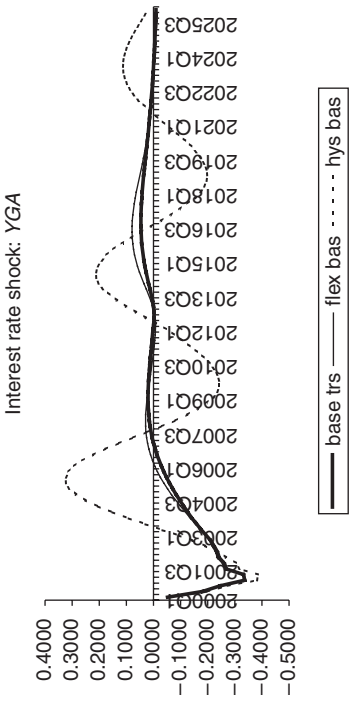
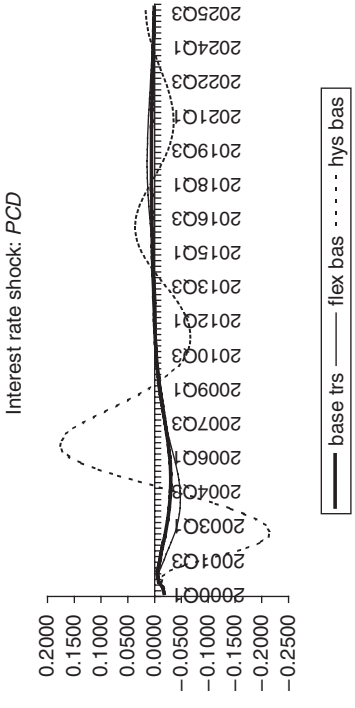


Figure 7.5 Temporary shock to interest rates, different labor market configurations with the standard Taylor rule.

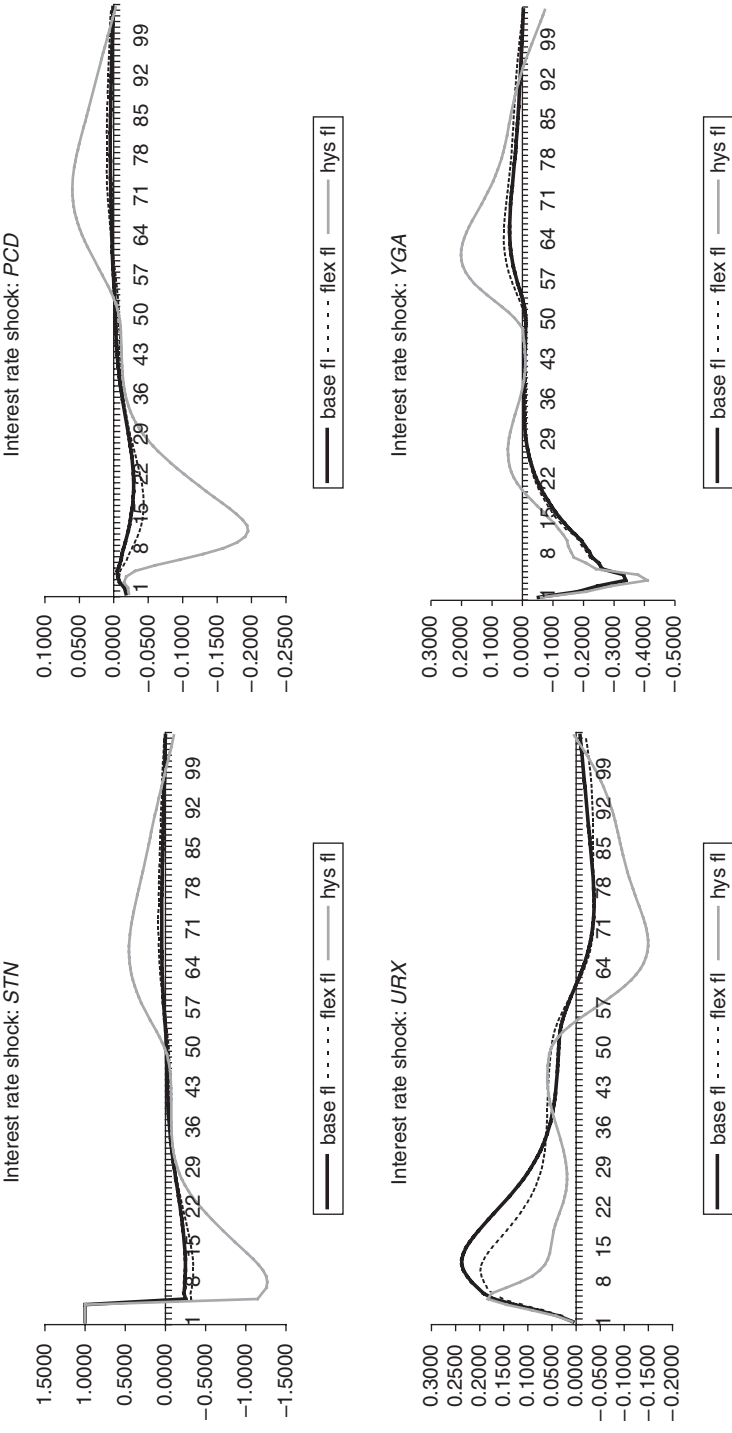


Figure 7.6 Temporary shock to interest rate, different labor market configurations with the forward-looking Taylor rule.

changes somewhat once the Taylor rule employed is forward-looking in all configurations of the labor market. In such a case, although the Hysteresis configuration still results in a much more cyclical response, the oscillations are considerably dampened, and also the periodicity of the cycle is apparently much longer.

### **The stochastic simulation results**

The stochastic simulation experiments have been carried out as follows. First, for all of the “stochastic” (econometric) equations in the AWM, the standard errors of the residuals have been computed. The 15 variables concerned are the HICP, investment deflator, investment, employment, inventories, long-term interest rates, import deflator, imports, consumption deflator, consumption, wages per head, export deflator, exports, exchange rate, and GDP deflator.

In particular no disturbance has been assumed for monetary policy, so that the subsequent results can be interpreted as dealing only with cases where there is a systematic monetary policy response and, therefore, no shock coming from that part of the model. This makes the experiment complementary to the recently reported deterministic simulations, to the extent that the latter were precisely assessing the impact of an exogenous monetary policy shock, specified as a temporary deviation from the otherwise systematic behavior assumed for monetary policy.

Thereafter, assuming normal and i.i.d. residuals, sequences of shocks have been generated for 25 years of quarterly data, namely 100 artificial observations for each shock. The variance of each individual shock was set to half of that obtained from the earlier mentioned computation.<sup>22</sup> After this period, all residuals were set back to zero for 75 years, in order to check how this control period without shocks will result into a full return to the deterministic steady state. Third, the same sequence of shocks has been applied to all model configurations—that is,  $3 \times 8 = 24$  versions of the AWM.

This exercise provides two types of results: First, over the “shocked” sample we generate data characterizing an economy consistent with the given model including stochastic disturbances. The existence of a sample without shocks allows us, moreover, to observe how quickly the return to baseline is achieved across the various models, in particular when looking at the distribution of the simulation results at each point in time. In addition, the data for all replications can be stacked and the whole distribution analyzed—both for the “shocked” sample (at least 2,500 observations per model) and the complete one (at least 10,000 observations per model).

Focusing on the Base case with a standard Taylor rule, Figure 7.7 reports quantiles at various levels for each quarter of the simulation horizon for the four main variables of interest, namely inflation, short-term rates, unemployment rate, and the output gap. The results indicate that the variability decreases quite quickly after shocks have vanished, namely as of 100 quarters. For all series, volatility reaches however a value close to zero—corresponding to what the model delivers without any shocks—only after an additional 40-year period or so. In terms of the respective variability of the various series, it seems that the variance of the interest rate is



the highest, whereas inflation has relatively low dispersion. This result holds for all configurations. Another striking result of this experiment is the quite obvious asymmetry of the distribution, since, for example, the 90 percent quantile is not simply the mirror image of the 10 percent one. This feature affects in particular interest rates, to a lesser extent unemployment and inflation, and almost not the output gap.

Once all data have been stacked, it is possible to interpret the derived histograms as providing a proxy to the underlying distributions. Figures 7.8–7.11 show the distributions for unemployment and inflation under the Base and the Hysteresis case, under the eight possible monetary policy regimes. Only from visual inspection, there seem to be strong departures from normality. Some distribution show signs of skewness or kurtosis, as in most of the Hysteresis cases (denoted *urxhys...*) with especially fatter tails on the upper side where unemployment is high. There are even signs of bimodality (see, e.g. the Base case with inflation weight divided by four, denoted *basqis*, or the Hysteresis case with weight multiplied by four, denoted *hysin4*). In most cases, however, the mode—that is, the more frequent outcome—is very close to the long run value for any given variable. This would even be more evident for the longest sample where the fully deterministic model weighs much more in the generated observations (not shown in the Figures). Finally, the shape of the distribution seems to be extremely dependent on the policy regime, see, for example, Figure 7.9 for inflation in the Base case (denoted *infbas...*) where quite clearly the dispersion is affected by the type of policy conducted.

Beyond these descriptive elements, further statistics can be computed from the stacked observations, for both the “shocked” and the full samples. In Tables 7.3 and 7.4, we present summary statistics to represent each of the distribution’s *mean*, *median*, *standard error*, *selected percentiles*, *selected cut-off point critical values* as well as more formal metrics—*Skewness*, *Kurtosis*, and *Normality*. Skewness refers to lack of symmetry: a distribution has positive skewness when it has a long thin tail to the right. Kurtosis refers to the extent to which the peak of a distribution departs from that of a Normal, being either pointed (*leptokurtic*) or flatter (*platykurtic*). Normal has a (excess) Kurtosis of zero. Formal definitions of these concepts are given below:

$$\text{Skewness} = \frac{N^2}{(N-1)(N-2)} \frac{m_3}{\sigma^3}$$

$$\text{Kurtosis} = \frac{N^2}{(N-1)(N-2)(N-3)} \frac{(N+1)m_4 - 3(N-1)m_2^2}{\sigma^4}$$

$$\text{Normality (Jarque-Bera)} = N \left( \frac{\text{Kurtosis}^2}{24} + \frac{\text{Skewness}^2}{6} \right)$$

where  $N$  is sample size,  $m_k = \frac{1}{N} \sum_{i=1}^N (X_i - \bar{X})^k$  and

$$\sigma = \sqrt{\frac{1}{N-1} \sum_{i=1}^n (X_i - \bar{X})^2}$$

For background to these tests, see, for example, Stuart *et al.* (1999).<sup>23</sup>

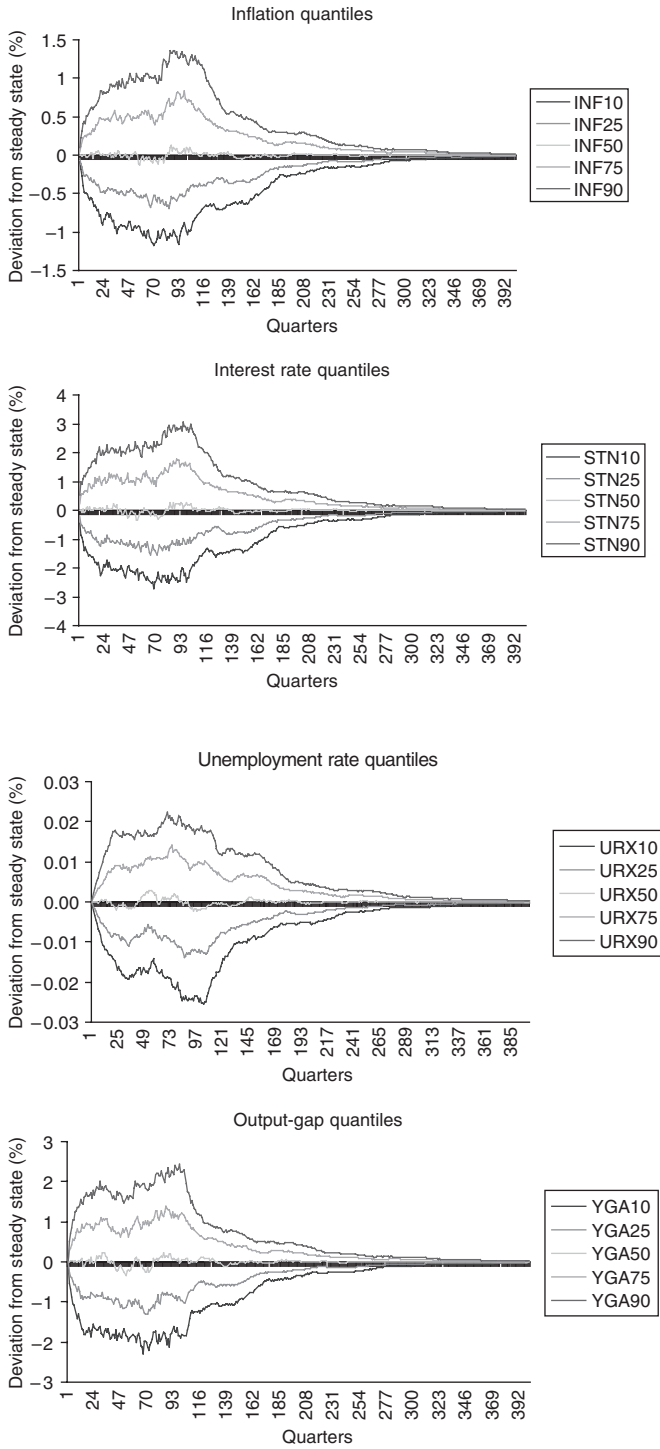


Figure 7.7 Base case and standard Taylor rule, quantiles.

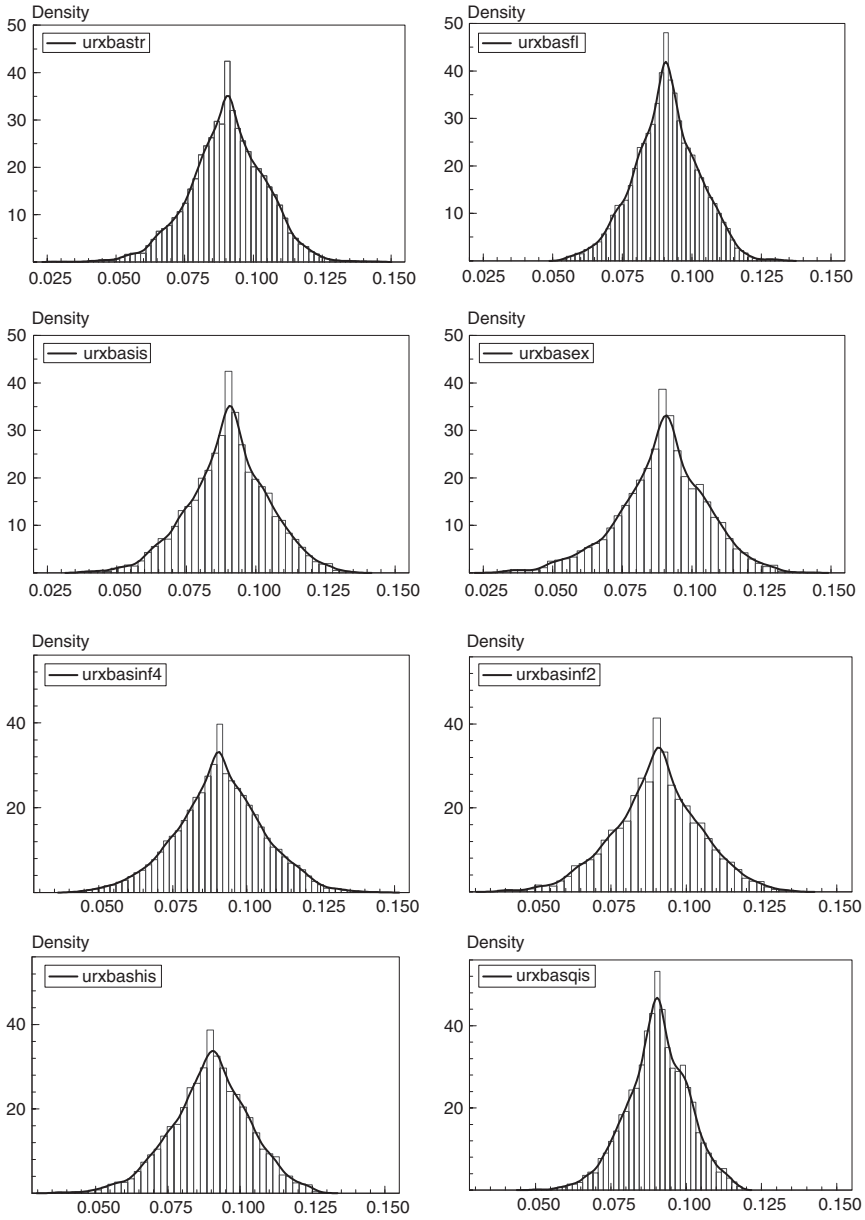


Figure 7.8 Unemployment distribution under different regimes, Base case.

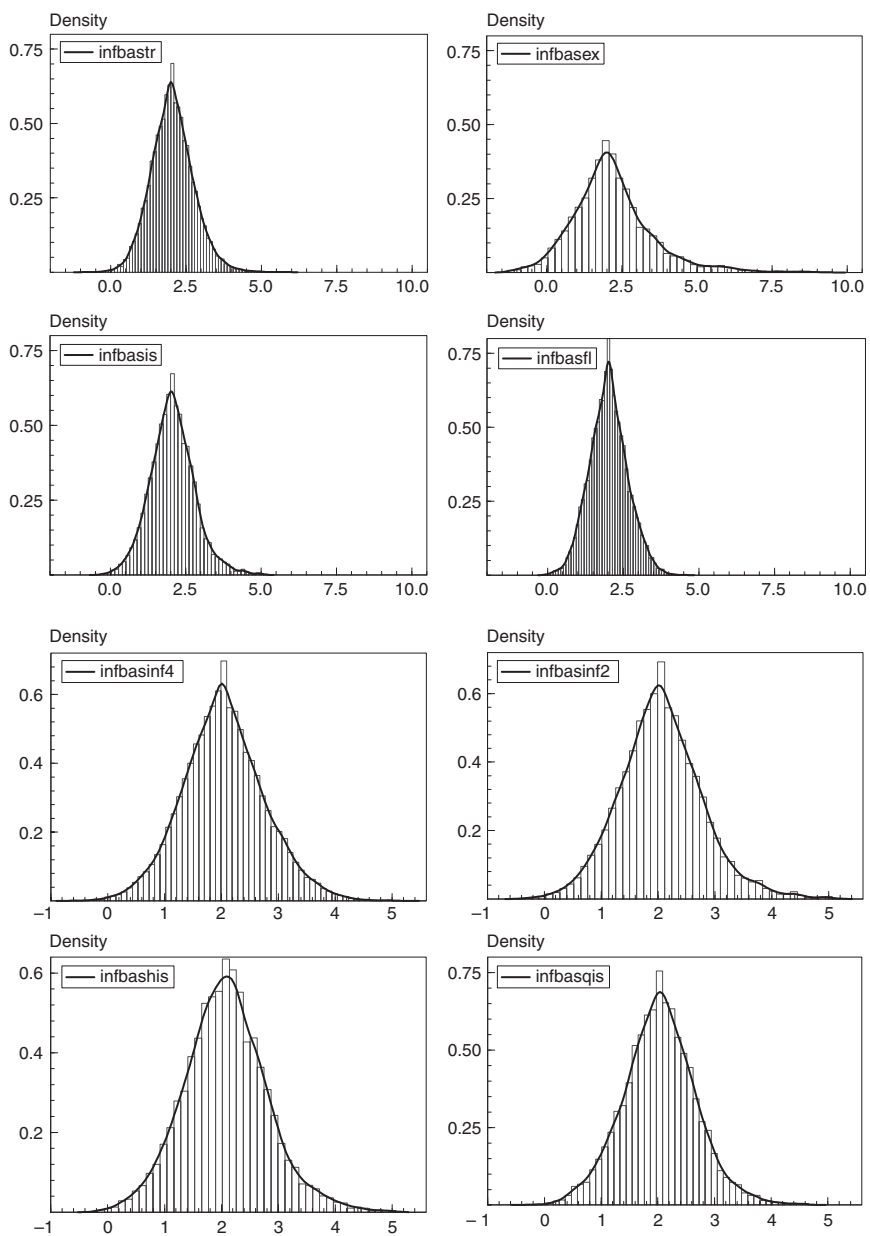


Figure 7.9 Inflation distribution under different regimes, Base case.

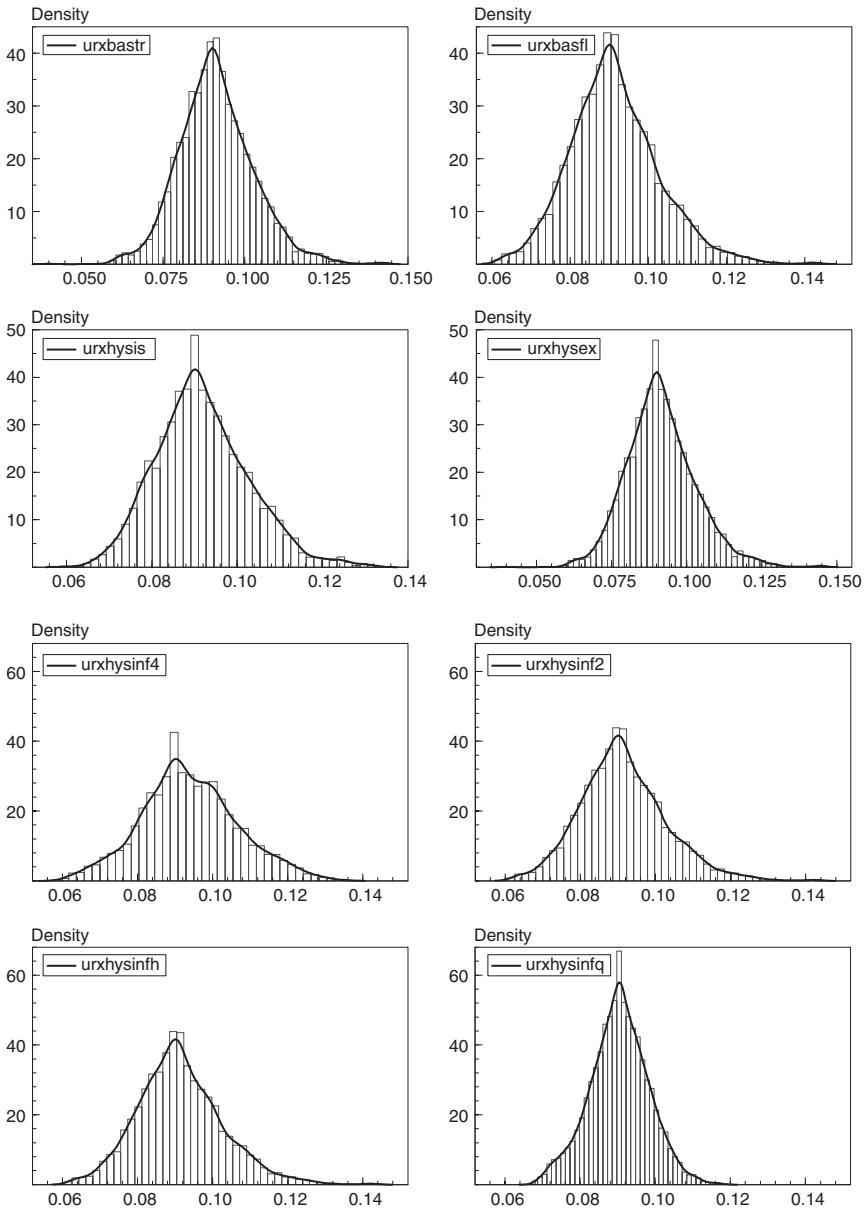


Figure 7.10 Unemployment distribution under different regimes, Hysteresis case.

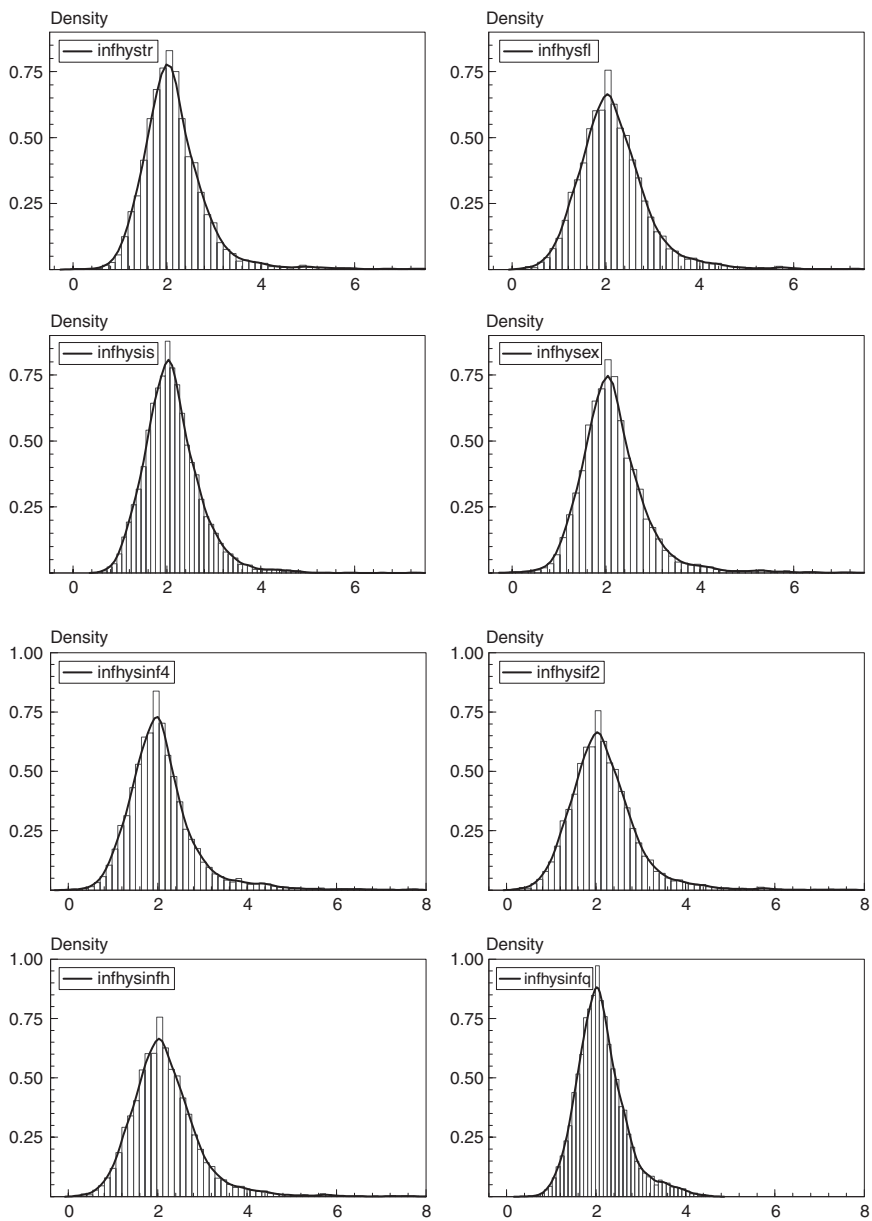


Figure 7.11 Inflation distributions under different regimes, Hysteresis case.

Table 7.3 Statistics for the unemployment stacked observations, “shocked” sample

| <i>Urx</i> | <i>TR std. dev.</i> | <i>TR FL</i> | <i>inf 4</i> | <i>inf 2</i> | <i>inf 0.5</i> | <i>inf 0.25</i> | <i>TR smoot</i> | <i>Expect</i> |
|------------|---------------------|--------------|--------------|--------------|----------------|-----------------|-----------------|---------------|
| Mean       |                     |              |              |              |                |                 |                 |               |
| base       | 9.05                | 9.07         | 9.09         | 9.02         | 8.96           | 9.04            | 9.01            | 8.94          |
| flex       | 9                   | 9.05         | 9.09         | 9.04         | 9              | 9.04            | 9               | 9.02          |
| hyst       | 9.13                | 9.14         | 9.39         | 9.35         | 9.14           | 9.04            | 9.18            | 9.15          |
| Ser        |                     |              |              |              |                |                 |                 |               |
| base       | 1.376               | 1.17         | 1.486        | 1.46         | 1.367          | 1.024           | 1.44            | 1.586         |
| flex       | 1.37                | 1.19         | 1.578        | 1.434        | 1.2            | 0.876           | 1.43            | 1.208         |
| hyst       | 1.145               | 1.142        | 1.282        | 1.361        | 1.142          | 0.788           | 1.09            | 1.15          |
| Kurt       |                     |              |              |              |                |                 |                 |               |
| base       | 0.546               | 0.15         | 0.266        | 0.313        | 0.277          | 0.281           | 0.313           | 0.558         |
| flex       | 0.384               | 0.324        | 0.346        | 0.469        | 0.62           | 0.462           | 0.42            | -0.128        |
| hyst       | 0.906               | 0.795        | -0.003       | 0.819        | 0.795          | 0.139           | 0.34            | 0.976         |
| Skew       |                     |              |              |              |                |                 |                 |               |
| base       | -0.155              | -0.05        | -0.037       | -0.144       | -0.232         | -0.223          | -0.156          | -0.338        |
| flex       | -0.037              | -0.095       | 0.038        | -0.079       | -0.22          | -0.256          | -0.06           | -0.077        |
| hyst       | 0.368               | 0.485        | 0.205        | 0.383        | 0.485          | -0.023          | 0.424           | 0.461         |
| Norm       |                     |              |              |              |                |                 |                 |               |
| base       | 311                 | 42           | 86           | 59           | 97             | 92              | 62.4            | 195           |
| flex       | 174                 | 140          | 142          | 127          | 475            | 192             | 207             | 12.94         |
| hyst       | 346.7               | 413          | 89.39        | 357          | 413            | 11.97           | 317             | 413           |
| T 0.05     |                     |              |              |              |                |                 |                 |               |
| base       | 6.65                | 7.09         | 6.56         | 6.49         | 6.61           | 7.25            | 6.53            | 6.08          |
| flex       | 6.68                | 7.03         | 6.39         | 6.63         | 6.96           | 7.5             | 6.62            | 6.96          |
| hyst       | 7.4                 | 7.37         | 7.29         | 7.27         | 7.37           | 7.66            | 7.52            | 7.42          |
| T 0.10     |                     |              |              |              |                |                 |                 |               |
| base       | 7.25                | 7.54         | 7.2          | 7.12         | 7.15           | 7.68            | 7.16            | 6.91          |
| flex       | 7.21                | 7.73         | 7.04         | 7.23         | 7.45           | 7.9             | 7.17            | 7.38          |
| hyst       | 7.77                | 7.76         | 7.83         | 7.75         | 7.76           | 8.02            | 7.84            | 7.77          |
| Med        |                     |              |              |              |                |                 |                 |               |
| base       | 9.02                | 9.06         | 9.07         | 9.05         | 8.96           | 9.01            | 9.05            | 9.03          |
| flex       | 8.98                | 9.05         | 9.03         | 9.04         | 9.04           | 9.05            | 9.03            | 9.04          |
| hyst       | 9.05                | 9.05         | 9.31         | 9.22         | 9.05           | 9.05            | 9.08            | 9.06          |
| T 0.90     |                     |              |              |              |                |                 |                 |               |
| base       | 10.55               | 10.6         | 11           | 10.87        | 10.42          | 10.08           | 10.85           | 10.89         |
| flex       | 10.49               | 10.43        | 10.78        | 10.87        | 10.51          | 10.13           | 10.83           | 10.52         |
| hyst       | 10.6                | 10.63        | 11.09        | 11.09        | 10.63          | 10.03           | 10.63           | 10.63         |
| T 0.95     |                     |              |              |              |                |                 |                 |               |
| base       | 10.88               | 11.02        | 11.59        | 11.43        | 10.8           | 10.28           | 11.34           | 11.44         |
| flex       | 10.86               | 10.99        | 11.24        | 11.46        | 10.93          | 10.43           | 11.34           | 10.96         |
| hyst       | 11.1                | 11.16        | 11.69        | 11.74        | 11.16          | 10.33           | 11.09           | 11.17         |
| CV 1 ser   |                     |              |              |              |                |                 |                 |               |
| base       | 25.8                | 23.3         | 27.7         | 25.9         | 24             | 19.9            | 25.6            | 25.8          |
| flex       | 23.9                | 15.3         | 28.1         | 25.7         | 21.3           | 15.3            | 24.5            | 13.8          |
| hyst       | 22.7                | 22.5         | 33.1         | 30.3         | 22.5           | 13.2            | 23.7            | 23            |

Table 7.4 Statistics for the inflation on stacked observation, “shocked” sample

| <i>Summary statistics inflation</i> |                     |             |              |              |                |                 |                 |               |
|-------------------------------------|---------------------|-------------|--------------|--------------|----------------|-----------------|-----------------|---------------|
| <i>Inf</i>                          | <i>TR std. dev.</i> | <i>TRFL</i> | <i>inf 4</i> | <i>inf 2</i> | <i>inf 0.5</i> | <i>inf 0.25</i> | <i>Tr smoot</i> | <i>Expect</i> |
| Mean                                |                     |             |              |              |                |                 |                 |               |
| base                                | 2.02/2.05           | 2.001/2.01  | 2.02/2.04    | 2.02/2.05    | 2.03/2.08      | 2.01/2.04       | 2.02/2.06       | 2.06/2.19     |
| flex                                | 2.03/2.09           | 1.999/1.990 | 2.03/2.05    | 2.03/2.06    | 2.02/2.08      | 2.01/2.03       | 2.03/2.10       | 2.04/2.06     |
| hyst                                | 2.05/2.19           | 2.05/2.17   | 2.03/2.10    | 2.05/2.16    | 2.05/2.17      | 2.04/2.12       | 2.04/2.12       | 2.05/2.18     |
| Ser                                 |                     |             |              |              |                |                 |                 |               |
| base                                | 0.42/0.709          | 0.361/0.63  | 0.451/0.722  | 0.453/0.731  | 0.418/0.732    | 0.36/0.644      | 0.443/0.733     | 1.043/1.341   |
| flex                                | 0.722/1.062         | 0.596/0.910 | 0.814/1.105  | 0.840/1.094  | 0.629/0.978    | 0.480/0.783     | 0.777/1.105     | 1.434/1.286   |
| hyst                                | 0.480/0.834         | 0.505/0.799 | 0.500/0.811  | 0.649/1.083  | 0.505/0.799    | 0.322/0.558     | 0.379/0.624     | 0.486/0.832   |
| Kurt                                |                     |             |              |              |                |                 |                 |               |
| base                                | 6.36/0.808          | 5.47/0.12   | 4.22/0.375   | 5.77/0.75    | 7.1/0.550      | 7.06/0.49       | 6.09/0.711      | 4.22/2.57     |
| flex                                | 3.36/0.938          | 3.825/0.418 | 2.57/0.723   | 6.56/1.067   | 7.23/1.61      | 5.23/0.742      | 4.13/1.32       | -0.633/-0.054 |
| hyst                                | 68.2/24.013         | 76.3/8.812  | 25.44/8.919  | 85.11/33.27  | 76.31/8.81     | 9.89/1.493      | 32.33/3607      | 60.883/23.09  |
| Skew                                |                     |             |              |              |                |                 |                 |               |
| base                                | 0.636/0.297         | 0.264/0.10  | 0.325/0.173  | 0.653/0.32   | 0.82/0.252     | 0.412/0.124     | 0.681/0.292     | 0.84/1.01     |
| flex                                | 0.629/0.444         | 0.273/0.238 | 0.268/0.427  | 0.725/0.502  | 0.979/0.593    | 0.740/0.448     | 0.626/0.52      | 0.081/0.153   |
| hyst                                | 5.775/3.554         | 5.662/1.904 | 3.25/2.110   | 6.875/4.441  | 5.66/1.904     | 1.934/0.865     | 3.13/1.897      | 5.203/3.302   |
| Norm                                |                     |             |              |              |                |                 |                 |               |
| base                                | 41986/621           | 50200/60    | 34493/239    | 14132/228    | 16580/155      | 23099/102       | 15009/208       | 6632.1/1239   |
| flex                                | 26200/1058          | 29499/332   | 16205/887    | 24239/610    | 41945/1771     | 15940/456       | 25244/1422      | 656/31        |
| hyst                                | 12220/16910         | 64685/3751  | 31278/6143   | 289180/3922  | 64685/3751     | 16611/1520      | 21748/3607      | 70666/10767   |





In order to summarize the wealth of information supplied, we proceed by looking in turn at each of the statistics that are reported, focusing on the one hand, on the differences across monetary policy responses (a given column in the Tables) and across labor market configurations, on the other (a given row in the Tables). Only results for the “shocked” sample are reported, “control” sample ones being available upon request. In most cases, the whole sample results are similar in terms of ranking the various configurations, and anyhow less relevant from an analytical viewpoint, since they include 75 percent of observations without shocks, therefore tracing more the return to baseline feature than the actual properties of the simulated economy.

Taking the earlier mentioned approach, and focusing on the “shocked” sample, the main results are as follows:

In terms of the *mean values* of both inflation and unemployment, some gaps appear between the average and the steady-state values, which are not negligible, although relatively small. The results are particularly notable for the Hysteresis case, irrespective of monetary policy, with both variables being higher than their long run value, up to 0.3 percentage points. Both the Base and the Flexible case yield lower unemployment than its steady-state value, with however the opposite result for inflation. Finally, The Flexible case is doing better than the Base one for unemployment, only if standard weights are used in the Taylor rule.

As to the resulting *standard deviations*, the Hysteresis case is characterized by a more concentrated unemployment distribution, that is, a low variance, and this holds across policy regimes. This could be related to a higher degree of stickiness in the unemployment rate, around higher values on average. In addition, it seems that, across labor market configurations, using forward-looking inflation expectations either in the rule or in the wage equation leads to lower variance for both unemployment and inflation. Another stylized fact is that increasing weights on inflation in the (contemporaneous) Taylor rule creates usually more dispersion, in particular, on unemployment.

Looking at the *normality* features, among a bunch of configurations that are all quite non-Gaussian, Hysteresis appears clearly as departing more markedly from normality than the other cases. Irrespective of the policy regime, Hysteresis creates very fat tails, positive skewness for unemployment (whereas it is negative for other cases) and stronger skewness for inflation. This can be related to the earlier mentioned discrepancy between the average and steady-state values.<sup>24</sup>

As regard the *quantiles*, the whole distribution under Hysteresis is shifted to the right, that is, with higher values at a given percentage. Another finding is that mostly upper bounds for both inflation and unemployment are affected by the weight put on inflation in the Taylor rule, whereas changes in the labor market configurations impact more on the lower bounds of the distributions.

The quantiles also provide information on the empirical *confidence band* around the mean value of a given variable. It appears that, consistent with the standard error results, Hysteresis corresponds to a narrower band for unemployment, whereas the Flexible case yields the wider band for inflation. Overall, the derived 90 percent confidence bands—taking the difference between the 5 percent

and the 95 percent critical values—are about 2 percent wide for inflation and 4 percent for unemployment in almost all cases. The unemployment band increases however with the weight put on inflation in the Taylor rule; this is less the case for inflation.

A paradoxical result is that, neither for inflation nor unemployment, does the Hysteresis case generate the highest share of the distribution—the  $p$ -value—beyond a given threshold.<sup>25</sup> The “unemployment trap” configuration seems therefore not to be observed, in spite of the very strong nonlinearity assumed in the employed calibration. On the other hand, density figures show that in some cases there is some accumulation of observations around values at 12 percent or so. This is the case, for example, for the Taylor rule and the interest rate smoothing—see *urxhystr* or *urxhysis* respectively—but these observations do not seem to have much weight overall. In many cases, however, the Flexible case does result in a lower share of high unemployment values, but this finding is almost reversed for inflation. Across all configurations, relatively high inflation is observed for between one-fourth and one-third of the observations, whereas high unemployment obtains for 15–25 percent of the then cases. Of course, by construction, those figures drop—to values around 10 percent—when considering the whole sample.

An additional general remark is that, for almost all indicators, differences across labor market configurations are largely dampened by using a forward-looking Taylor rule. This holds especially for unemployment performance, be it in terms of first and second moments or quantiles; this is the case also, albeit to a lesser extent, for inflation outcomes. Another finding holding across configurations is that aggressiveness (i.e. high weight on inflation)—and without forward-lookingness—does not necessarily result in lower inflation, it may even cause higher unemployment and increased variability in the economy. Similarly, interest rate smoothing leads to lower unemployment, but at the expense of variability, with moreover stronger and more volatile inflation. A final general remark is that the mean unemployment and its variability are often at the lowest level with either a Flexible labor market configuration or with model-consistent inflation expectations entering wage formation.

## **Conclusions**

This chapter has considered the interaction between monetary policy and the labor market in the Euro-area, using an estimated macroeconomic model. We assumed that the Euro-area Nairu is invariant to cyclical factors, and changes in monetary policy. Nevertheless, we have considered a number of different labor market configurations that offer some form of local departures from that hypothesis, which were implemented by changing key model parameters.

Specifically, we examine a case where labor demand responds more strongly to real wages and also the elasticity of wages to unemployment in the Phillips curve is increased. We also consider a strongly non linear (hysteretic) case where this elasticity decreases when unemployment increases. In addition, regarding the policy

environment, a number of alternatives to the standard Taylor rule have been considered, namely a forecast-based rule, a rule with interest rate smoothing, various weights for inflation, and finally inflation expectations entering wages have been made more forward-looking (model-consistent) and less dependent on steady-state inflation.

In comparison with the standard version of the model, the results from deterministic simulations have shown that the response of unemployment to a monetary policy shock was stronger and more cyclical in cases with more aggressive response to current inflation or interest rate smoothing. It also appeared that the nonlinear Phillips curve case resulted in an initially lower response of unemployment with thereafter, however, much slower convergence back to steady state and moreover strong cycles. The more flexible labor market dampened somewhat the response. The forecast-based Taylor rule had a particularly strong effect, in terms of considerably attenuating the differences across configurations, even in the case of the nonlinear Phillips curve.

As to the stochastic simulations, they have shown that there are—even in the standard version of the model—substantial signs of nonlinearity and non-normality in the model, which may indicate that deterministic simulation results should be considered with due care.

Focusing on the labor market aspects, most configurations result, for example, into an average value of the unemployment rate being lower than its steady-state value, with the striking exception of the nonlinear Phillips curve. In addition, this hysteretic Phillips curve also delivers average inflation higher than steady state, with moreover very pronounced skewness and much fatter tails. However no sizeable “unemployment trap” has been found to occur in the nonlinear case, although the whole distribution of unemployment seemed shifted towards higher values. The additional sluggishness implied in the unemployment rate makes the hysteretic configuration the lowest in variance terms, so that unemployment is concentrated around a higher average value. In contrast, a more responsive labor market generates more volatility.

Another main finding is that, using forward-looking Taylor rule or model-consistent expectations in wages reduces variance of both inflation and unemployment, whereas the opposite is true when the weight on contemporary inflation is increased in the rule—and this affects, particularly, unemployment. More generally, on almost all indicators, the differences across labor market configurations, like those found for the deterministic analysis, are much more muted once a forecast-based rule is employed.

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## Notes

- 1 Blanchard and Summers (1986) pioneered this interpretation. For in-depth discussions of the concept and implications of Hysteresis in unemployment, with a particular focus on nonlinearity and heterogeneity, see Amable *et al.* (1995) or Cross (1995).
- 2 The slowness of unemployment to return to its equilibrium value is often referred to as the “speed limit effect” (Turner 1995).
- 3 Such arguments (i.e. avoiding worst-case outcomes) are in line with the so-called *min-max* algorithm in the policy-optimization literature.
- 4 Okun’s Law states that the elasticity of the ratio of actual to potential real output to the change in the employment rate is a constant (typically quoted as 0.3).
- 5 Real marginal costs and output gaps are in principle interchangeable given the existence of certain proportionality conditions. For a discussion see, for example, Galí (2001), McAdam and Willman (2002), Neiss and Nelson (2002).
- 6 On this debate as to whether policy-makers should target labor market variables such as the labor share, see Rudd and Whelan (2002).
- 7 Tobin’s case against the natural rate was set out in his AEA Presidential address (Tobin 1972a). Furthermore, Tobin (1995) provides an overview of his thoughts on the natural rate and Tobin (1972b) provides a critical discussion of Friedman’s economics.
- 8 Pro-cyclicality (countercyclicality) between  $Y_t$  and  $X_t$  implies  $\text{corr}(Y_t, X_t) > 0$  ( $< 0$ ). Furthermore, if a series is a “lagging indicator,” its highest correlation with Real GDP occurs *after* the contemporaneous realization of output—that is,  $\max_{k > 0} |\text{corr}(Y_t, X_{t+k})|$ .
- 9 The impact of exogenous shocks to the Nairu in the AWM are documented in Dieppe and Henry (2002). The present chapter does not address the issue since it focuses rather on changes in structural parameters such as elasticities.
- 10 This equation cannot be interpreted strictly speaking as a structural labor demand equation when taken in isolation. It is the whole working of the model as a system which ensures that the resulting solution is consistent *inter alia* with a labor demand curve.
- 11 Note that we do not in turn vary (i.e. weaken or strengthen) the elasticity of output with respect to employment. This would be an interesting additional experiment. However since we change the wage–unemployment elasticity, we do (albeit indirectly) change the implied responsiveness between employment and output.
- 12 Details on all of the equations as well as on the long run solution and steady-state properties of the AWM are documented in Fagan *et al.* (2001).
- 13 Stochastic simulations reported in Detken *et al.* (2001) show that the real exchange rate ensuring equilibrium between real supply and real demand, albeit uniquely determined, is initial condition dependent on the AWM.
- 14 It should be stressed that the AWM Base configuration comprises an elasticity of wages to unemployment, that is, a log–log relation between the two variables. We do not investigate what happens in terms of the concavity–convexity of the Phillips curve—that is, elasticity vs. semi-elasticity specification—since this has been extensively documented in, for example, Clark *et al.* (1997).
- 15 The chosen specification is particularly nonlinear and would, for example, imply implausible responses to unemployment rates around 5 percent. Results can be considered as relevant for unemployment values of at least 6 percent, which for the Euro-area has been the case always over the last 20 years. Experiments conducted with a similar function using the absolute instead of the relative deviation from *URT* showed that such a more limited nonlinearity would result in much less significant impacts on the overall dynamics of the model.
- 16 Even despite this possibility, and even given  $\beta = 0$  the Taylor rule’s stabilizing properties remain due to Phillips curve relations.
- 17 The default of the model is  $\rho > 0$ ; however, many empirical studies—for example, Clarida *et al.* (1998)—have highlighted the strongly positive value that this parameter takes in practice.

- 18 This, though, is not a universally held opinion, see, for example, Fair (2002a,b), Wright (1997); nor necessarily historically accurate: Taylor (1999) estimated that the response of nominal interest rates to movements in inflation was 0.8 (1960s–1970s) (i.e.  $\alpha < 1$ ) but 1.5 (1980s–1990s).
- 19 In practice, estimations of policy rules suggest that policy interest rates are highly autoregressive (e.g. Clarida *et al.* 1998). That policy-makers “smooth” their interest rates is often justified on grounds of financial and expectation stability, policy transparency, risk aversion and the long and variable effect lags of monetary policy, etc. (e.g. see the discussion in Cukierman 1989). The perceived benefits and actual practice of such gradualism is often at odds with evidence from models. One might expect, for example, that the costs of a disinflation would be higher (relative to no smoothing) since it would be more difficult to tighten and then loose monetary policy rapidly. It might also be expected that generally a smoothed policy response would lead to more target overshooting given such inertia in policy response and a longer horizon for the attainment of policy targets (e.g. Smets 2000).
- 20 McAdam and Morgan (2001) also performed a number of such monetary impulse responses. Their results are quite different, however, since they systematically disable parts of the model (e.g. closing off the tax reaction function, delaying the re-enactment of endogenous monetary policy, manipulating expectations, etc). On the other hand, once simulation environments are similar, results are compatible—as documented in Dieppe and Henry (2002).
- 21 For all simulations, results are summarized in the form of charts for the short-term interest rate *STN*, the inflation rate *PCD*, the unemployment rate *URX* and the output gap *TGA*.
- 22 This rescaling was necessary in order to facilitate the computations, since using the algorithm available in the current version of Troll, some of our models confronted with larger shocks were very slow to converge. We preferred that to substantially amending the algorithm. Under a broad assumption of linearity—which quite obviously is not fully valid in the case at hand—the results thereafter are therefore consistent with shocks that are about half the size of those actually experienced. Another caveat is that monetary policy shocks are absent—no residual has been assumed to vary for the Taylor rule. This is justified by the fact that no attempt had been made to estimate the corresponding equation, so that the implied size and variance of the residuals may hardly be interpretable. In any case, our interest lies in comparing the different labor market regimes/policy rule configurations, not so much the absolute levels of the variables or their volatility.
- 23 The currently reported statistics are sample-size-dependent and therefore not comparable across simulations—in any event they all clearly indicate that the null of normality is rejected in all cases.
- 24 All of the 15 shocks have been checked *ex post* for normality—in all cases, the normality statistics is nonsignificant with skewness at most of 0.03 while the corresponding figure for kurtosis is  $-0.10$ . Also the implied distribution appears close to a normal one. Such checks are necessary to make sure that the non-normality features of the simulated series do not simply reflect those of a specific draw of the shocks.
- 25 This critical value has been set equal to the long run value plus one standard error of the corresponding variable, that is, 9.9 percent for unemployment and 2.44 percent for inflation which corresponds roughly to the 90 percent quantile in the Base case with a Taylor rule over the whole simulated sample.

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## **Part III**

# **Structuralist causes of unemployment and monetary policy**



## 8 **The structuralist perspective on real exchange rate, share price level, and employment path**

What room is left for money?

*Hian Teck Hoon, Edmund Phelps, and Gylfi Zoega*

The current sluggish performance of the US economy follows one of the most remarkable booms in recorded history. The late 1990s was a period of striking expansion of both output and employment, with the unemployment rate hitting 3.9 percent in 2000; productivity growth was much improved, in part because of higher utilization, though not exceptional.<sup>1</sup> The absence of rising inflation during this period came as a surprise to many, since the level of the natural rate of unemployment was commonly estimated to be in the range of 5–6 percent by the mid-1990s. The noninflationary boom, however, reminds one of another episode where nonmonetary forces were strongly at work, namely, the nondeflationary slump in Europe and elsewhere in the 1980s and 1990s, which appeared to signal a move to a higher natural rate of unemployment. The modeling of such structural slumps and booms is the task that we have tackled in a series of works in recent years, the book *Structural Slumps* being a milestone.<sup>2</sup>

The theory set out in *Structural Slumps* is based on intertemporal nonmonetary models of the modern (thus incentive-compatible) kind and provides microeconomic foundations for a moving natural rate of unemployment. Involuntary unemployment occurs, since incentive wages and consequent job rationing are allowed, and this unemployment is structural, not a result of deficient aggregate demand. The determining structure includes tax rates and regulations, the focus of supply-side (SS) theory, and includes fluctuations in technical progress, the focus of “real business cycle” (RBC) theory, but includes much more. The implications exhibit some sharp differences from those of Keynesian theory and some striking parallels, as we shall see.

What basically characterizes the structuralist perspective and differentiates it from both RBC and SS models is its view of business life: the imperfect information, the business assets firms need, and the expectations they have to form. A firm incurs costs to acquire and retain employees (workers who know their job, have learned the ropes) and customers (buyers who know how to reach it), not just equipment and plant. The rate of investment in each asset is a function of the

value, or shadow price, placed by firms on that asset and the cost of investing in it. A raft of nonmonetary fundamentals—world real interest rates, expectations for technical advances and thus productivity growth, entitlements, the stocks of the business assets, the wealth of the workers, tax rates, the political climate, investor trust, etc.—drive the values placed on the business assets, the cost of investing in them, and thus the rates of investment in them.<sup>3</sup>

Our “baseline” models of business asset investment and the employment path are restricted to the case of (intertemporal) equilibrium: more accurately, to a “punctuated” equilibrium in which, infrequently or more frequently as the case may be, a wholly unforeseen shift in one or more of the fundamentals occasionally occurs—a parametric shift or even a loss of some kind of capital—causing jumps in the real values of each of the business assets onto their new correct expectations time-paths. Yet some of the key forces among these fundamentals, such as the visions of (each of) the economy’s entrepreneurs about future profit opportunities and the judgments of financiers and professional investors, are plainly speculative, unobservable, unmeasurable; moreover, the consequences of both these unobservable forces and the observable ones, such as the world real interest rate and the long-term national productivity trend, for the values (the shadow prices) entrepreneurs put on the customer, the employee, and much else are likewise unobservable. This poses difficulties (and opportunities!) for testing and using the theory, as it did for testing and using Keynes’ theory.<sup>4</sup>

Two recent studies of ours meet that problem by hypothesizing that the net overall influence of these unobservable forces on the assets’ shadow prices (and thus on the employment path) is reflected, alongside the net influence of some other observable forces, by the level of the stock market. Since either the level of employment or its growth is an increasing function of *every one* of the (three) shadow prices, it is plausible that an increase in the current index of real share prices, interpreted as the current shadow price of the representative basket of the firms’ several business assets, is also expansionary for employment on the average. The studies found a statistical relationship between the first difference of employment and the real share price index taken as a ratio to some indicator of the cost of investing in employees and customers.<sup>5</sup> An alternative measure of the unobservable share prices is total market capitalization as a ratio to GDP. Figure 8.1 shows the relationship (cross-section) between stock market capitalization to GDP ratio and the employment rate.

A clear positive relationship is visible. It is to be noted that Switzerland is way off the line. The very high value of stock market capitalization in Switzerland would lead us to predict an even higher employment rate. However, as allowed by the theory, the supply function may be convex and only asymptotically approaches full employment, in which case the position of Switzerland in the figure may not come as a big surprise after all.

This chapter, in pursuing that strategy, faces up to some questions. First, there is another asset price that was neglected in the two previous studies, namely, the real exchange rate. In the customer-market model, an appreciation (strengthening) of the real exchange rate in a country causes firms to moderate their price markups,

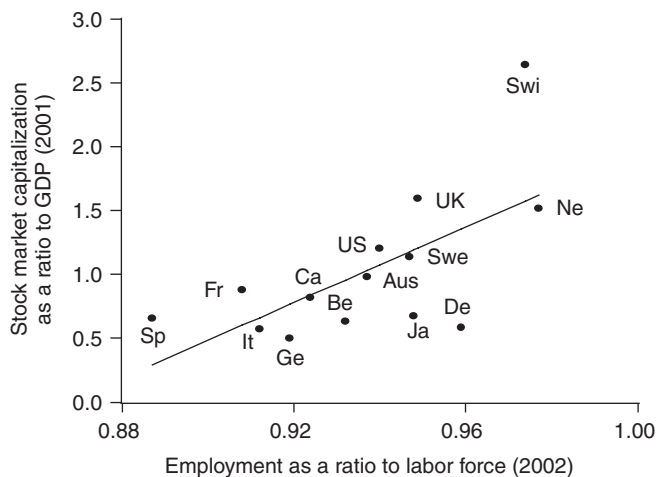


Figure 8.1 Employment and the stock market.

thus pulling *up* the product wage and employment—an *upward* move along what is called the wage curve: the real appreciation may hence lower the natural rate of unemployment! This is the provocative hypothesis at the heart of this chapter. So we ask whether employment rises in response to a strengthened real exchange rate just as it rises in response to a strengthening of real share prices. The question is especially interesting since, as is well known, monetary theories of economic activity say that the stock market and the foreign exchange market pull in opposing directions: in those Keynesian and monetarist models, a strengthening of real share prices increases economic activity by boosting “effective demand” but a strengthening (appreciation) of the real exchange rate decreases activity by cutting effective demand.<sup>6</sup>

Real exchange rates are typically reported in the form of indices that enable a comparison over time but not across countries. For this reason we use data from the World Bank on hypothetical exchange rates that would give purchasing-power parity (PPP) between a country and the United States. The ratio of this hypothetical exchange rate and the actual exchange rate—observed in foreign exchange markets—can be used to test our hypothesis on the relationship between real exchange rates and the natural rate of employment and unemployment.

Figure 8.2 has the relationship between the real exchange rate—defined as described in the previous paragraph—and the employment rate (one minus the rate of unemployment) in a cross-section of the same OECD economies. Note the upward sloping relationship: a real exchange rate appreciation appears to go hand in hand with higher employment rates—when domestic output becomes relatively more expensive, the rate of employment goes up, instead of falling as Keynesian theory might lead us to believe. Though not perfect, the relationship is surprisingly strong (correlation is 0.68). This simple graph is indicative that the

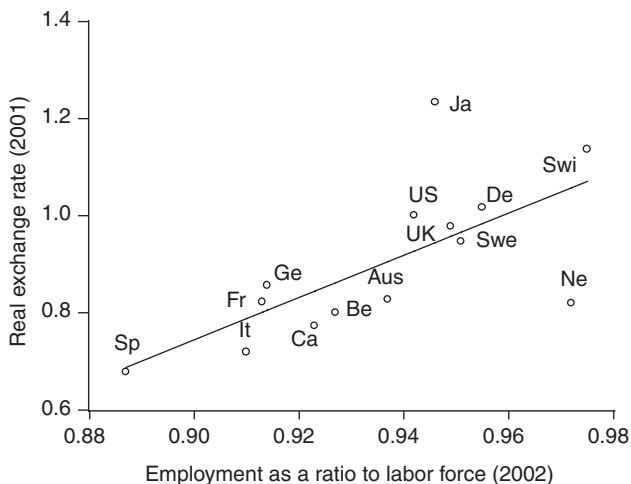


Figure 8.2 Employment and real exchange rates.

relationship between real exchange rates and employment may be more involved than the textbook version of the open economy (New) Keynesian model would lead one to believe.

We first lay out the theory and the answer to the key question, whether a real exchange rate appreciation tends to raise or lower the rate of employment. Figure 8.2 appears to imply that a stronger real exchange rate acts to raise the employment rate. However, it is not clear whether it is the cause or the effect. After all, our model also says that a weakening of profit prospects and the consequent drop in investment and ultimate employment causes a weaker real exchange rate as well as lower real share prices. From a forecasting standpoint, this distinction makes little difference: either way, whether as causes or effects, the strength of the real exchange rate and that of the real share-price level are theory-grounded predictors of where present forces are taking the economy one or two years ahead—absent a shift in the winds. A weak real exchange rate, like a weak stock market, spells weak activity ahead.

We then consider the implications of our model for the conduct of monetary policy. Clearly, a Central Bank faces a daunting task during structural booms and slumps because the underlying natural rate of unemployment is changing over time. Our model yields a solution for the domestic real interest rate that is compatible with the endogenously determined natural rate of unemployment. This is the natural rate of interest, discussed by Knut Wicksell. By keeping the current short-term real interest rate in tandem with the natural rate of interest, a Central Bank is able to control the equilibrium inflation rate and keep the economy along a path of time-varying natural rate of unemployment. The natural rate of interest could, therefore, serve as the guiding light of a Central Bank's interest rate policy during structural booms and slumps.



The chapter's third section examines the data and finds that a real exchange rate appreciation may raise the employment rate, hence providing support for our theoretical prediction and casting doubt on the simplest versions of the Keynesian model. The result is a rather hopeful step in the confirmation of our structuralist model. We find that a weaker real exchange rate, in sheltering firms from overseas competitors, invites higher markups—effectively, a contraction in the supply of output and jobs—which causes employment to contract, not expand as in the monetary views.

The final section takes a look at recent US experience, asking whether the current slump is of a structuralist nature. Again, the results are promising. The economic boom experienced in the United States in the late 1990s is almost entirely explained by our model, while the petering out of that boom and the recent rise in unemployment is to a large extent compatible with our model.

### Theory

Here we set out a model of the small open economy in which all firms, foreign and domestic, operate in a market subject to informational frictions. We first examine a case where, initially all the relevant customers of national firms—firms that produce only with national labor—are nationals. Although the small open economy is too small, by definition, to affect perceptibly the world real rate of interest, national firms will certainly feel changes in demand by its national customers, and so will the exchange rate and the real interest rate in terms of the goods supplied by national firms and their price.

With regard to the  $i$ -th firm, we let  $x^i$ , a continuous variable, denote (the size of) its customer stock; let  $c^{si}$  denote the amount of consumer output it supplies per customer; and let  $p^i$  denote its price, say, in units of the domestic good. We will let  $p$  denote the price at the other domestic firms and  $p^e$  denote the price that the firm and its customers expect is being charged by other domestic firms (all measured in units of the domestic good). We introduce a variable  $e$ , where  $e$  tells us how many units of the foreign good must be given up in exchange for one unit of the domestic good. Consequently, an increase in  $e$  is a real exchange rate appreciation.

In product-market equilibrium, by definition, every firm and its customers have correct expectations about the other firms, that is,  $p = p^e$ . With their expectations thus identical in product-market equilibrium, the identically situated domestic firms will then behave alike, so that  $p^i = p = p^e$ . A firm, in maximizing the value of its shares, has to strike a balance between the benefits of a high price, which are increased revenue and reduced cost, thus increased profit, in the present, and the benefits of a low price, which are an increased profit base in the future as customers elsewhere gradually learn of the firm's price advantage. The key dynamic is therefore the law of motion of the firm's customer stock,

$$dx^i/dt = g(p^i/p, e)x^i \quad g_1 < 0; \quad g_{11} \leq 0; \quad g_2 < 0; \quad g_{22} \leq 0; \quad g(1, 1) = 0 \quad (1)$$

The joint assumption that  $g_1 < 0$ ;  $g_{11} \leq 0$  means that the marginal returns to price concessions are nonincreasing, in the sense that successive price reductions

of an equal amount by firm  $i$  yield a nonincreasing sequence of increments to the exponential growth rate of customers. The inequality  $g_2 < 0$  implies a gain of customers at the expense of foreign suppliers when the real exchange rate depreciates, though successive weakening of the real exchange rate yields a nonincreasing sequence of increments to the exponential growth rate of customers since  $g_{22} \leq 0$ . What the sign of  $g_{12}$  is relates to the question of what the effect of foreign competition on domestic firms' market power is. Suppose that  $e < 1$  so there has been a real exchange rate depreciation, hence foreign goods are selling at a premium. Then each identically situated domestic firm is increasing its market share at the expense of foreign suppliers. In such an environment, a reduction in  $p^i$ , given  $p$ , can be expected to generate a smaller increase in the rate of inflow of customers compared to a situation where  $e > 1$  (and each identically situated domestic firm is losing customers to foreign suppliers). Since stiffer foreign competition (higher  $e$ ) confers a higher marginal return to a price concession, firm  $i$  is induced to go further in reducing its markup, holding other things constant. In our theory, therefore, the assumption that  $g_2 < 0$ ;  $g_{22} < 0$  taken alone or jointly with  $g_{12} < 0$  implies that an appreciation of the real exchange rate will lead to lower domestic markups and hence increased output supplied due to the increased competition that domestic producers face from foreign suppliers.

It turns out that our key theoretical results that follow will depend on the assumption of  $g_2 < 0$ ,  $g_{22} < 0$ , and  $g_{12} < 0$ . Under this assumption, a real exchange appreciation will raise the marginal benefit of cutting domestic prices—in terms of retaining more customers—and such price cuts will appear in the labor market as upward shifts of the labor demand curve, raising employment and reducing unemployment (i.e. the natural rate of unemployment). The assumption implies that when domestic goods are relatively expensive, the marginal benefit from cutting prices—in terms of customers recruited—is greater, hence prices are lower given nominal wages, the real demand wage is higher, and so is the rate of employment in equilibrium. Intuitively, high domestic prices may have made consumers aware or suspicious of further price increases. When customers pay closer attention to price decisions, this increases the gain domestic firms reap from price cuts—in the form of an expanded market share—and the loss inflicted on the domestic market share from price increases.

Readers may wonder whether a policy of “pricing to market” might nullify our results. If foreign producers sell their output in our market at a fixed domestic price that does not respond to changes in the (nominal) exchange rate, so the degree of exchange rate pass-through is zero, the real exchange rate will be unchanged. In contrast, when foreign producers fix the foreign price of their product, or at any rate do not change it equiproportionately in response to a nominal exchange rate change, and allow the domestic (import) price to fluctuate, the real exchange rate is bound to fluctuate. The high correlation in the data between nominal and real exchange rates suggests that the latter scenario is by no means unrealistic, so our model has applicability despite our abstracting from pricing-to-market behavior. The degree of exchange rate pass-through is, in particular, high when (nominal) exchange rate changes are perceived to have a large permanent component.<sup>7</sup>

The representative firm has to choose the price at which to sell to its current customers. Raising its price causes a decrease, and lowering the price an increase, in the quantity demanded by its current customers according to a per-customer demand relationship,  $D(p^i/p, c^s)$ , where  $c^s$  in this context is set equal to the average expenditure per customer,  $c^d$ , at the other firms. For simplicity, assume that  $D(p^i/p, c^s)$  is homogeneous of degree one in total sales,  $c^s$ , and so rewrite  $c^{si} = \eta(p^i/p) c^s$ ;  $\eta'(p^i/p) < 0$ ;  $\eta(1) = 1$ . Each firm chooses the path of its real price or, equivalently, the path of its supply per customer to its consumers, to maximize the present discounted value of its cash flows. The maximum at the  $i$ -th firm is the value of the firm,  $V^i$ , which depends upon  $x^i$ :

$$V^i \equiv \max \int_{\infty}^0 [ (p^i/p_t) - s ] \eta(p^i/p_t) c_t^s x_t^i \exp^{-\int_0^t r_t ds} dt$$

where  $s$  is unit cost. The maximization is subject to the differential equation giving the motion of the stock of customers of the  $i$ -th firm as a function of its relative, or real, price, and the real exchange rate given by (1) and an initial  $x_0^i$ . The current-value Hamiltonian is expressed as

$$[ (p^i/p) - s ] \eta(p^i/p) c^s x^i + q^i g(p^i/p, p^i/p^*) x^i$$

where  $q^i$  is the shadow price, or worth, of an additional customer and  $p^*$  is the price charged by the foreign supplier expressed in our domestic currency. The first-order condition for optimal  $p^i$  is

$$\begin{aligned} \eta(p^i/p) \frac{c^s x^i}{p} + [ (p^i/p) - s ] \eta'(p^i/p) \frac{c^s x^i}{p} \\ + q^i \left[ g_1(p^i/p, p^i/p^*) \frac{x^i}{p} + g_2(p^i/p, p^i/p^*) \frac{x^i}{p^*} \right] = 0 \end{aligned} \quad (2)$$

Another two necessary first-order conditions (which are also sufficient under our assumptions) from solving the optimal control problem are:

$$dq^i/dt = [r - g(p^i/p, p^i/p^*)] q^i - [ (p^i/p) - s ] \eta(p^i/p) c^s \quad (3)$$

$$\lim_{t \rightarrow \infty} \exp^{-\int_0^t r_t ds} q_t^i x_t^i = 0 \quad (4)$$

One can readily show that “marginal  $q$ ” is equal to “average  $q$ ” so we have  $q^i = V^i/x^i$ .

Equating  $p^i$  to  $p$ , and setting  $q^i = q$ , delivers the condition on consumer-good supply per firm for product-market equilibrium:

$$1 + [ \eta(1)/\eta'(1) ] - s = -(q/c^s) [ 1/\eta'(1) ] [ g_1(1, e) + e g_2(1, e) ]; \quad \eta(1) = 1 \quad (5)$$

The expression on the LHS of (5) is the algebraic excess of marginal revenue over marginal cost, a negative value in customer-market models as the firm supplies

more than called for by the static monopolist's formula for maximum current profit, giving up some of the maximum current profit for the sake of its longer term interests. An increase in  $q$  means that profits from future customers are high so that each firm reduces its price (equivalently its markup) in order to increase its customer base. Hence, lower prices in the Phelps-Winter model are a form of investment, an investment in market share. Note also the role played by the real exchange rate ( $e$ ). If stiffer foreign competition reduces market power of domestic firms, then a higher  $e$  makes domestic firms increase their output, even further beyond the point where current marginal revenue equals marginal cost as dictated by a static monopolist. This channel is present if either  $g_{12}(1, e) < 0$  or  $g_{22}(1, e) < 0$ .

Alternative specifications of the labor market give rise to a unit cost  $\varsigma$  that is a rising function of  $c^s x/\Lambda$ . One assumption is to suppose that there is a wage curve that is generated from a shirking view of the labor market. Another alternative is to suppose that there is a neoclassical labor supply that is positively sloped in the (employment, real wage) plane. From (5), one can express consumer-good supply per customer relative to productivity,  $c^s/\Lambda$ , in terms of  $q/\Lambda$ ,  $e$ , and  $x$ , that is,  $c^s/\Lambda = \Omega(q/\Lambda, e, x)$ . One can show that  $0 < \varepsilon_{q/\Lambda} = d\ln(c^s/\Lambda)/d\ln(q/\Lambda) < 1$ ;  $\varepsilon_e = d\ln(c^s/\Lambda)/d\ln e > 0$ ; and  $-1 < \varepsilon_x = d\ln(c^s/\Lambda)/d\ln x < 0$ , where  $\varepsilon_j$  denotes the partial elasticity of  $c^s/\Lambda$  with respect to the variable  $j$ . As explained before, an increase in  $q$  makes investments in customers through reducing the markup attractive and so expands output. An increase in  $e$ , that is, a real exchange rate appreciation causes markups to decrease as domestic firms face stiffer competition from foreign suppliers and consequently leads to increases in output and employment. Finally, with rising marginal costs, an increase in the number of customers at each firm leads to a less than proportionate decline in the amount of output supplied per customer. Noting that the markup, say,  $\mu$  can be expressed as  $1/\varsigma$ , we can say that our theory implies that, for given  $x$ , the markup is inversely related to  $q/\Lambda$  and  $e$  so we write  $\mu = m(q/\Lambda, e)$ . Given  $x$ , there is a monotonically negative relationship between the natural rate of employment and the markup, so we can write  $1 - u_n = \Theta(q/\Lambda, e)$ ;  $\Theta_{q/\Lambda} > 0$ ;  $\Theta_e > 0$ . In a diagram with  $q/\Lambda$  and  $e$  on the two axes, the iso- $(1 - u_n)$  contour is downward sloping with a move in the northeast direction corresponding to a higher level of  $1 - u_n$ .

There remains the task of describing the mechanisms of saving, investment, and asset valuation in the capital market. Households have to plan how much of income to save, putting their savings in domestic shares; any excess is invested overseas and any deficiency implies the placement of shares overseas. Firms have to plan their accumulation of customers, issuing (retiring) a share for each customer gained (lost); any excess of customers over the domestic population implies some customers are overseas and any deficiency means that foreign firms have a share of the market. Since the stock of customers, hence shares, is sluggish, the level of the share price must clear the asset market.

In a symmetric situation across firms, (3) simplifies to

$$(1 - \varsigma)c^s/q + (dq/dt)/q + g(1, e) = r \quad (6)$$

This equation in the firm's instantaneous rate of return to investment in its stock of assets, which are customers, is an intertemporal condition of capital-market equilibrium: it is entailed by correct expectations of  $dq/dt$ ,  $r$ , and  $e$  at all future dates. Assume that initially all shares issued by domestic firms are held by nationals.

Invoking the Blanchard-Yaari dynasties with exponential mortality, the economy here satisfies an Euler-type differential equation in the rate of change of consumption per customer,  $c^d$ . Consumption growth is governed by the excess of the interest rate over the rate of pure time preference, denoted  $\rho$ , and by the ratio of (non-human) wealth, denoted  $W$ , to consumption. Upon setting customers' consumption per customer equal to the output supplied to them per customer,  $c^s$ , one obtains

$$dc^s/dt = (r - \rho)c^s - \theta(\theta + \rho)W \tag{7}$$

where  $\theta$  denotes the instantaneous probability of death and  $W = qx$  here. In requiring here that  $q$  at each moment be at such a level as to make the path of planned consumption (its growth as well as its level) consistent with the path of output from (5), we are requiring that the market where goods are exchanged for shares (at price  $q$ ) be in equilibrium. No household will find the prevailing share price different from what is expected.

Finally, for international capital-market equilibrium with perfect capital mobility, the real interest parity condition must be satisfied, which states that any excess of domestic real interest rate,  $r$ , over the exogenously given world real rate of interest,  $r^*$ , must be met by an exact amount of expected rate of real exchange depreciation. This equation is:

$$r = r^* - (de/dt)/e \tag{8}$$

Equations (5)–(8) give us four equations in the four variables:  $c^s/\Lambda$ ,  $q/\Lambda$ ,  $e$ , and  $x$ . However, using the relation  $c^s/\Lambda = \Omega(q/\Lambda, e, x)$  derived from (5), one can reduce the system to three dynamic equations in the three variables:  $q/\Lambda$ ,  $e$ , and  $x$ , the last being a slow-moving variable. We proceed to do the necessary substitutions to obtain the 3 by 3 dynamic system, but it will turn out convenient to present an analysis of a subsystem treating the state variable  $x$  as frozen at its initial value.<sup>8</sup> In a diagram involving  $q/\Lambda$  and  $e$  on the two axes and depicting the two stationary loci associated with equations (7) and (8), we can then show how an adjustment of  $x$ , in response to an economic shock, shifts the two loci to reach a sort of quasi-long run steady state where  $e$  is back to one, hence satisfying the ppp in the (quasi) long run.

### The 3 by 3 dynamic system

The dynamics of the system can be described by the behavior of the endogenous variables  $q/\Lambda$ ,  $e$ , and  $x$  after substituting out for  $c^s/\Lambda$  using  $c^s/\Lambda = \Omega(q/\Lambda, e, x)$ :

$$\begin{aligned} (dq/dt)/q = & [(1 + \varepsilon_e)/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]f(q/\Lambda, e, x) \\ & + [\varepsilon_e/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]h(q/\Lambda, e, x) \end{aligned} \tag{9}$$

$$(de/dt)/e = [(1 - \varepsilon_{q/\Lambda})/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]h(q/\Lambda, e, x) - [\varepsilon_{q/\Lambda}/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]f(q/\Lambda, e, x) \tag{10}$$

$$(dx/dt)/x = g(1, e) \tag{11}$$

where

$$f(q/\Lambda, e, x) = -\{1 - Y[\Omega(q/\Lambda, e, x)x]\}[\Omega(q/\Lambda, e, x)/(q/\Lambda)] + \rho + \{\theta(\theta + \rho)qx/[\Lambda \Omega(q/\Lambda, e, x)]\} - (1 + \varepsilon_x)g(1, e)$$

$$h(q/\Lambda, e, x) = r^* - \rho - [\theta(\theta + \rho)qx/(\Lambda \Omega(q/\Lambda, e, x))] + \varepsilon_x g(1, e)$$

The linearized dynamic system around the steady state  $((q/\Lambda)_{ss}, e_{ss}, x_{ss})$ , where  $e_{ss} = 1$  and  $x_{ss} = 1$  is given by:

$$[(dq/dt)/q \quad (de/dt)/e \quad (dx/dt)/x]' = A[(q/\Lambda) - (q/\Lambda)_{ss} \quad e - 1 \quad x - x_{ss}]' \tag{12}$$

where  $[\dots]'$  denotes a column vector, and the 3 by 3 matrix  $A$  contains the following elements:

$$a_{11} = [(1 + \varepsilon_e)/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]\{f_{q/\Lambda} + [\varepsilon_e/(1 + \varepsilon_e)]h_{q/\Lambda}\}$$

$$a_{12} = [(1 + \varepsilon_e)/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]\{f_e + [\varepsilon_e/(1 + \varepsilon_e)]h_e\}$$

$$a_{13} = [(1 + \varepsilon_e)/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]\{f_x + [\varepsilon_e/(1 + \varepsilon_e)]h_x\}$$

$$a_{21} = [(1 - \varepsilon_{q/\Lambda})/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]h_{q/\Lambda} - [\varepsilon_{q/\Lambda}/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]f_{q/\Lambda}$$

$$a_{22} = [(1 - \varepsilon_{q/\Lambda})/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]h_e - [\varepsilon_{q/\Lambda}/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]f_e$$

$$a_{23} = [(1 - \varepsilon_{q/\Lambda})/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]h_x - [\varepsilon_{q/\Lambda}/(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)]f_x$$

$$a_{31} = 0$$

$$a_{32} = g_e$$

$$a_{33} = 0$$

We have  $g_e < 0$  as a real exchange rate appreciation leads to a flow decrease of customers (so  $dx/dt < 0$  when  $e > 1$ ), and one can readily check that  $f_{q/\Lambda} > 0$ ,  $h_{q/\Lambda} < 0$ ,  $f_x > 0$ , and  $h_x < 0$ . In conjunction with the following two assumptions, we obtain signs for  $f_e$  and  $h_e$ , which provide sufficient conditions for a unique perfect foresight path:

**Assumption 1** *Ceteris paribus*, an increase in  $e$  raises the rate of return to holding a share in the domestic firm by raising the quasi-rent,  $[1 - \varsigma]c^\delta$ , taken as a ratio to  $q$ , by more than it decreases the rate at which the customer base shrinks,  $g_e$ .

**Assumption 2** *Ceteris paribus*, an increase in  $e$  reduces the customer's required rate of interest through shrinking the (nonhuman) wealth to consumption ratio,  $\theta(\theta + \rho)(qx/c^\delta)$ , by more than it increases the required interest rate through raising the growth rate of consumption,  $-\varepsilon_x g_e$ .

Under Assumptions 1 and 2, we also have  $f_e < 0$  and  $h_e > 0$ . We can then sign the elements in the matrix  $A$  as follows:

**Lemma 1**  $a_{11} > 0$ ,  $a_{12} < 0$ ,  $a_{13} > 0$ ,  $a_{21} < 0$ ,  $a_{22} > 0$ ,  $a_{23} < 0$ ,  $a_{31} = 0$ ,  $a_{32} < 0$ , and  $a_{33} = 0$ .

**The 2 by 2 dynamic system**

The two equations of greatest interest are the linearized versions of (9) and (10), where  $x$  is treated as given. Then, it is straightforward to see that the slope of the stationary  $q$  locus is given by  $de/dt|_{\dot{q}=0} = -a_{11}/a_{12} > 0$  and the slope of the stationary  $e$  locus is given by  $de/dt|_{\dot{e}=0} = -a_{21}/a_{22} > 0$ . Since both  $q$  and  $e$  are jumpy variables, the case where the stationary  $e$  locus is steeper than the stationary  $q$  locus in the  $(q, e)$  plane—with  $q$  on the horizontal axis and  $e$  on the vertical axis—gives rise to multiple rational expectations equilibria. We will focus on the case where we obtain unique rational expectations equilibrium, which requires that the determinant given by  $a_{11}a_{22} - a_{12}a_{21}$  be positive. This implies that the stationary  $q$  locus must be steeper than the stationary  $e$  locus for unique rational expectations equilibrium. This case is depicted in Figure 8.3, where we also draw a contour depicting the natural rate of employment,  $1 - u_n = \Theta(q/\Lambda, e)$  going through the intersection point.

A real exchange rate depreciation, in sheltering our economy from international competition, invites an increase in the markup, which translates into a decline of the real product wage and, given an upward sloping wage curve, leads to a decline in employment. Hence a real-exchange-rate depreciation can be seen to be a cause of the employment contraction. There is, however, also a sense in which a real-exchange-rate depreciation is also an effect, possibly alongside a decline of the stock market, of worsened prospects for jobs and output due to an

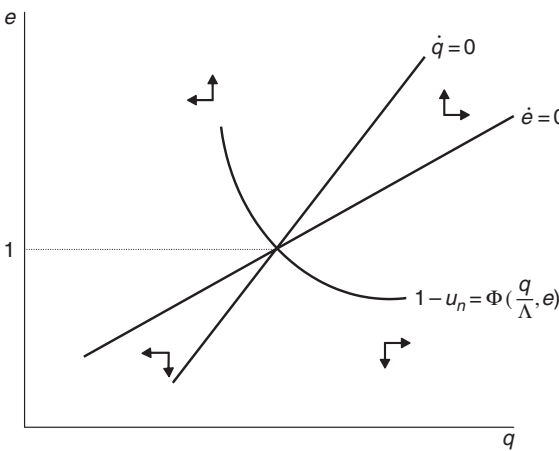


Figure 8.3 Unique rational expectations equilibrium.

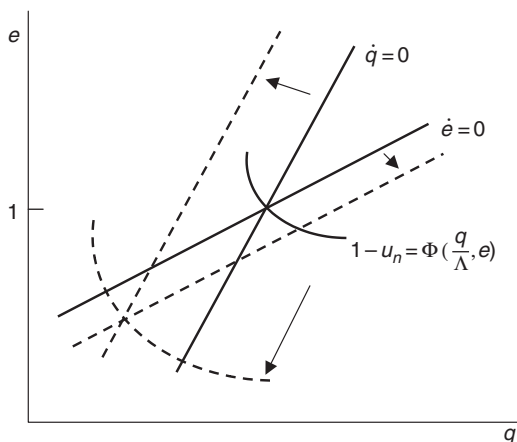


Figure 8.4 Effect of higher  $r^*$ .

adverse exogenous shock. To illustrate this, let us consider the consequences of an unanticipated jump in the exogenously given external real rate of interest,  $r^*$ . In terms of Figure 8.3, one can readily check that the stationary  $q$  locus, which is the steeper locus, shifts to the left since at any given  $e$ , a lower  $q$  is now required to satisfy the asset pricing condition. On the other hand, the stationary  $e$  locus shifts to the right as a higher  $q$  is required to support a higher domestic real interest rate, which must now be equated to a higher external real interest rate. The result, as we see in Figure 8.4, is an unambiguous decline in the real exchange rate and the real share price, and the iso- $(1 - u_n)$  contour passing through the new intersection point lies closer to the origin. Hence, the decline in the real exchange rate, and a depressed stock market as well, must correspond to worsened job prospects in our theory.<sup>9</sup>

### Monetary policy

In an era of inflation targeting (implicit or explicit) such as the present one, where economic agents have come to form expectations of inflation that are largely borne, it is plausible, as we argue later, that the marked swings of the actual unemployment rate reflect primarily movements of the natural rate of unemployment. When the actual inflation rate equals the expected rate of inflation, the unemployment rate is given (in models where unemployment can jump) by the current state variable (say, the customer stock) and the equilibrium schedule, or saddle path, leading toward the medium-term natural rate; in these conditions, movement of the actual rate is driven by swings in this natural unemployment and nothing else. In general, though, the market may misperceive or fail to perceive structural shifts, including policy shifts, so that the economy is not *generally* in intertemporal equilibrium (in the expectational sense). The Central Bank may be



a source of expectational errors, causing the economy to depart from equilibrium behavior. A Central Bank that is unaware of an important structural shift or that misestimates the medium-term rest point to which the economy is capable of tending (misestimating the medium-term natural unemployment rate or the medium-term natural rate of interest) is apt to induce expectational errors.

In order to study monetary policy in a world with short run price level sluggishness, we now introduce the AS equation that would result from the Calvo (1983) staggered pricing model and an expectational AD equation, and suppose that the Central Bank uses the Taylor rule for setting the short-term nominal rate of interest. Writing  $y_t = \Lambda(1 - u_t)$  and  $y_{Nt} = \Lambda(1 - u_{Nt})$ , where  $y_{Nt}$  denotes potential output, we let  $z_t \equiv y_t - y_{Nt}$  represent the output gap. The key Calvo equation describing the rate of change of the inflation rate,  $\pi_t$ , is then given by

$$\frac{d\pi_t}{dt} = -\delta^2 z_t \tag{13}$$

where  $\delta$  denotes the (constant) probability that a firm receives a signal to reset its price. The expectational AD equation expressed in terms of the output gap,  $z_t$ , can be written as

$$\frac{dz_t}{dt} = i_t - \pi^\ell - r_{Nt} \tag{14}$$

where  $\pi^\ell$  is the expected rate of inflation,  $i_t$  is the short-term nominal interest rate set by the Central Bank and  $r_{Nt}$  is the natural rate of interest. Under perfect foresight, one can write  $\pi^\ell = \pi$  in equation (14). Let us write the Taylor rule as

$$i_t = \bar{i}_t + a(\pi_t - \bar{\pi}) + bz_t \tag{15}$$

where  $a$  and  $b$  are positive constants and  $\bar{\pi}$  is the inflation target. Substituting equation (15) into (14), and setting  $\pi^\ell = \pi$ , we obtain

$$\frac{dz_t}{dt} = \bar{i}_t - a\bar{\pi} - r_{Nt} + (a - 1)\pi_t + bz_t \tag{16}$$

Now, equations (13) and (16) provide a system of two equations in the two variables  $\pi_t$  and  $z_t$  if we regard  $\bar{i}_t$  and  $r_{Nt}$  as exogenous. One can readily check that the determinant of the matrix associated with this system of equations is given by  $\delta^2(a - 1)$ , which would be positive if and only if the Taylor principle holds, namely, that  $a > 1$ . Under this assumption, we obtain a unique rational expectations equilibrium with  $z_t = 0$  and  $\pi_t = \bar{\pi}$ . Consequently, the equilibrium is characterized by  $1 - u_t = 1 - u_{Nt}$  for all  $t$ , and the required path of the short-term nominal interest rate is given by  $i_t = r_{Nt} + \bar{\pi}$ . By adjusting the short-term nominal interest rate to reflect changes in the natural rate of interest, the economy's rate of unemployment completely reflects movements in the natural rate of unemployment.

The model of Part I that was developed under the assumption of full flexibility of prices gave us a theory of the natural rate of interest. We can therefore derive an expression giving the natural rate of interest, and show that it is a function of the real share price normalized by productivity, the real exchange rate, and the stock of customers. By taking note that

$$c^s/\Lambda = \Omega(q/\Lambda, e, x)$$

we obtain through various substitutions the following expression for the Wicksellian natural rate of interest in our model of Part I:

$$\begin{aligned} r = & \frac{1}{(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)} \left[ \rho + \frac{\theta(\theta + \rho)(q/\Lambda)x}{\Omega(q/\Lambda, e, x)} \right] + \frac{(\varepsilon_x - \varepsilon_{q/\Lambda})}{1 - \varepsilon_{q/\Lambda} + \varepsilon_e} g(1, e) \\ & + \frac{\varepsilon_e}{(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)} r^* - \frac{\varepsilon_{q/\Lambda}}{(1 - \varepsilon_{q/\Lambda} + \varepsilon_e)} \left( \frac{1 - \mu^{-1}}{q/\Lambda} \right) \Omega(q/\Lambda, e, x) \quad (17) \end{aligned}$$

where  $\mu$ , the markup is a function of  $q/\Lambda, e, x$ . It is readily checked from (17) that a rise in  $q$ , holding other things constant, is associated with a higher natural rate of interest. Intuitively, a higher  $q$  raises the wealth to per capita consumption ratio and also increases the rate of growth of per capita consumption, consequently increasing the household's required real rate of interest. A real exchange rate appreciation, however, has an ambiguous effect on the natural rate of interest as it lowers the wealth to per capita consumption ratio but increases the rate of growth of a representative household's consumption. If the former effect dominates, which is a sufficient condition for saddle-path stability, then a real exchange rate appreciation in our model lowers the natural rate of interest. In steady state, of course, we have  $r = r^*$ .

What are the implications of the Central Bank's misestimating the natural rate of interest? We can solve the model to show that the equilibrium rate of inflation is a function of the current and expected future gaps between the natural rate of interest and the intercept term in the Taylor rule ( $\bar{i}$  in (15)).<sup>10</sup> Replacing  $z_t$  in equation (13) with (15), and noting that the required path of the short-term nominal interest rate is given by  $i_t = r_{Nt} + \bar{\pi}$ , we can solve forward to obtain

$$\pi_t = \bar{\pi} + (\delta^2/b) \int_t^\infty (r_{N_s} - \bar{i}_s + \bar{\pi}) e^{-(a\delta^2/b)(s-t)} ds \quad (18)$$

If the Central Bank fails to adjust the intercept term  $\bar{i}$  upwards when the natural rate of interest increases or the intercept term is decreased without there being a decline in the natural rate of interest, this would tend to raise inflation and the output gap. In the converse situation, there would tend to be deflation and a decline in the output gap. To prevent the inflation rate from either rising or falling, it would be necessary to adjust the intercept term in tandem with the natural rate of interest. In a recent study, two European Central Bank economists

discuss the consequences of taking into account movements in the natural rate of interest in simple monetary policy rules based on data of the Euro-area since the early 1970s.<sup>11</sup> They found that taking into account the time-varying properties of the natural rate of interest led to increased stabilization of the output gap and inflation rate.

Apart from misestimating the natural rate of interest, a Central Bank could also misestimate the natural rate of unemployment, which leads to another sort of error. Suppose we observe an episode where an expectation of bright future prospects leads to a booming stock market together with a real exchange rate appreciation—similar to that which the US economy experienced in the second half of the 1990s. According to our theory, both the rise of  $q/\Lambda$  and  $e$  has the effect of lowering  $u_n$ . In the extreme case that helps make our point most starkly, suppose that the actual decline of  $u$  observed was entirely the result of the decline of  $u_n$  but the Central Bank attributes it entirely to a fall *relative* to  $u_n$ , that is, a fall of  $u - u_n$ . Then, although a correct application of the Taylor rule would suggest that the short-term nominal interest rate be left unchanged *on account* of employment or output stabilization, a Central Bank that does not see that the booming stock market and the stronger real exchange rate has lowered the natural rate of unemployment would incorrectly raise the short-term nominal interest rate to a level that is not justifiable. (The short-term nominal interest rate should solely be raised in tandem with a rise of the natural rate of interest in accordance with an upward adjustment of the intercept term in the Taylor rule in (15).) The result would be a decline in the inflation rate and the output gap.

### **Evidence on employment and the real exchange rate**

We have seen that the model outlined in the earlier section yields a positive relationship between employment, on the one hand, and share prices and the real exchange rate, on the other hand. In the customer-market model, an increase in share prices and an appreciation of real exchange rates induce domestic firms to cut their markup, which implies an increase of the demand wage in terms of domestic product. The upward shift in the demand-wage schedule pulls the economy rightwards and upwards along its “wage curve,” causing employment as well as the product wage to increase. We now wish to test our proposition empirically by first using OECD data and then focusing exclusively on the recent US experience.

#### ***OECD unemployment***

The countries included in our statistical study are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Spain, Sweden, the United Kingdom, and the United States. We have data on share prices, productivity (for normalizing), and real (effective) exchange rates for these countries covering the period 1977–2000. The real (effective) exchange rate is compiled by the International Monetary Fund (IMF).

The estimated equation is of the error-correction variety,

$$\Delta f(u_{it}) = \beta_{i1} \left\{ \alpha_i + \gamma_1 e_{it-1} + \frac{\gamma_2}{s_{it-1}} + \gamma_3 (1 + r_{it-1}^*)^5 + \gamma_4 p_{it-1}^{oil} \right\} - f(u_{it-1}) + \beta_{i2} \Delta \pi_{it} + \beta_{i3} \Delta e_{it} \quad (19)$$

where  $i$  is the country index and  $t$  denotes the years ( $i = 1, 2, \dots, 16$ ;  $t = 1976, 77, \dots, 2000$ ). The equation postulates a long run relationship between unemployment, on the one hand, and—in light of our theory—real exchange rates  $e$ , real share prices  $s$ , world real interest rates  $r^*$  (measured in decimals), and real oil prices  $p^{oil}$ , on the other hand.<sup>12</sup> The terms in the square bracket represent an upward sloping supply curve in the employment/real exchange rate and the employment/real share price planes.

Inflation and exchange rate shocks push unemployment off its long run equilibrium path but—assuming that  $\beta_1$  is positive, unemployment gradually converges back to its long run equilibrium following such shocks.<sup>13</sup> The speed of adjustment towards equilibrium is measured by this coefficient  $\beta_1$ , which one hopes will take a value somewhere between zero and one. Singling out the potential influence of effective demand in creating disequilibrium and having in mind, in particular, the Central Bank's imperfect demand management, as just discussed, the equation says that unemployment will be above (below) its equilibrium path if and only if price inflation is falling (rising).

The function  $f$  is a nonlinear function of the unemployment rate;  $(u^{0.5} - 1)/0.5$ , following Bean (1994).<sup>14</sup> The idea is to capture the (strict) convexity of the wage-setting relationship—each consecutive fall in unemployment requires ever-larger shifts of labor demand. Note that  $\alpha_i$  is a country-specific fixed effect that captures any omitted country-specific effects. While each country has its own fixed effect, groups of countries are made to share a sensitivity coefficient  $\beta_1$ , as well as the sensitivity to inflation shocks ( $\beta_2$ ) and changes in the real exchange rate ( $\beta_3$ ). Table 8.1 has the definition of the variables.

The equation was estimated with a panel of 326 observations. The reported estimates were derived using *weighted least squares*. Table 8.2 has the coefficient estimates  $\gamma_1$ ,  $\gamma_2$ ,  $\gamma_3$ , and  $\gamma_4$ .

*Table 8.1* Definition of variables

|           |   |
|-----------|---|
| $u$       | Unemployment rate (source: OECD).   |
| $e$       | Real effective (trade-weighted) exchange rate, measuring the relative price of domestic and foreign consumer goods (source: IMF). |
| $s$       | Real share prices normalized by real GDP per employed worker (source: IMF).   |
| $r^*$     | World real rate of interest (weighted average of G7 yield on government bonds) (source: IMF).                                     |
| $p^{oil}$ | Real price of oil (source: Citibase)  |
| $\pi$     | Inflation (GDP deflator) (source: IMF).   |

The results in the table are consistent with predictions of our structuralist model. First, an appreciation of the real exchange rate causes the steady-state unemployment rate to fall ( $t = 4.12$ ). Second, an elevation of real stock prices also lowers unemployment ( $t = 8.27$ ). An increase in the world real rate of interest raises unemployment ( $t = 9.09$ ). Finally, an increase in the real price of oil causes unemployment to rise ( $t = 4.93$ ). Importantly, the results from estimating equation (19) confirm a negative association between real exchange rates and the unemployment rate as suggested by structuralist theory.

The reader may wonder why real share prices and the world real rate of interest are included side by side since the former might be thought to encapsulate the latter. One reason for this inclusion is that if share prices are highly volatile owing to misguided speculation, that volatility may obscure the effect of changes in the world interest rate on unemployment unless it is entered explicitly on the right-hand side of the estimating equation.<sup>15</sup> Table 8.3 has the group-specific coefficients.

The effect of surprise inflation causes unemployment to fall for all country groups. The employment effect of the inflation shock is smallest in Japan, then in the United States, and roughly the same in the other four areas. The short-term unemployment effect of a real exchange rate appreciation is less robust. The sign of the estimated coefficient is also only correct in Japan. The speed of adjustment

Table 8.2 Estimation results

| <i>Coefficient</i> | <i>Estimate</i> | <i>t-statistic</i> |
|--------------------|-----------------|--------------------|
| $\gamma_1$         | -0.02           | 4.12               |
| $\gamma_2$         | 1.28            | 8.27               |
| $\gamma_3$         | 2.76            | 9.09               |
| $\gamma_4$         | 1.28            | 4.93               |

Table 8.3 Further estimation results: group effects

| <i>Areas</i>  | <i>Sensitivity coefficient</i> |                    | <i>Inflation shock</i> |                    | <i>Real exchange shock</i> |                    |
|---------------|--------------------------------|--------------------|------------------------|--------------------|----------------------------|--------------------|
|               | <i>Estimate</i>                | <i>t-statistic</i> | <i>Estimate</i>        | <i>t-statistic</i> | <i>Estimate</i>            | <i>t-statistic</i> |
| Australia     | 0.51                           | 4.71               | -7.81                  | 2.88               | -0.02                      | 2.40               |
| Europe*       | 0.15                           | 7.93               | -5.01                  | 3.94               | -0.01                      | 1.95               |
| Japan         | 0.08                           | 3.85               | -1.79                  | 1.51               | 0.00                       | 1.31               |
| Scandinavia** | 0.06                           | 2.14               | -8.02                  | 3.05               | -0.03                      | 2.33               |
| Canada        | 1.15                           | 6.39               | -6.00                  | 2.41               | -0.03                      | 2.36               |
| United States | 0.85                           | 5.00               | -2.41                  | 0.81               | -0.00                      | 0.29               |

Notes

\* Including Denmark.

\*\* Excluding Denmark.

to steady state is greatest in Australia, the United States, and Canada and much smaller in Europe, Scandinavia, and Japan. This confirms our prior expectations.

We have so far omitted one important variable in our model. This is the market share of domestic producers,  $x_t$ . Clearly, domestic output and employment are an increasing function of the market share. The reason for this omission is simply lack of data. However, we did experiment with calculating the market share by assuming that it takes the value 1 in year 1978—all domestic customers are customers of domestic firms—and then updating it using the following difference equation:

$$x_t = x_{t-1} - 0.2 \left( \frac{\bar{e}_t}{\bar{e}} - 1 \right) x_{t-1} \quad (20)$$

where  $\bar{e}$  denotes the average real exchange rate over the period 1978–2000—which is our proxy for the PPP real exchange rate and the number 0.2 is only a rough guesstimate of the responsiveness of the market share to real exchange rates. The equation suggests that an elevated (i.e. appreciated) real exchange rate makes customers drift away to foreign firms while a lower value of  $\bar{e}$  makes new customers join domestic firms.

Including the market share  $x_t$  in equation (20) gave a negative coefficient with a  $t$ -ratio of 2.21, as predicted by our structuralist theory. This suggests that a transiently larger market share goes together with transiently lower unemployment (hence higher employment rate and higher output). This is what we expected. Apart from this, the results were qualitatively unaffected. We now turn to the most recent employment experience of the United States in light of our theory.

### ***The 1990s boom in the United States***

Figure 8.5 has a plot of the rate of employment in the United States (one minus the rate of unemployment) against the SP500 index (in logs), when the latter has been normalized by labor productivity (all sectors) and the consumer price index (CPI). The long swings in the two series are clearly related—and in a sustained rather than purely transient way. A positive relationship between the two series has also been verified for a range of countries (see Phelps and Zoega (2001)). The persistent unemployment found in a number of Continental economies is simultaneously reflected in the failure of stock prices (normalized) to recover.

The fall in the employment rate in the United States in the early 1970s corresponded to a fall in the normalized share price with a common trough in year 1975 and then again in year 1982. There followed a joint recovery peaking in year 2000, followed by a decline in both series. There are also instances when the two series go separate ways: employment expanded in the late 1960s, the late 1970s, and the late 1980s without a corresponding elevation of stock prices. It follows that these may possibly have brought in rising inflation, since a rise in employment above its noninflationary level—or natural rate—creates rising inflation in our model. The recession in 1990–92 also seems to fit this mold although with the



Figure 8.5 Share prices (normalized) and employment in the United States.

Note

The employment series is one minus the rate of unemployment (in decimals). The share price series is the SP500 normalized by the CPI index (1995 = 1) and a measure of labor productivity (1995 = 1). The value of the SP in 1995 was 470, which is therefore also the value of the normalized series.

reverse sign—employment fell without a corresponding fall in stock prices. In contrast, the rise in share prices in the late 1990s appears not fully reflected in the employment rate. At its peak in year 2000, the employment rate had not yet reached the peak of the late 1960s, although the stock market was much higher. Similarly, the employment rate in 2003 is lower than what could be expected from the stock market, which is still high by historical standards. This may suggest that employment could expand without risking inflation. (More on this later.)

Figure 8.6 shows the inflation rate and its first difference over the same period. The periods of rising price inflation are the late 1960s, the late 1970s, and—to a lesser extent—the late 1980s. These periods correspond to those when employment expanded without any accompanying elevation of share prices. In contrast, the inflation shock in the mid-1970s is clearly caused by the oil price hikes in 1973–74. Wage inflation also picked up in the late 1970s and the late 1980s. Interestingly, wage inflation rose in the late 1990s to a greater extent than price inflation—the real wage rose during this period.

If share prices truly affect the level of the natural rate of unemployment, they should be of use in explaining and predicting inflation. As a prelude, Figure 8.7 has a plot of the relationship between the first difference of the inflation rate (CPI and wages)—that is, unexpected inflation—and the employment rate. Not surprisingly, there emerges no clear relationship between the two variables. The data clearly reject the joint hypothesis of an expectations-augmented Phillips curve and a constant natural rate of unemployment.

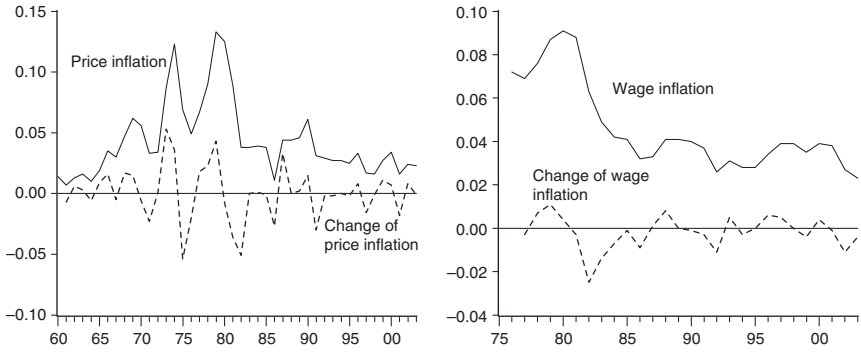


Figure 8.6 Price and wage inflation in the United States.

Note

Inflation (in decimals) is measured as the rate of change of the CPI from last quarter of the previous year to the last quarter of the current year.



Figure 8.7 The (non) relationship between inflation and employment in the United States.

The incorporation of share prices should help clarify the relationship between inflation and employment if changes in share prices go hand in hand with changes in the nonobservable natural rate of unemployment. In effect, changes in share prices affect the position of the inflation–unemployment trade-off. We test this by estimating an expectations-augmented Phillips curve of the following form:

$$\pi_t = \alpha + \pi_{t-1} + \beta[(1 - u_t) - (\gamma_1 s_t + \gamma_2 g_t + \gamma_3 e_t)] + \phi \Delta(1 - u_t) + \varepsilon_t \quad (21)$$

where  $\pi$  denotes inflation (either price inflation (CPI) or wage inflation),  $1 - u$  is the employment rate,  $s$  is the SP500 share price index normalized by labor



productivity,  $g$  is the rate of (labor) productivity growth and  $e$  is the (trade-weighted) effective real exchange rate. The first difference of the employment rate is also included because a rapid expansion—or a rapid convergence to steady state—may be more prone to generate rising inflation. The results appear in Table 8.4. Columns (1) and (2) show results when inflation is measured with price (CPI) inflation while in columns (3) and (4) wage inflation is used instead (wages and salaries in private industry).

In the first column, only stock prices are used to predict inflation, in addition to the employment rate, the first difference of the employment rate, and lagged inflation. All three variables have a statistically significant coefficient with the expected sign. We then add (labor) productivity growth and the (effective) real exchange rate to the equation since these should affect the level of the natural rate of unemployment; both an acceleration of productivity growth as well as a real exchange rate appreciation should raise employment in our model. The productivity growth rate has a statistically significant and a positive coefficient while the real exchange rate has an insignificant coefficient. The positive and significant coefficient of the productivity rate implies that higher expected productivity growth lowers the natural rate of unemployment and hence also inflation in equation (21).<sup>16</sup> Regrettably, when adding the effective real exchange rate one is forced to discard the first 10 observations due to missing data.

In columns (3) and (4) wage inflation (rate of change of wages and salaries in private business) is the dependent variable instead of changes in the CPI. The wage data start in year 1975, which shortens the sample period by 15 years.

Table 8.4 Estimation of Phillips curves

| Variables            | Price inflation |         |          |         | Wage inflation |         |          |         |
|----------------------|-----------------|---------|----------|---------|----------------|---------|----------|---------|
|                      | (1)             |         | (2)      |         | (3)            |         | (4)      |         |
|                      | Estimate        | t-ratio | Estimate | t-ratio | Estimate       | t-ratio | Estimate | t-ratio |
| Constant term        | -0.77           | 4.07    | -0.69    | 3.08    | -0.51          | 6.23    | -0.37    | 4.07    |
| Employment rate      | 0.94            | 3.57    | 1.29     | 5.21    | 0.67           | 6.17    | 0.68     | 6.89    |
| Change of employment | 0.91            | 3.88    | 0.81     | 2.88    | 0.61           | 6.09    | 0.45     | 4.12    |
| Share prices (logs)  | 0.02            | 2.74    | 0.01     | 1.56    | 0.02           | 6.14    | 0.01     | 3.50    |
| Productivity growth  |                 |         | 0.86     | 1.87    |                |         | 0.28     | 1.18    |
| Real exchange rates  |                 |         | 0.00     | 0.14    |                |         | 0.03     | 1.53    |
| Observations         | 42              |         | 42       |         | 27             |         | 27       |         |
| R-squared            | 0.34            |         | 0.61     |         | 0.67           |         | 0.73     |         |
| R-squared (adj.)     | 0.29            |         | 0.54     |         | 0.63           |         | 0.67     |         |

Notes

Employment is measured in decimals. Share prices are normalized by prices (CPI, annual averages) and the level of labor productivity where its value in year 1975 is equal to the unnormalized one. Productivity growth is also measured in decimals and measures the rate of change of average (annual) productivity. Real exchange rates are measured by an index that takes the value 100 in year 1995.

However, one gets even better results in this case. The R-squared of the equation is higher and the statistical significance of share prices and the real exchange rate is now much higher, although productivity growth has a somewhat lower  $t$ -ratio. The coefficient for the real exchange rate is now clearly positive; a real appreciation reduces inflation.

Now take the estimation results from Table 8.4 (columns (1) and (3)) and calculate the difference between the actual and the natural rate of employment—using only share prices—and then use this to predict the first difference of the inflation rate. The results are shown in Figure 8.8. The left-hand-side panel shows actual and predicted change of price inflation while the right-hand-side panel shows the change of wage inflation. In contrast to Figure 8.7, we now have a clear relationship between inflation and its causal variables. The most notable prediction failures are the price inflation shocks in the mid-1970s and the late 1970s that correspond to the two oil crises.

Now invert equation (21) so that it explains the employment rate, and move inflation to the right-hand side:

$$1 - u_t = -\frac{\alpha_0}{\beta + \phi} + \frac{\phi}{\beta + \phi}(1 - u_{t-1}) + \frac{1}{\beta + \phi}\Delta\pi_t + \frac{\gamma_1\beta}{\beta + \phi}s_t + \varepsilon_t \quad (22)$$

The results follow in Table 8.5. Not surprisingly in light of equation (21), rising inflation causes employment to go up and higher share prices and higher employment go together.

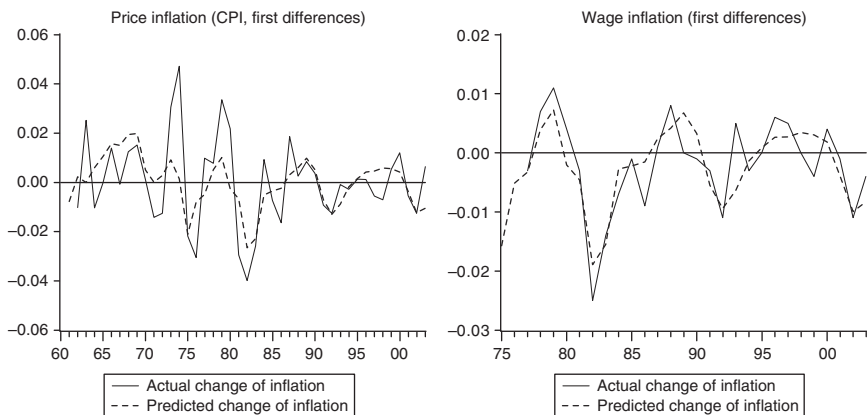


Figure 8.8 Actual and predicted change of price and wage inflation.

Note

Predicted change of inflation uses the estimated results in columns (1) and (3) of Table 8.4.

Table 8.5 Estimation of employment equation

| Variables              | Price inflation<br>(on right-hand side) |         | Wage inflation<br>(on right-hand side) |         |
|------------------------|---|---------|--|---------|
|                        | Estimate                                | t-ratio | Estimate                               | t-ratio |
| Constant term          | 0.41                                    | 4.37    | 0.57                                   | 3.90    |
| Lagged employment rate | 0.50                                    | 4.06    | 0.31                                   | 1.75    |
| Inflation shock        | 0.25                                    | 2.49    | 0.87                                   | 6.07    |
| Share prices (logs)    | 0.01                                    | 2.23    | 0.01                                   | 2.80    |
| Observations           | 42                                      |         | 27                                     |         |
| R-squared              | 0.75                                    |         | 0.87                                   |         |
| R-squared (adj.)       | 0.73                                    |         | 0.86                                   |         |

Note  
See explanations below Table 8.4.

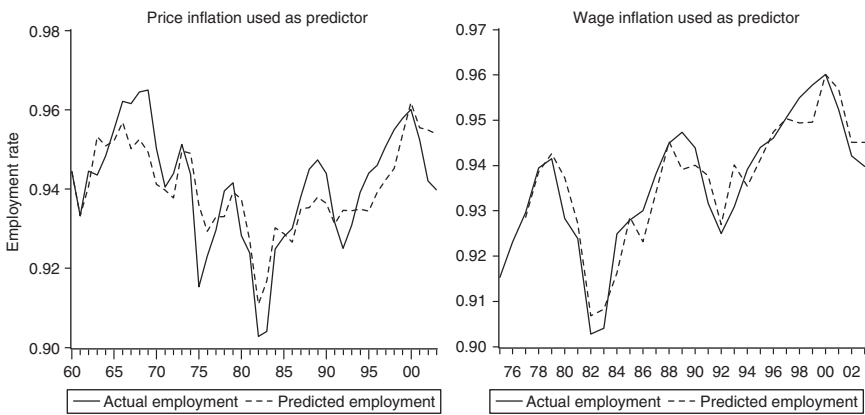


Figure 8.9 Simulated and actual employment.

One can use this estimated equation to simulate the employment path for the United States. Figure 8.9 plots actual and simulated—that is predicted (within sample) from Table 8.5—employment path for 1960–2003 using price inflation, and then for the period 1976–2003 using wage inflation.

The fit appears quite impressive. Equation (22) does a good job at tracking the long swings of employment in the United States. In particular, the late 1990s boom is captured by the equation. There are some discrepancies though. When using price inflation, the main discrepancies appear in the late 1960s—the boom was too strong!; the recessions of 1975 and 1982—too steep; the late 1980s—the expansion stronger than predicted; and the last 3 years, when employment has been lower than what could be expected on the basis of share prices and price inflation/disinflation. While the (highly augmented) price equation captures the 1990s boom well it under-accounts for the strong fall in employment since year

2000. In contrast, the wage equation captures very well both the late 1990s boom as well as the end of it. This goes to show that the wage deceleration in recent years has coincided with rising unemployment, which again suggests that the rising unemployment may in part be due to cyclical—as opposed to structural—factors. Hence our structural model does a better job at explaining the genesis of this recent boom than it does at explaining its end.

## Conclusions

With this chapter, we have really bound together two studies, one on the issue of the direction of effect of the real exchange rate on unemployment, and the other on the issue of whether effective demand in general and monetary policy in particular has been systematically important in the large swings in economic activity in the postwar period.

With regard to the first study within our chapter, our findings are clearly that the structuralist view on the effects of the real exchange rate is correct, the Keynesian view wrong. A more sophisticated perspective found in the Mundell-Fleming model would say that real exchange rate appreciations and depreciations are not causal, as they simply serve to reconcile the IS curve to the intersection of the LM curve with the  $r^*$  line—an intersection that itself already determines the level of employment. But none adhering to a monetary perspective appears to acknowledge that real exchange rate depreciations are contractionary through the supply-side, so to speak.

With regard to the second study, we do not find that monetary factors come to the rescue of such deficiencies as we can identify in our structuralist analysis. We continue to maintain that our structural model can account for the long swings in the rate of employment in the United States. In particular, it sheds a new light on the noninflationary boom in the late 1990s. This was one of the more remarkable booms in modern history with simultaneous output and productivity growth, low unemployment, and stable inflation. The absence of rising inflation during this period came as a surprise to many, since the level of the natural rate of unemployment was commonly estimated to be in the range of 5–6 percent by the mid-1990s. Our explanation is that the short run natural rate of unemployment was pulled down during this period by fresh expectations of a future surge of productivity improvements, expectations that are captured at least approximately by the booming stock market. There is the possibility, however, that the steepness of the economy's downturn over the 3 years, 2001–03 was in some part, the result of monetary mechanisms causing wage disinflation. The absence of clear evidence of price disinflation, however, makes this monetary argument less powerful than it would otherwise be.

## Notes

- 1 In 1996–2000, the rate of growth of output per man-hour in the business sector ranged between 2.3 and 3 percent.
- 2 See Phelps (1994).

- 3 The employee model, also called the turnover-training model or quitting model, derives from Phelps (1968). The customer model originates in Phelps and Winter (1970).
- 4 Keynes, whose theory gave center stage to the unpredictability and unobservability of entrepreneurs' visions and optimism, expressed skepticism that statistical analyses, such as those Jan Tinbergen began to undertake, would be valuable in forecasting employment swings or in testing his theory's explanation of them. Subsequent practitioners avoided the problem by treating investment demand as exogenous. With James Tobin's introduction of his "Q ratio," empirical work sought to estimate the role of entrepreneurs' expectations on investment, pushing back the exogeneity from investment demand to share prices.
- 5 See Fitoussi, Jestaz, Phelps, and Zoega (2000) and Phelps and Zoega (2001).
- 6 Making his case for a flexible exchange rate, Milton Friedman famously argued that, to paraphrase it a little, if expected future profit prospects deteriorate and so share prices drop, thus threatening investment demand, the real exchange rate will drop just enough to offset the drop in share prices, thus holding or returning employment to some fixed preternatural level—a natural rate taken to be invariant or simply the previous employment level. The Mundell-Fleming model nicely demonstrates that proposition, and the Dornbusch model modifies it.
- 7 See Froot and Klemperer (1989). Using a customer-market model similar to ours, Froot and Klemperer show that the extent of "pricing to the market" depends on the expected persistence of nominal exchange rate changes. A transient appreciation of the domestic currency may induce foreign producers to raise the domestic (import) price of their output in order to benefit further from the temporarily high value of the currency—since the future loss matters less due to the expectation that the value of the currency will be lower—while a permanent appreciation raises both the benefit and cost of raising current prices, hence leaving the foreign price unchanged, and the domestic (import) price lower.
- 8 A complete characterization of the  $3 \times 3$  system is done in Hoon and Phelps (2002).
- 9 To get to the quasi-long run steady state where  $e$  is back to 1, we note that as customers are gained so  $x$  increases, both the stationary  $q$  locus and the stationary  $e$  locus gradually shift left to intersect at the original level of 1 with a lower  $q$ .
- 10 See Woodford (2003).
- 11 See Giammarioli and Valla (2003).
- 12 We should note that the results are robust to the exclusion of the oil price variable, which did not appear in the theoretical model.
- 13 Note that we allow for a short-term effect of real-exchange-rate changes on unemployment—to capture any short-run Keynesian effect—as well as a long run relationship between the two variables.
- 14 See Bean (1994).
- 15 For another reason for this inclusion, see Fitoussi, Jestaz, Phelps, and Zoega (2000).
- 16 This is in accordance with studies by, among others, Hoon and Phelps (1997), Pissarides (2000), and Ball and Moffitt (2001).

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# 9 The long stagnation and monetary policy in Japan

A theoretical explanation

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## Introduction

The long stagnation of the Japanese economy during the 1990s (and now it appears even during the 2000s!) is a historical event. Explanation of this long stagnation of once such a vigorous economy is surely a great challenge to macroeconomists. In fact, a number of possible causes of the long stagnation of the Japanese economy have been offered: falls of asset price, hangover of bad loans, liquidity trap, policy mistakes, both fiscal and monetary, “hollowing out” due to rising China, and so on. Most likely, causes are multiple rather than single. Granted, in this chapter, we focus on a particular factor, namely *uncertainty*. Specifically, using a theoretical model, we show that mounting uncertainty possibly traps the economy into a long stagnation. We also discuss its implication for the efficacy of monetary policy.

Kuttner and Posen (2001: 96), in their analysis of what they call the Great Recession of Japan, draw the following conclusion.

In short, the basic lesson of Japan’s Great Recession for policy maker is to trust what you learned in intermediate macroeconomics class: even under difficult economic circumstances, and even in institutional contexts far removed from those in which they were developed, the stabilization policy framework of the mainstream textbooks still applies.

We certainly do not recommend policy-makers in Japan or elsewhere to throw the mainstream macroeconomics textbooks away. We, of course, believe in macroeconomics. However, in our view, the Japanese economy today *does* present economists and policy-makers with the real difficulties the textbook remedies cannot easily handle.

A case in point is monetary policy. In Japan, the nominal interest rate has been basically zero. Many economists argue that in this “liquidity trap,” the Bank of Japan (BOJ) can still lower the real interest rate by generating the expected inflation. Towards this goal, what the BOJ must do is just to supply base money amply enough. This argument is popular in Japan. Abroad, proponents are, among others, such eminent economists as Krugman (1998), Bernanke (2000), Blanchard (2000), and Rogoff (2002). In the mainstream macroeconomics class, this answer

would get full marks. In this chapter, we explain a theoretical reason why we cannot necessarily give full marks for the standard approach. In our analysis, uncertainty plays the central role.

Tobin (1972: 9), in his presidential address to the American Economic Association, proposes a notion of “stochastic macro-equilibrium.” He argues that it is “stochastic, because random intersectoral shocks keep individual labor markets in diverse states of disequilibrium, macro-equilibrium, because the perpetual flux of particular markets produces fairly definite aggregate outcomes.” Our model is stochastic, and our approach is akin to what Tobin called “a theory of stochastic macro-equilibrium.”

This approach is very different from the mainstream macroeconomics such as real business cycle theory (Kydland and Prescott (1982)) in that it rejects the assumption of the representative agent. It takes heterogeneity of economic agents as essential in analyzing the macroeconomy. Since the macroeconomy consists of a large number of economic units, for example,  $10^7$  households and  $10^6$  firms, the precise optimizing behavior of each unit is irrelevant for understanding the behavior of the macroeconomy. Stochastic approach is necessary; See Aoki (1996, 2000) and Yoshikawa (2003).

The chapter is organized as follows. The first section briefly surveys the Japanese economy and macroeconomic policies during the 1990s. The second section presents our model. It underlines the importance of uncertainty as a hindrance to the economy. The third section gives some evidences which suggest that the degree of uncertainty indeed appears to have risen in the Japanese economy. The fourth section provides concluding remarks. The appendix explains microeconomic foundations for the macromodel in second section.

## **The Japanese economy during the 1990s**

In the buoyant 1980s, when some even suggested “Japan as Number One,” who would have imagined such gloomy 1990s? As it turned out, Japan suffered from the decade long stagnation during 1990s. This section briefly surveys the Japanese economy and macroeconomic policies during the 1990s.

### ***The economy***

The past 15 years saw an extreme surge and then a subsequent fall in stock and land prices in Japan. The “bubbles” became the key word. Thus, it is natural and understandable that many economists, both home and abroad have turned to the “wealth effects” one way or another to understand the Japanese economy during the period. However, it is actually not so trivial whether and how changes in asset prices affected the economy. As we will explain later, the credit crunch occurred during 1997–98, and it was the major cause of  $-2.5$  percent growth of real GDP (the worst record in the postwar Japan) in 1998. There is no denying that a fall in asset prices and bad loans are the major problem which Japan still faces today. And yet, they are far from the whole story.



Table 9.1 Contribution of demand components to GDP growth (%)

|      | GDP growth | Consumption | Housing investment | Fixed investment | Inventory investment | Public consumption | Public investment | Exports | Imports |
|------|------------|-------------|--------------------|------------------|----------------------|--------------------|-------------------|---------|---------|
| 1990 | 5.1        | 2.6         | 0.3                | 2.0              | -0.2                 | 0.1                | 0.3               | 0.7     | -0.8    |
| 1991 | 3.8        | 1.5         | -0.5               | 1.2              | 0.3                  | 0.2                | 0.3               | 0.6     | 0.3     |
| 1992 | 1.0        | 1.2         | -0.3               | -1.1             | -0.5                 | 0.2                | 1.0               | 0.5     | 0.1     |
| 1993 | 0.3        | 0.7         | 0.1                | -1.9             | -0.1                 | 0.2                | 1.2               | 0.2     | 0.0     |
| 1994 | 0.6        | 1.1         | 0.4                | -0.9             | -0.3                 | 0.2                | 0.2               | 0.5     | -0.8    |
| 1995 | 1.5        | 1.2         | -0.3               | 0.8              | 0.2                  | 0.3                | 0.1               | 0.6     | -1.4    |
| 1996 | 5.1        | 1.7         | 0.7                | 1.8              | 0.4                  | 0.2                | 0.8               | 0.8     | -1.3    |
| 1997 | 1.6        | 0.3         | 0.9                | 1.5              | 0.1                  | 0.1                | -0.9              | 1.4     | -0.1    |
| 1998 | -2.5       | -0.3        | -0.6               | -1.4             | -0.6                 | 0.1                | -0.2              | -0.3    | 0.9     |
| 1999 | 0.2        | 0.7         | 0.1                | -1.0             | 0.1                  | 0.1                | 0.6               | 0.3     | -0.6    |

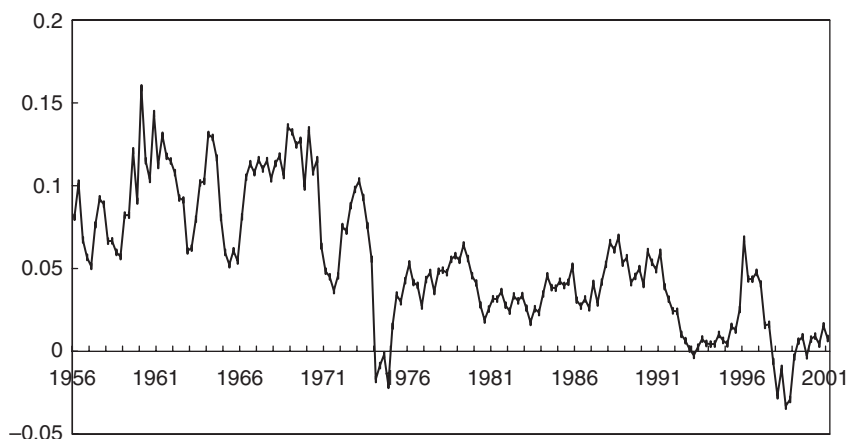


Figure 9.1 GDP growth 1950:1–2001:1.

After the asset price bubbles burst, the Japanese economy officially entered the recession in 1991. At first, it appeared as a normal cyclical downturn, but it was actually only the beginning of the decade long stagnation. The average growth rate of Japan during 1992–98 is exactly 1.0 percent (the first column of Table 9.1). During the same period, the US economy enjoyed the 3 percent growth. The 1 percent growth is even lower than that of the EU which suffers from such high unemployment.

As shown in Figure 9.1, during the high growth era of the 1950s and 1960s, the Japanese economy grew by almost 10 percent every year. After the first oil shock of 1973–74, the growth rate fell,<sup>1</sup> but still it was 4 percent on average through the end of the 1980s. It was higher than those of most OECD economies. Then the growth rate declined further from 4 to 1 percent during the 1990s. The important question is, of course, why the Japanese economy suffered from such a long stagnation.

On a close examination of Table 9.1, one finds that the generally depressed 1990s is actually divided into three subperiods: (1) the 1992–93 recession, (2) the 1994–96 recovery, and (3) another recession<sup>2</sup> during 1997–98. A sensible way to get an overview of the Japanese economy during the 1990s is to look at the demand-decomposition of the growth rate of real GDP. Table 9.1 presents contribution of demand components such as consumption, investment, and exports to growth of GDP. The contribution is here defined as the growth rate of each demand component, say investment, times its share in real GDP. By construction, the figures sum up to the growth rate of GDP.

The table shows that fixed investment is by far the most important factor to account for the 1992–93 recession, the 1994–96 recovery, and also the 1997–98 recession. In fact, investment is the most important explanatory variable for the Japanese business cycles throughout the postwar period (Yoshikawa 1993). This stylized fact applies to the 1990s. When the growth rate fell from 3.8 to 0.3 percent during 1991–93, for example, the contribution of investment fell from 1.2 to –1.9 percent, accounting for nearly 90 percent of a fall in the growth rate. Similarly, when growth accelerated from 0.3 to 5.1 percent during 1993–96, the contribution of investment rose from –1.9 to 1.8 percent, again accounting for 80 percent of the recovery.

Thus, to explain the long stagnation of the Japanese economy during the 1990s, we must explain depressed fixed investment. For the 1991–94 recession, we must refer to normal stock adjustment after the long boom during the bubble period (Yoshitomi 1998). And for the 1997–98 recession, the credit crunch played the major role. However, we need to explain why investment stagnated for such a long period *on average*. After all, investment basically responds to demand; when demand grows, investment also grows whereas if demand stagnates, so does investment. We must, therefore, explain the long stagnation of demand.

Other than fixed investment, depressed consumption is notable.<sup>3</sup> For 1998, we even observe an unprecedented *decline* in consumption. Contrary to the common belief, however, a fall in asset prices had relatively small effects on consumption. One might expect that the negative wealth effects depressed consumption after the bubble burst in the early 1990s. Altogether, households enjoyed almost ¥1,200 trillion worth of capital gains on their assets (¥200 trillion on stock, and ¥1,000 trillion on land, respectively) during the bubble period of 1986–90. Subsequently, they suffered from the ¥400 trillion worth of capital losses during 1990–92. The analysis of consumption by type of household reveals that capital losses on stock did exert the negative wealth effects on consumption of the retirees and a portion of the self-employed who were the major stock owners. These types of households share only 12 percent, however.

The major capital gains and subsequent losses accrued on land. As one would expect, most land which households own is indivisibly related to housing. Therefore, to the extent that housing service and other consumables are weak substitutes, and that land and housing are indivisible, it is not so surprising nor irrational as it might first appear, that sizable capital gains and losses on land left most households to keep their houses and their consumption basically intact.

Capital gains and losses on stock and land affected household consumption only marginally. Bayoumi (1999), using vector autoregressions (VARs) also finds that the effects of land prices on output largely disappears once bank lending is added as an explanatory variable, and concludes that the “pure” wealth effects are quite limited.

Among the factors not taken up as yet to explain depressed consumption we take up job insecurity. It is well known that the unemployment rate in Japan had been very low by international standard. During the 1980s, when the unemployment rate reached 10 percent in many EU countries, that in Japan remained 2 percent. The unemployment rate was traditionally low in Japan for several reasons. Thanks to bonus payments and the synchronized economy-wide wage settlements called the *Shunto* (Spring Offense), wages in Japan are believed to be more flexible than in other countries.<sup>4</sup> Furthermore, the necessary adjustment of labor is done through changes in working hours of workers rather than changes in the numbers of workers. On the supply-side, cyclical fluctuations in the labor force participation rate are large; In recessions, when the so-called “marginal” workers (typically female) lose jobs, they often get out of labor force rather than remain in the labor force and keep searching for jobs. These factors kept the unemployment rate from rising.<sup>5</sup> Even during the 1992–94 recession, the unemployment rate, though rising, did not reach 3 percent (Table 9.2).

However, the long stagnation during the 1990s has thoroughly changed the structure of the Japanese labor market. Most important, with the slogan of “restructuring,” firms are now ready to discharge workers. Table 9.2 shows that the number of involuntary job losers has been more than tripled between 1992 and 1999. In 1999, the unemployment rate in Japan finally became higher than the US counterpart. Until 5 years ago, nobody had expected that it would ever happen.

In the autumn of 1997, big financial institutions such as the *Hokkaido Takushoku Bank* and the *Yamaichi Security* went into bankruptcy. These events made an unmistakable announcement that the celebrated employment for life in Japan was

Table 9.2 Unemployment

|                            | Year |      |      |      |      |      |      |      |
|----------------------------|------|------|------|------|------|------|------|------|
|                            | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 |
| Unemployment rate (%)      | 2.2  | 2.5  | 2.9  | 3.2  | 3.4  | 3.4  | 3.9  | 4.8  |
| The unemployed (10,000)    | 142  | 166  | 192  | 210  | 225  | 230  | 277  | 339  |
| Involuntary job separation | 32   | 41   | 50   | 55   | 59   | 54   | 74   | 106  |
| Voluntary job separation   | 61   | 69   | 78   | 83   | 87   | 95   | 106  | 107  |
| New school leavers         | 6    | 7    | 9    | 11   | 13   | 12   | 26   | 30   |
| Others                     | 36   | 39   | 45   | 50   | 55   | 59   | 63   | 82   |

Source: Statistics Bureau, Management and Co-ordination Agency, *Monthly Report on the Labour Force Survey*.

Note

For 1998 and 1999, the figures are for March, not the annual average.

over. Understandably, job insecurity depressed consumption. In 1998, consumption actually fell. This unprecedented event can be well explained by a sharp rise in the unemployment, particularly involuntary unemployment. Nakagawa (1999) demonstrates that uncertainty surrounding the public pension system has also depressed consumption.

Besides the major factors such as fixed investment and consumption, there were other relatively minor but still important factors to explain the stagnation of the Japanese economy. For example, a sharp increase in imports during 1994–96 hindered the feeble economy from recovery. Imports are much more cyclical in Japan than in other countries such as the United States. However, an increase in imports during 1994–96 (the average growth rate 12 percent) was anomalous even by the Japanese standard; namely, the propensity to import sharply rose during the period.

Some economists such as McKinnon and Ohno (1997), in fact, attribute the stagnation of the Japanese economy to the high yen.<sup>6</sup> However, the appreciation of the yen from 240 per dollar (1985) to 120 (1988) was actually caused by high productivity growth in the Japanese export sector, and, therefore, followed the purchasing power parity (PPP) with respect to tradables (Yoshikawa 1990). Therefore, it is not plausible to regard the appreciation of the yen as the major cause for the long stagnation of the Japanese economy. In fact, as shown in Table 9.1, exports had been the most stable component of GDP throughout the 1990s except for 1998 when the Asian financial crisis rather than the appreciation of the yen hindered exports.

Having briefly seen the Japanese economy during the 1990s, we now turn to macroeconomic policies. We begin with fiscal policy.

### ***Fiscal policy***

Fiscal policy in the 1990s was in sharp contrast to that in the 1980s. In the fiscal year 1980, after two oil shocks during the 1970s, the budget deficits had become a serious problem; debt finance shared one-third of the budget, and the outstanding debt reached ¥70 trillion. Throughout the 1980s, the single objective of the Ministry of Finance (MOF) was to balance the budget. With the key phrase of the “minus ceiling,” the MOF effectively constrained expenditures. Thanks to an increase in tax revenues during the bubble-boom, the MOF’s goal had been basically achieved by 1990. As of 1990, the deficits/GDP ratio of Japan was lowest among major OECD countries (Figure 9.2); if the social security account is taken into account, the budget was actually in surplus.

However, as the recession deepened beginning 1992, the expansionary fiscal policy was called for, and with it deficits mushroomed. The deficit/GDP ratio had reached 10.9 percent by 1999, which is comparable to that of Italy at the beginning of the 1990s. The monotonous worsening of Japan’s budgetary position during the 1990s is indeed in sharp contrast to the trend observed for other OECD countries.

With such high costs, how do we assess the fiscal policy during the 1990s? Pessimists say that it was simply a failure because it did not produce any sustained

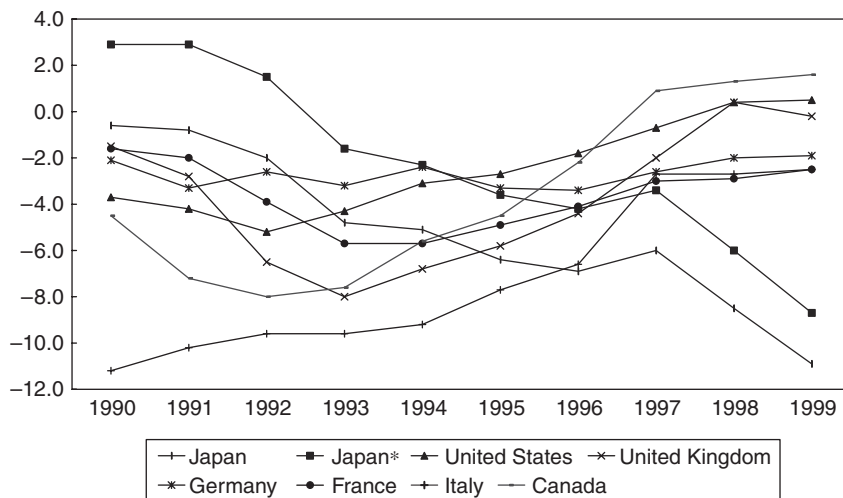


Figure 9.2 Deficit/GDP(%).

Source: OECD (1999). *Economics Outlook*, No. 65, June.

Note

Japan\* includes the social security account. Public deficit includes both the central government's and the local government's.

growth. The contribution of public expenditures to growth can be seen in Table 9.1. The table shows that fiscal expenditures sustained growth during 1992–93, and also in 1996. Without fiscal expansion, the Japanese economy would have almost surely suffered from the negative growth in 1993. Posen (1998) goes so far as to argue that the 1994–96 recovery was also generated by fiscal expansion. Posen may exaggerate the role of fiscal expansion in that fixed investment was clearly the most important factor to explain the 1995–96 recovery, and that a recovery of investment may not be directly linked to fiscal expansion. However, one can reasonably argue that without fiscal expansion during 1992–93, a prolonged recession with negative growth would have made the 1995–96 recovery impossible, and that in this sense fiscal expansion contributed to the 1995–96 recovery.

The 5 percent growth in 1996 made the MOF confident enough to pursue the holy goal of budgetary balance. Many economists observe that a rise in the consumption (value added) tax from 3 to 5 percent and other social insurance contribution amounting to ¥9 trillion, depressed consumption and thereby triggered the 1997–98 recession. The fiscal tightening was actually not confined to the revenues. Table 9.1 shows that public investment was drastically cut in 1997; its contribution changed from 0.8 percent for 1996 to –0.9 percent for 1997, and, therefore, a cut in public expenditures by itself lowered growth of real GDP by 1.7 percent. Fiscal tightening through both revenues and expenditures, contributed to the 1997–98 recession.

As of the year 2002, the pessimism prevails around fiscal policy. For one thing, the current deficit situation is so bad as to be unsustainable. The primary balance is in deficit. The outstanding public debt is ¥700 trillion (140 percent relative to GDP); this roughly amounts to ¥20 million per family of four, three times as high as its average annual income of ¥6 million.

The pessimism not only stems from the size of debts and deficits, but also from mounting doubt about efficiency and justice behind deficits. In every economy, the public finance involves transfers of income among households and firms. Transfers of income are, in fact, one of the major purposes of the public finance and, therefore, in itself there is nothing wrong about it. However, there is a broad consensus that aside from the size of deficits, there is a serious problem about the current situation of the public finance in Japan.

To understand the problems facing Japan, one can visualize the Japanese economy as a two-sector economy: one consisting of highly efficient manufacturing sector, and the other consisting of inefficient small firms and the self-employed, particularly in the nonmanufacturing sector including agriculture. The existing political system allows significant income transfers from the former to the latter through both public expenditures and taxes, and other social security contributions.<sup>7</sup> There is a broad consensus that the ¥100 trillion spent by the public sector during the 1990s contributed very little to raising profitability in the economy.

Kutter and Posen (2001) take efforts to show that the fiscal multiplier in Japan is 1.7. Most Japanese economists would agree that this figure is reasonable, but think that the size of the multiplier is not really the issue. If not full marks, there is no denying that fiscal policy *was* on the whole expansionary during the 1990s (Figure 9.2). The fiscal pessimism does not stem from the fear that the multiplier is small, but from the fact that fiscal expansion did not bring about sustainable growth. Even now, an increase in public expenditures surely raises GDP, but may not necessarily produce sustainable growth. Some say that if not, spend more. But until when? The debt/GDP ratio is currently 140 percent, and many economists question whether the deficits are sustainable.

### ***Monetary policy***

Monetary policy is widely believed to be responsible for the asset price bubbles during the late 1980s and the subsequent long stagnation during the 1990s.<sup>8</sup> According to this view, during the 1980s, low interest rates produced the asset price bubbles, and the high land prices, in turn, allowed the liquidity constrained firms to make excessive investment by way of an increase in the collateral values. For the same reason, but now to the opposite direction, the collapse of the asset market entailed the stagnation of investment during the 1990s. Though this “standard” view contains a bit of truth, it does not actually stand up to careful analyses.

There are actually a number of studies which demonstrate a significant relationship between real variables such as investment and real GDP on the one hand, and asset prices, land prices in particular, on the other. Since asset prices and

GDP went up and down broadly in tandem, these findings are not surprising. The problem is interpretation. Most of the analyses interpret their findings as indicating that changes in asset prices affected investment of financially constrained firms by way of changes in their collateral values; Ogawa and Suzuki (1998), for example, find land prices significant in their investment functions. Bayoumi (1999) also finds in his VARs that land price changes were an important factor behind the rise in the output gap over the bubble period and the subsequent decline.<sup>9</sup>

However, this is not exactly what happened in Japan during the late 1980s and the 1990s. During the bubble period, it was believed (falsely in retrospect) that land-intensive sectors, such as holiday resorts and office spaces in Tokyo, would command high profits in the near future. These (false) expectations made land prices explode, and *at the same time* induced firms to make land-intensive investment. Firms purchased land with money borrowed from banks, and banks, based on their expectations of higher land prices in the future, often allowed more than 100 percent (!) collateral values for land which firms just purchased. Therefore, theoretically, firms could borrow money from banks without any collaterals in advance to purchase land. This is very different from the standard story explained earlier, according to which an increase in the price of land which firms had owned *in advance* made it possible for the liquidity constrained firms to borrow more money to make desired investment. In fact, the ultimate cause of *both* a rise in land prices *and* an extraordinary surge in land-intensive investment was false expectations on future profitability of holiday resorts and office spaces in Tokyo. In short, misallocation of capital was the ultimate cause.

After the bubbles burst, the asset prices collapsed, and at the same time investment also fell. However, it is once again not self-evident that this fact suggests that a fall in the asset prices cut investment by way of a fall in the firms' collateral values. For example, investment of large firms and small firms fell during the 1992–94 recession roughly in the same magnitudes. Large firms do not finance their investment by borrowings from banks but rather by issuing bonds, and new equities in capital market. They are not financially constrained, and, therefore, the collateral story does not hold true for large firms at the outset. And yet, investment of large firms fell in the same magnitude as that of small firms. Meltzer (2001), and Hayashi and Prescott (2002) also express skeptical views against the significance of financial constraints. Thus, a careful study is necessary to determine how a fall in the asset prices affected investment during the 1990s.

Now, let us briefly review the record of monetary policy during the period. The call rate (the overnight money market rate), the most important instrument of monetary policy in Japan, was kept high at the level of 7.5 percent during 1990–91 (see Table 9.3). The stock price which reached ¥38,915 at the end of 1989 had fallen below ¥15,000 by 1992. The land price also started falling the same year. The economy was in deep recession in 1992. The BOJ had already lowered the discount rate from 6.0 to 5.5 percent in July 1991. Through five successive cuts within a year, it had fallen to 3.25 percent by July 1992.

Despite the further cuts in the interest rates during 1993–94, the economy hardly revived. The annual growth rate of money supply ( $M2 + CD$ ) which was

Table 9.3 Interest rates

|      | (1)<br>Call rate<br>(%) | (2)<br>The 10-year<br>government<br>bonds<br>(%) | (3)<br>The long<br>lending rate<br>(%) | (4)<br>The term<br>premium<br>(2) - (1)(%) | (5)<br>The private<br>risk<br>premium<br>(3) - (2)(%) |
|------|-------------------------|--|--|--|---|
| 1990 | 7.4                     | 6.8  | 8.1                                    | -0.6                                       | 1.3   |
| 1991 | 7.5                     | 5.8  | 6.9                                    | -1.7                                       | 1.1   |
| 1992 | 4.7                     | 4.8  | 5.5                                    | 0.1  | 0.7   |
| 1993 | 3.1                     | 3.5  | 3.5                                    | 0.4  | 0.0   |
| 1994 | 2.2                     | 4.6  | 4.9                                    | 2.4  | 0.3   |
| 1995 | 1.2                     | 2.9  | 2.6                                    | 1.7  | -0.3  |
| 1996 | 0.5                     | 2.8  | 2.5                                    | 2.3  | -0.3  |
| 1997 | 0.5                     | 2.0  | 2.3                                    | 1.5  | 0.3   |
| 1998 | 0.3                     | 1.0  | 2.2                                    | 0.7  | 1.2   |
| 1999 | 0.03                    | 1.8  | 2.3                                    | 1.8  | 0.5   |

12 percent in 1990, had fallen to zero by 1992. Since a sharp decline in bank lending was basically responsible for this fall in money growth, the question was why this sharp decline in bank lending occurred. Bayoumi (1999) interprets his finding that bank lending is more important than land price itself in explaining output gap as supporting the financial disintermediation hypothesis. He argues that “undercapitalized banks responded to falling asset prices and other balance sheet pressures by restraining lending to maintain capital adequacy standards.” Some economists in Japan suggested the same, and argued that the credit crunch was responsible for the weak investment. However, as shown in Table 9.3, during 1991–93, the interest rates kept declining. If the credit crunch had occurred, the interest rate would have risen. Therefore, the major cause of a sharp decline in bank lending during 1991–93 was a downward shift of demand curve (a fall in demand for bank lending) rather than an upward shift of supply curve (the credit crunch or a cut in supply of bank lending). As shown in Figure 9.1, the diffusion index of “Lending Attitude of Financial Institutions” of the BOJ Tankan (Short-term Economic Survey of Corporations) indeed shows that responding to successive cuts in the call rate, banks’ lending attitudes improved during 1992–95. Gibson (1995) also concludes that, although a firm’s investment is sensitive to the financial health of its main bank, the effect of the problems in the banking sector on aggregate investment during 1991–92 was small. The private risk premium defined as the difference between the long lending rate and the 10-year government bond rate, also declined during the period (Table 9.3). In summary, the effects of a fall in land prices and consequent bad loans on bank lending was not significant during the 1992–94 recession. By looking at bank level data, Woo (1999) draws the same conclusion.

The economy recovered during 1994–96. With easy monetary policy, the call rate had kept declining. However, the long-term interest rate had stopped declining



to raise the term premium (Column (4) of Table 9.3). This is actually something one should expect when the economy is on the road to recovery. In fact, the growth rate of real GDP reached the respectable 5.1 percent in 1996. Facing this recovery, the MOF decided to tighten budget for 1997.

Meanwhile, a fall in the stock price created a serious problem for the Japanese banks to meet the BIS capital adequacy standards. The new legislation in April 1996 allowed the authority to step in if a bank were likely to fail to meet the BIS requirement. This new policy regime was to start in April 1998. In March 1997, the MOF made clear the new capital adequacy requirements. Unfortunately, this basically correct policy action was not well-timed. Desperate to raise the capital–asset ratio within a short period of time, banks squeezed their assets by cutting lendings. In the autumn, the bankruptcy of big financial institutions such as the *Yamaichi Security*, and the *Hokkaido Takushoku Bank* triggered the real credit crunch. Figure 9.3 shows that the *Tankan* DI of lending attitude of banks abruptly worsened during this period despite the BOJ’s efforts to ease money.<sup>10</sup>

What was the impact of this credit crunch? Motonishi and Yoshikawa (1999) assess the macroeconomic magnitude of the credit crunch by estimating investment functions separate for large and small firms in both the manufacturing and non-manufacturing sectors. The explanatory variables are from the BOJ’s *Tankan*, which has the diffusion indices for business conditions and for credit constraints facing firms shown in Figure 9.3. As one might expect, they find that credit constraints are not significant for investment of large firms, but are significant for small firms, particularly in the non-manufacturing sector. They conclude that the credit crunch, by way of depressing investment of financially constrained firms, lowered the growth rate of real GDP by 1.3 percent during 1997–98. Their analysis takes into account only fixed investment, but actually, two-thirds of bank lendings is for running costs and inventory investment rather than fixed investment. We can, therefore, reasonably argue that at the minimum, the credit crunch

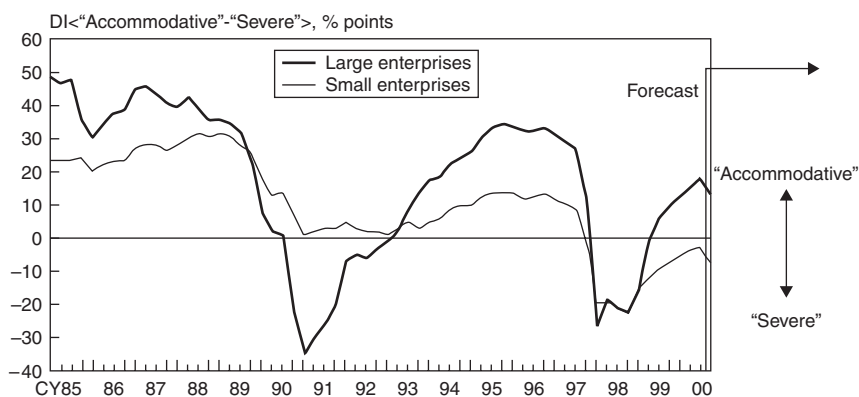


Figure 9.3 Lending attitude of financial institutions.

Source: Bank of Japan, “*Tankan* Short-term Economic Survey of Enterprises in Japan.”

accounts for one half of  $-2.5$  percent growth of real GDP in 1998. The low interest rates were of no help in the credit crunch.

The renewed recession forced the BOJ to lower interest rates further. The call rate became 0.3 percent in 1998, and finally 0.03 percent in 1999. With transaction costs, 0.03 percent effectively means zero-interest rate, the absolute minimum for nominal interest rate. The BOJ, thus, lost the instrument for traditional monetary policy.

Economists then started discussing how monetary policy could possibly affect the economy facing zero-interest rate. Krugman (1998) argues that with zero nominal interest rate, the Japanese economy is caught in the *liquidity trap*, and that the BOJ must create expected inflation to lower the real interest rate to get the economy out of this trap. How to generate inflationary expectations? Increase money supply! The answer seems so obvious. Is this policy effective and/or feasible?

In Krugman's model and the similar proposals for lowering the real interest rate by way of generating inflationary expectations, demand is assumed to be interest elastic. However, in the Japanese economy during the 1990s, a major problem facing monetary policy is low interest elasticity of demand, in particular, investment. Indeed, the Japanese economy was not trapped in the zero-interest rate from the beginning. Table 9.2 shows that in 1992, the call rate was still 4.7 percent, and that it had been lowered to zero by 1999. Low interest rates, in fact, together with preferential taxes, pushed housing investment, but did not revive fixed investment. Based on the interest elasticity for the US economy, Krugman suggests that to fill the 5 percent GDP gap, the 3–3.75 percent inflationary expectations would be enough. However, with low interest elasticity which appears to hold for the Japanese economy during the 1990s, the necessary expected inflation will easily become as high as 30 percent!

Beyond that, in Krugman's model, the "future" is not in liquidity trap, and the simple quantity theory of money is assumed to hold in the future: price is proportional to money supply in the future. Thus, in theory it is easy for the Central Bank to generate the expected inflation despite the absence of the current actual inflation. The only thing the Central Bank must do is to persuade the public *now* to believe that money supply will increase enough to generate inflation *in the future*. However, in reality, the most important factor to determine the expected inflation is the current *actual* inflation. Whatever the policy actions of the Central Bank, who would believe in inflation so easily in the economy actually facing deflation? As long as we believe in the Phillips curve wisdom, namely the story that only high pressure in the real economy produces inflation, then we are likely to be led to the catch 22 in our effort to cure recession by generating inflationary expectations!

Blanchard (2000: 190–3) states that "the Phillips curve wisdom remains largely true in modern treatments of the determination of prices, wages, and output: If output is above its natural level, then we are likely to see inflation increase." Despite such a remark, he is optimistic that the BOJ can generate inflationary expectations to lower the real interest rate; "All that is needed is to convince markets that money growth will be cumulatively higher over the next 10 years by

20 percent.”<sup>11</sup> He notes that monetary policy affects long-term interest rates “mostly—entirely?—through its effects on expectations,” and continues that “the only thing specific to Japan today is that emphasis is not on changes in future expected nominal interest rates, but on the expected future price level. This is not an essential difference.” We believe that there is an essential difference in the role of expectations in the determination of prices in goods and financial markets. For this reason, facing the zero interest bound, we take depreciation of the yen as a more plausible and effective transmission mechanism than a decline in the real interest rate (see Meltzer (2001) and Svensson (2001)).

Anyway, a large increase in the supply of money coupled with inflation targeting is such a popular solution to the problems faced by the Japanese economy today. Abroad, proponents are, among others, Krugman (1998), Bernanke (2000), Blanchard (2000), and Rogoff (2002).

We noted earlier that consumption and investment stagnated so long despite the BOJ’s continuing efforts to ease money. In the next section, we present a theoretical analysis which suggests that the problem faced by Japan may not be so easily cured by the readymade textbook prescription.

### The model

In this section,<sup>12</sup> we present a theoretical model which shows the importance of *uncertainty* as a hindrance to the economy. The model is highly abstract, but is still useful in understanding the Japanese economy.

Suppose that there are  $\mathcal{N}$  economic agents in the economy. There are  $K$  possible levels of production. Each agent, as a result of respective optimization, chooses one of  $K$  levels. Without loss of generality, we can assume that  $K$  is just two, “high” and “low”. This assumption simplifies our presentation. The “high” level of production is denoted by  $y^*$  whereas the “low” level by  $y$  ( $0 < y < y^*$ ).

If the number of economic agents which produce at the high level,  $y^*$ , is  $n$  ( $n = 1, \dots, \mathcal{N}$ ), then total output in the economy or GDP is

$$Y = ny^* + (\mathcal{N} - n)y \tag{1}$$

We denote the share of economic agents which produce at  $y^*$  by  $x$ .

$$x = \frac{n}{\mathcal{N}} \quad (n = 1, \dots, \mathcal{N}) \tag{2}$$

Using  $x$ , we can rewrite  $Y$  as follows:

$$Y = \mathcal{N}[xy^* + (1 - x)y] \tag{3}$$

When  $\mathcal{N}$  is large,  $x$  can be regarded as a real number ( $0 \leq x \leq 1$ ). Equation (3) shows that  $Y$  and  $x$  correspond to each other. While  $x$  fluctuates between 0 and 1, so does  $Y$  between  $\mathcal{N}y$  and  $\mathcal{N}y^*$ .

Changes in  $x$  are assumed to follow a particular jump Markov process, known as the birth-death process. For a short period of time  $\Delta t$ , there are three possibilities; namely, no economic agent changes its production level, or one either raises or lowers its production level. This property is similar to the Poisson process, and is very robust in continuous time models. The process is then characterized by two transition rates, one from state  $y$  to  $y^*$  and the other from  $y^*$  to  $y$ .

The probability that one economic agent producing at the low level,  $y$  raises its production to high production level  $y^*$ , naturally depends on the number of agents producing at  $y$ ,  $\mathcal{N}(1 - x)$ . Similarly, the transition rate from  $y^*$  to  $y$  depends on  $\mathcal{N}x$ .

Moreover, transition rates are assumed to be state-dependent in that  $\mathcal{N}(1 - x)$  and  $\mathcal{N}x$  are modified by  $\eta_1(x)$  and  $\eta_2(x)$ , respectively. Specifically, the transition rate from  $y$  to  $y^*$ ,  $r$  is

$$r = \lambda \mathcal{N}(1 - x) \eta_1(x) \quad (\lambda > 0) \quad (4)$$

and, the transition rate from  $y^*$  to  $y$ ,  $q$  is given by

$$q = \mu \mathcal{N}x \eta_2(x) \quad (\mu > 0) \quad (5)$$

The transition rates  $r$  and  $q$  depend not only on the number of economic agents in each state, but also on  $\eta_1(x)$  and  $\eta_2(x)$ .  $\eta_1(x)$  and  $\eta_2(x)$  mean that *the optimal strategy taken by each agent depends on the state of the economy,  $x$  or  $Y$* . For example, equation (4) means that a switch of strategy by an economic agent from “bear” who finds  $y$  as optimal, to “bull” who finds  $y^*$  as optimal depends on the share of bulls. Equation (5) means that the same is true for a switch of strategy from  $y^*$  to  $y$ .

Here,  $\eta_1(x)$  and  $\eta_2(x)$  are defined as

$$\eta_1(x) = \zeta^{-1} e^{\beta g(x)} \quad (\beta > 0) \quad (6)$$

$$\eta_2(x) = 1 - \eta_1(x) = \zeta^{-1} e^{-\beta g(x)} \quad (7)$$

$$\zeta = e^{\beta g(x)} + e^{-\beta g(x)} \quad (8)$$

$\zeta$  simply makes sure that the sum of  $\eta_1(x)$  and  $\eta_2(x)$  is equal to one as it must be. At first sight, the earlier equations may look arbitrary or even odd. However, they are actually quite generic. The Appendix explains how naturally equations (6) and (7) arise in microeconomic models of choice under uncertainty.

The function  $g(x)$  in (6) indicates how advantageous a switch of strategy from bear to bull is. The greater the  $g(x)$ , the more advantageous is a switch from bear to bull, and vice versa. We assume that  $g(x)$  becomes zero at  $\bar{x}$ . Note that at  $\bar{x}$ ,  $\eta_1(\bar{x})$  and  $\eta_2(\bar{x})$  are both  $\frac{1}{2}$ , and, therefore that a switch from  $y$  and  $y^*$ , and that from  $y^*$  to  $y$  are equally probable. We assume that  $g(x)$  has a stable critical value  $\bar{x}$  as shown in Figure 9.4.

Obviously,  $g(x)$  function plays an important role. We note that most of standard economic analyses can be interpreted as shifts of this  $g(x)$  function in our present analysis. Take the IS/LM analysis, for example. Suppose that a decline in

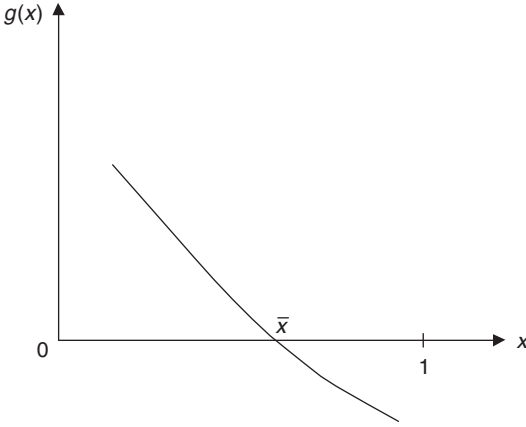


Figure 9.4  $g(x)$  function.

profitability made the IS curve shift down. GDP or  $Y$  declines. This situation corresponds to the case where given  $x$ , economic agents now find more advantageous to switch from bull to bear, namely,  $g(x)$  function shifts down to the left as shown in Figure 9.5(a). The stable critical point moves to the left accordingly. Next, suppose that the authority lowered the interest rate to fight against this recession. The LM curve moves downward to the right leading  $\mathcal{I}$  to rise. This now corresponds to the case where thanks to the expansionary monetary policy, given  $x$ , economic agents find it more advantageous to switch from bear to bull than otherwise. The  $g(x)$  function shifts up to the right as shown in Figure 9.5(b).

The other important parameter in transition rates is  $\beta$ . The Appendix shows that  $\beta$  in equations (6) and (7) is a parameter which indicates the degree of uncertainty facing economic agents. Suppose, for example, that the payoff facing agent is normally distributed. Then  $\beta$  is simply the inverse of its variance. Thus, when the degree of uncertainty rises,  $\beta$  declines, and vice versa. In the limiting case, when  $\beta$  becomes zero, both  $\eta_1(x)$  and  $\eta_2(x)$  become  $\frac{1}{2}$ . In this case, uncertainty is so great that economic decisions become equivalent to tossing a coin.

Now, the share of bulls,  $x$  changes stochastically, and so does GDP (recall equation (3)). Specifically, it follows the jump Markov process with two transition rates (4) and (5). Denote the expected value of  $x$  by  $\phi$ :

$$\phi = E(x) \tag{9}$$

Then  $\phi$  follows the following ordinary differential equation (note that  $\phi$  is not stochastic)<sup>13</sup>

$$\dot{\phi} = (1 - \phi)\eta_1(\phi) - \phi\eta_2(\phi) \tag{10}$$

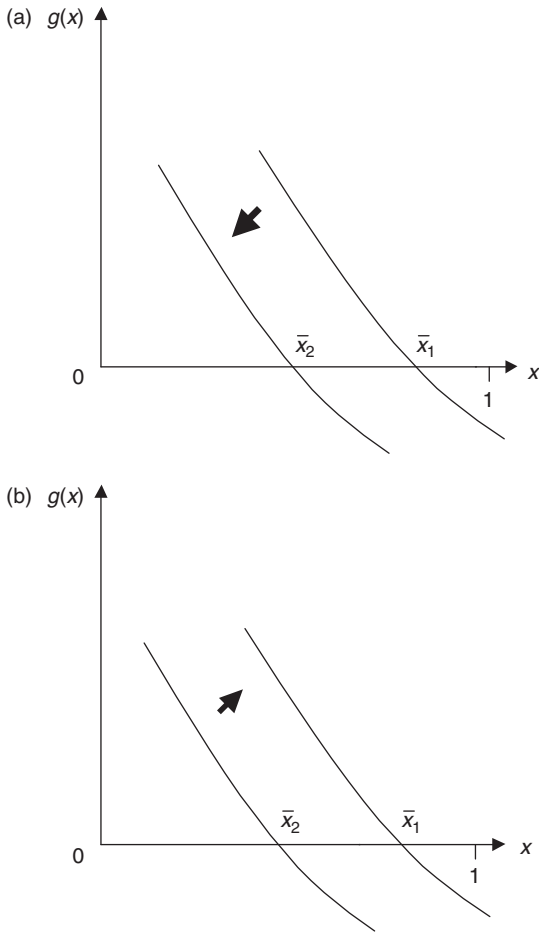


Figure 9.5 Shifts of  $g(x)$  function: (a) Downward shift; (b) Upward shift.

The steady state of equation (10) is given by

$$\frac{\eta_1(\phi)}{\eta_2(\phi)} = \frac{\phi}{1 - \phi} \tag{11}$$

From equations (6) and (7), we derive that this equation is equivalent to

$$2\beta g(\phi) = \log\left(\frac{\phi}{1 - \phi}\right) \tag{12}$$

We observe that when there is little uncertainty, namely  $\beta$  is very large, equation (12) becomes equivalent to

$$g(\phi) = 0 \tag{13}$$

Thus, when there is little uncertainty (large  $\beta$ ), the expected value of  $x$ ,  $\phi$  is equal to the zero of  $g(x)$  function, that is  $\bar{\phi}$  which satisfies

$$g(\bar{\phi}) = 0 \tag{14}$$

This  $\bar{\phi}$  is the unique stable equilibrium which satisfies  $g'(\phi) < 0$ , namely a critical point  $\bar{x}$  in Figure 9.4. In this case,  $x$  changes stochastically, but spends most of the time in the neighborhood of  $\bar{\phi}$ . Accordingly, GDP fluctuates stochastically but spends most of the time in the neighborhood of

$$Y = N[\bar{\phi}y^* + (1 - \bar{\phi})y] \tag{15}$$

As we explained it earlier with respect to  $g(x)$  function, the standard analyses hold without any problem in this case. If policy makers find the current average level of  $Y$  too low, for example, then they can raise fiscal expenditures or lower the interest rate. These policies would shift  $g(x)$  function upward to the right as shown in Figure 9.5(b). The expected value of  $Y$  would increase since in this case of low uncertainty (large  $\beta$ ), it is basically determined by the zero of  $g(x)$  function (equation (14)).

When the degree of uncertainty rises, however, the Kuttner–Posen (2001: 96) proposition that the stabilization policy framework of the mainstream textbooks applies does not hold. There are several reasons. First, as uncertainty rises and  $\beta$  gets small, there is a possibility that multiple equilibria emerge, and that the economy may be trapped into a “bad” equilibrium. Second, when the degree of uncertainty is high, the response of the economy to any policy action *necessarily* becomes small, namely standard macroeconomic policies become less effective.

To explain these points, it is useful to introduce the *potential* function. It is given by

$$U(x) = -2 \int^x g(y) dy - \frac{1}{\beta} H(x) \tag{16}$$

The function  $g(y)$  and  $\beta$  are the same as the ones in equations (6) and (7), and  $H(x)$  is the Shannon entropy

$$H(x) = -x \ln x - (1 - x) \ln(1 - x) \tag{17}$$

It would be necessary to explain  $H(x)$ . Recall that each of  $N$  economic agents faces a binary choice of being either bull or bear.  $H(x)$  is nothing but the logarithm

of binomial coefficient  ${}_N C_n$ , namely the number of cases where  $n$  out of  $N$  agents are bulls. Using the Stirling formula that  $\log N! \cong N(\log N - 1)$ , we obtain

$$\begin{aligned} \log {}_N C_n &= \log \left[ \frac{N!}{(N-n)!n!} \right] \\ &= N \left[ -\left(\frac{n}{N}\right) \log \left(\frac{n}{N}\right) - \left(1 - \frac{n}{N}\right) \log \left(1 - \frac{n}{N}\right) \right] \\ &= NH(x) \end{aligned}$$

The function  $H(x)$  expresses the combinatory aspect of our problem in which a large number of economic agents *stochastically* make binary choices. It is this combinatory aspect that standard economic analysis entirely ignores, and yet that plays a crucial role in the analysis of any system, either physical or social, consisting of a large number of entities.

Let us keep this in mind, and go back to the analysis of the expected value of  $\mathcal{I}$ . The expected value of  $x$ ,  $\phi$  which determines the expected value of  $\mathcal{I}$ , obeys ordinary differential equation (10). Now, it is easy to see that locally stable critical points of this dynamics given by equation (10) are local minima of the potential function (16):

$$U'(\phi) = -2g(\phi) - \frac{1}{\beta}H'(\phi) = -2g(\phi) + \frac{1}{\beta} \log \left( \frac{\phi}{1-\phi} \right) = 0 \quad (18)$$

When  $\beta$  is large (little uncertainty),  $U'(\phi) = 0$  is basically equivalent to  $g(\phi) = 0$ , and, therefore, the potential function has a unique minimum. The standard textbook results hold.

When  $\beta$  is small, however, the expected value of  $x$ ,  $\phi$  is not the zero of  $g(\phi)$ , but is determined by both  $g(\phi)$  and  $H'(\phi)\beta$ . This should be clear from equation (18). In this case, several problems arise which make standard macroeconomic policies less effective than in the case where there is little uncertainty (large  $\beta$ ). We take up two issues in the following paragraphs.

### ***Multiple equilibria***

Suppose that  $g(x)$  function has multiple critical points as shown in Figure 9.6. Points  $a$ ,  $c$  are unstable whereas point  $b$  is stable. The stable equilibrium is unique. When uncertainty is insignificant (large  $\beta$ ), the potential function has a unique stable equilibrium. As explained earlier, this unique stable equilibrium is determined by  $g(\phi) = 0$ . The dynamics in this case is illustrated in Figure 9.7(a). In this case, monetary policy is surely expected to affect the equilibrium. When the real interest rate is lowered, for example, more economic agents would find a switch from “bear” to “bull” more advantageous than otherwise; namely the function  $g(x)$  changes when the interest rate is lowered in such a way that  $g(x)$  is greater for any  $x$  than previously. Therefore, the stable equilibrium  $\phi$  which satisfies  $g(\phi) = 0$  as



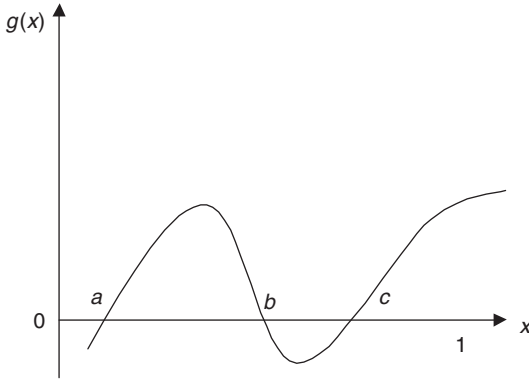


Figure 9.6  $g(x)$  with multiple zero.

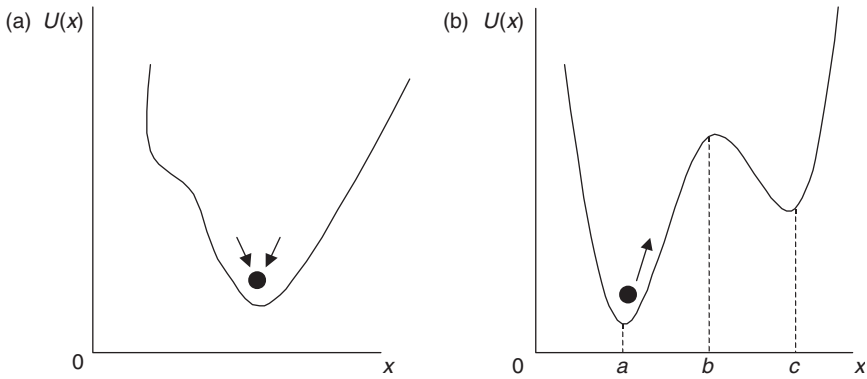


Figure 9.7 The shape of potential function and fluctuations of the economy.

shown in Figure 9.4 gets large, and GDP rises accordingly. If the nominal interest rate remains unchanged, a rise in inflationary expectations would bring about the same result.

When the degree of uncertainty facing economic agents rises (small  $\beta$ ), however, the same story does not hold. Although  $g(x)$  has a *unique stable* equilibrium,  $U'(\phi)$  may have *multiple stable* equilibria. In that case, the economy may be trapped into a “bad” equilibrium (point  $a$  in Figure 9.7(b)). In this case, the fundamental problem is uncertainty or small  $\beta$ . Even if we change the function  $g(x)$  by lowering the real interest rate, it dose not really help; monetary policy may affect the bad equilibrium, but does not help the economy escape from it.

Note, in passing, that in this model, the economy stochastically fluctuates, and that unlike in deterministic models with multiple equilibria, the problem of *equilibrium selection* does *not* arise. That is, Krugman’s (1991) problem of “history versus expectations” does not arise in our stochastic approach. Although monetary

policy is not really helpful, the economy stochastically escapes from the bad equilibrium moving to the good equilibrium. The problem is that it may take an unbearably long period.

The dynamics in the neighborhood of an equilibrium can be analysed in the following way. Suppose that  $\phi^*$  is a stable equilibrium; namely  $\phi^*$  satisfies equation (18) or  $U'(\phi^*) = 0$ . Since  $\phi$  follows the differential equation (10), we can easily find that the dynamics of the deviation  $\phi$  from  $\phi^*$ . That is,  $\delta\phi = \phi - \phi^*$  obeys the following equation:

$$\frac{d}{dt}(\delta\phi) = \beta\phi^*(1 - \phi^*) \left. \frac{d^2U}{dx^2} \right|_{x=\phi^*} \quad (19)$$

Thus, when  $\beta$  is small or the potential function is flat, that is,  $d^2U/dx^2$  is small at the bottom, the move of  $\phi$  toward  $\phi^*$  is slow, and vice versa.

### ***The effectiveness of macroeconomic policies***

Suppose once again that  $g(x)$  function has a unique stable equilibrium as shown in Figure 9.4. Further, for the sake of definiteness, consider the case where an “expansionary” policy such as lowering the real interest rate was taken. This is equivalent to an upward shift of  $g(x)$  function as shown in Figure 9.5(b); namely, we change  $g(x)$  in transition rates (6) and (7) to

$$g(x) + h(x)$$

where

$$h(x) > 0, \quad h'(x) \cong 0$$

With this change in  $g(x)$  function,  $\phi^*$  which satisfies equation (18) or  $U'(\phi^*) = 0$ , changes to  $\phi^* + \delta\phi$ . By definition,  $\phi^* + \delta\phi$  satisfies

$$-2[g(\phi^* + \delta\phi) + h(\phi^* + \delta\phi)] + \frac{1}{\beta} \log\left(\frac{\phi^* + \delta\phi}{1 - \phi^* - \delta\phi}\right) = 0 \quad (20)$$

This can be solved out to be

$$\delta\phi = 2h(\phi^*) \left/ \left[ \frac{1}{\beta} \left( \frac{1}{\phi^*(1 - \phi^*)} \right) - 2g'(\phi^*) \right] \right. > 0 \quad (21)$$

Here, we used the assumptions  $h'(x) = 0$  (no particular bias in policy) and  $g'(\phi^*) < 0$  ( $\phi$  is a stable equilibrium).

Equation (21) shows how equilibrium  $\phi$ , which determines the expected value of  $\mathcal{Y}$ , responds to a change in function  $g(x)$ , here represented by  $h(\phi^*) > 0$ . To put

it simply, it shows the effectiveness of macroeconomic policy. Since we are considering an expansionary policy,  $\delta\phi$  is positive, or  $\phi^*$  rises. However, the extent of an increase in  $\phi^*$  depends crucially on  $\beta$  or uncertainty. When uncertainty is negligible,  $\beta$  is so large that  $\delta\phi$  approaches its maximum value,  $-h(\phi^*)/g'(\phi^*) > 0$ . On the other hand, as the degree of uncertainty rises ( $\beta$  declines),  $\delta\phi$  gets smaller and smaller approaching zero. This result is quite generic. When uncertainty rises, the effectiveness of macroeconomic policies which affect agents' economic incentives *necessarily* weakens. In the limit, the economy facing infinite uncertainty is trapped into a chaos in which no economic policy works (or, in fact, no economic decision makes sense).

**Some suggestive evidences**

The model in the previous section suggests that when the degree of uncertainty rises, the effectiveness of macroeconomic policies weakens. In this section, we provide some evidences which suggest that the degree of uncertainty indeed appears to have risen in the Japanese economy during the 1990s.

GDP is, of course, the most important macroeconomic variable, and, therefore, is expected to significantly affect the economic perception of agents. Therefore, first we measure the degree of uncertainty using the GDP growth rates. Figure 9.8 shows the coefficient of variation (standard deviation divided by mean) of the quarterly GDP growth rates for 5 years (20 quarters). For the sake of comparison, we also show it for the United States. We observe that the coefficient of variation has, in fact, risen extraordinarily in Japan during the 1990s, especially in the latter half.

We also estimate AR(2) for quarterly GDP by applying the rolling regression. Uncertainty is now measured by the standard error of regressions (SER).

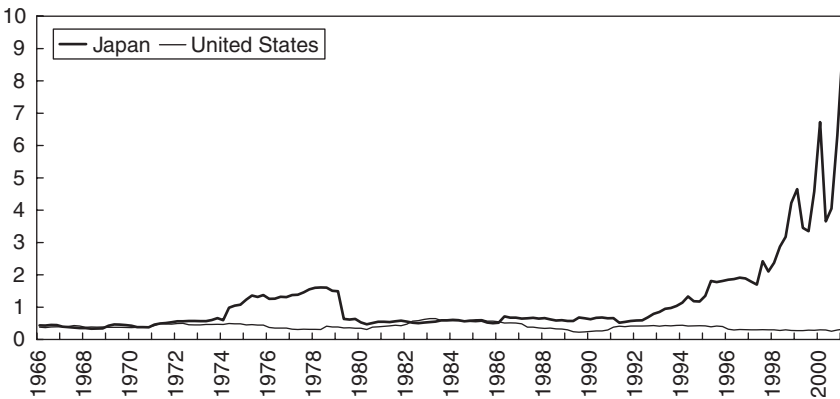


Figure 9.8 CV of growth rate of GDP for Japan and United States.

Note

CV: Standard deviation/Mean of quarterly GDP growth rates over the past 5 years.

Specifically, we estimate the following equation for the sample period 1961:1–2001:1,

$$\Delta \ln Y_t = \alpha_0 + \alpha_1 \Delta \ln Y_{t-1} + \alpha_2 \Delta \ln Y_{t-2} + u_t$$

where  $Y_t$  is real GDP (quarterly, seasonally adjusted).

Figure 9.9 shows the rolling SER divided by the mean. Again, we show it for the United States for the sake of comparison. A glance at Figure 9.9 reveals that SER/Mean has risen extraordinarily in Japan during the 1990s. Figures 9.8 and 9.9 suggest that the degree of uncertainty has, in fact, risen in Japanese economy.

So far, for the economy as a whole in what follows, we take up some micro-economic data for household and firm, respectively. The growth rates of real wages for 1980–2001 are shown in Figure 9.10. It shows that real wages in 1990s are more volatile than in 1980s; The standard deviation for 1986:4–91:1 is 0.73 while that for 1991:2–2001:4 is 1.10. Consistently, Figure 9.11 shows that a change in the index of consumption has also become more volatile in the 1990s: The standard deviation for 1976:1–89:12 is 1.7 while that for 1990:1–99:12 is 2.3. Figures 9.10 and 9.11 both suggest that households face greater uncertainty in the 1990s than in the previous period.

The same proposition applies to firms as well. The Cabinet Office (formerly, the Economic Planning Agency) compiles the survey every year, asking firms how they predict the GDP growth rates for the next year, next 3 years, and 5 years, respectively. The frequency is reported for each class by 1 percent. The share of the modal class in the survey is shown for each year in Figure 9.12. The share of the modal class can be interpreted as indicating how broad is consensus about future prediction; If the share is high, there is a broad consensus on growth rate in the future, and vice versa.

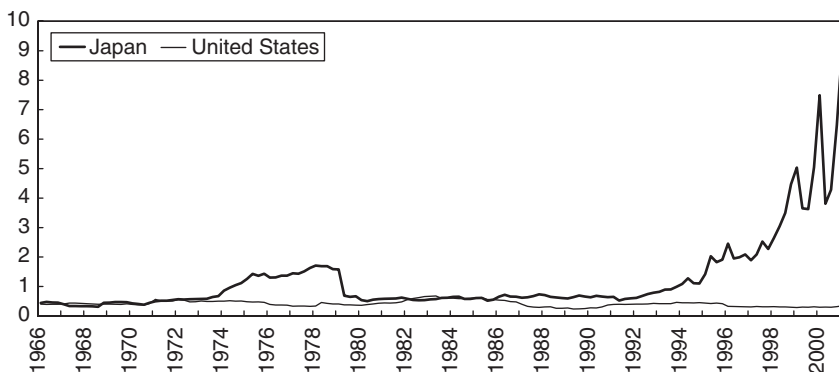


Figure 9.9 SER/Mean of GDP growth rate for Japan and United States.

Note

SER = Standard error of regression of AR(2) (estimated over the past 5 years) of real GDP growth rate.

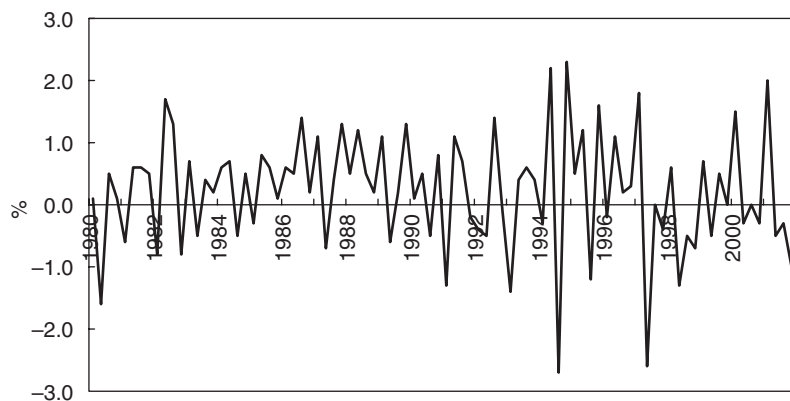


Figure 9.10 Growth rate of real wage.

Source: Ministry of Health, Labor, and Welfare, *Monthly Labour Survey*.

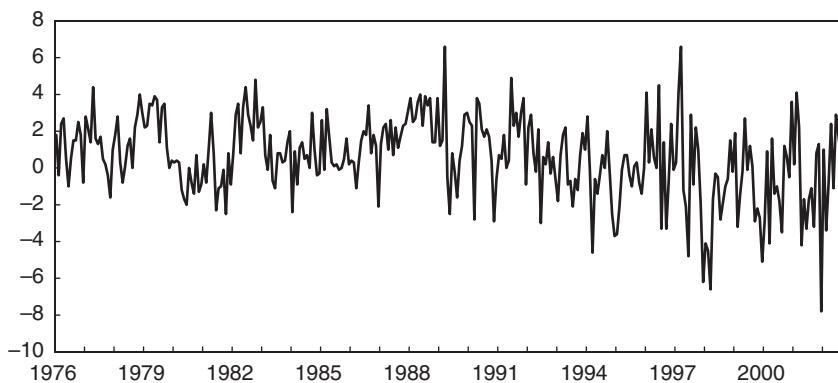


Figure 9.11 The change in the index of consumption.

Source: Ministry of Public Management, Home Affairs, Posts and Telecommunications, *Family Income and Expenditure Survey*.

Note

The change compared with the same month of the previous year.

One would expect that the longer the time horizon, the greater the variance of predictions. In this survey, therefore, less consensus is expected for the 3- and 5-year predictions than for the 1-year prediction. Such a result is indeed obtained for the 1980s (Figure 9.12). However, for the 1990s, a broad consensus is not obtained even for the 1-year prediction. In fact, for the latter half of the 1990s, the longer the time horizon of prediction, the broader is the consensus. Moreover, the share of the modal class tends to decrease. In the sense that the prediction made by firms widely varies, firms appear to face greater uncertainty during the 1990s than in the previous period.

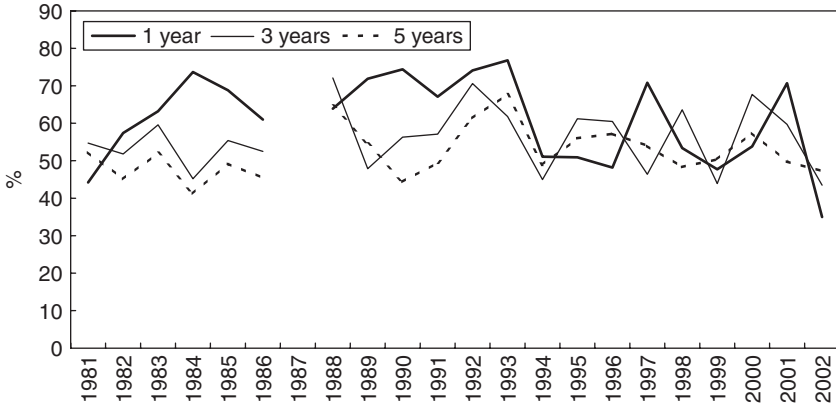


Figure 9.12 The share of the modal class.

Source: The Cabinet Office (the former Economic Planning Agency), *The questionnaire about corporate activity*.

Note

The data in 1987 is missing.

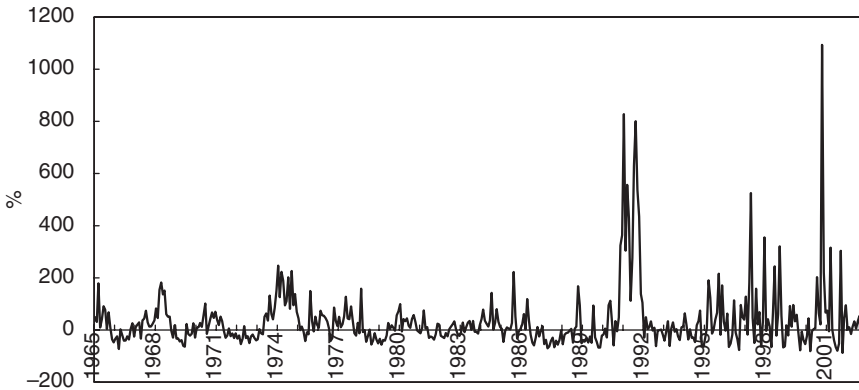


Figure 9.13 The increasing rate of the total liabilities.

Source: Tokyo Shoko Research, Ltd., *Business Failure News (Monthly)*.

Finally, we present data on business failures. Figure 9.13 shows the total liabilities which bankrupt firms bear. It suggests that bankruptcies of large corporations have increased in the 1990s.

### Conclusions

Although there was a mini-recovery during 1995–96, the average growth rate of the Japanese economy during the 1990s was a mere 1 percent. With historically

low interest rates and a series of fiscal stimuli, the economy did not really revive. What is the fundamental cause of this long stagnation? Can monetary policy overcome the zero interest bound by generating inflationary expectations?

Various explanations have, in fact, been proposed. One very influential view focuses on a demographic trend. The Japanese economy is rapidly aging. The population is expected to peak in 2004 and decline by 6.8 percent in the next 25 years. The share of those aged 65 and older in total population will become one-third which is almost twice as high as the current level. The labor force, on the other hand, is expected to decline by 0.6 percent per year for the next 25 years, namely during 2000–25. Because of the labor force decline, growth rate of the economy is bound to decline, and anticipating this trend, firms start adjusting their capital stock by curbing investment. According to this view, with a declining labor force, the potential growth rate of the Japanese economy declined from 4 percent to 2 or 1.5 percent.<sup>14</sup> This is the basic reason why the growth rate remained 1 percent despite such expansionary fiscal and monetary policies. The 1998 *White Paper* of the Japanese government endorsed this view (Economic Planning Agency 1998).

Facing a rapid aging and declining labor force, is the Japanese economy bound to concede a growth rate as low as 1 percent? The standard growth accounting, however, shows that to account for the growth of the Japanese economy, labor is a relatively minor factor. One cannot explain high growth during the 1960s nor a fall in the growth rate in the 1970s by labor. Growth must be basically explained by capital and total factor productivity (TFP). Beyond that, economists find that more than a half of salaries or wages is remuneration for human capital rather than “raw labor.” A declining labor force means a declining number of heads, but does not necessarily mean a parallel decline in human capital (Table 9.4). Therefore, an apparently persuasive thesis that declining labor force necessarily lowers economic growth is, actually, too simple.

Hayashi and Prescott (2002) focus on TFP. They conclude that the fundamental problem facing the Japanese economy is a low productivity growth rate. They argue that the old Solow (1956) growth theory, treating TFP as exogenous, accounts well for the Japanese lost decade of growth. It is certainly true that the TFP stagnated in Japan during the 1990s. However, it is well known that the measured productivity reflects, at least in part, the performance of the economy

Table 9.4 Growth accounting

|            | 1960s (%) | 1970s (%) | 1980s (%) | 1990s (%) |
|------------|-----------|-----------|-----------|-----------|
| Capital    | 6.9       | 3.8       | 2.8       | 1.9       |
| Labor      | 0.4       | 0.0       | 0.4       | -0.3      |
| TFP        | 3.7       | 0.7       | 1.0       | 0.0       |
| GDP growth | 11.1      | 4.5       | 4.2       | 1.6       |

Source: MITI, *White Paper*, 1998.

Note

TFP = Total factory productivity. For the concept, see Solow (1957).

(see e.g. Basu (1996)). In other words, the stagnation of the economy entails low measured TFP growth.

Although the supply factors are surely important for economic growth, they are not the whole story. Aoki and Yoshikawa (2002) suggest that “saturation of demand” is an important factor to restrain growth. In the less mathematical literature and causal discussions, the idea of “demand saturation” has been very popular. In fact, plotting a time series of production of any representative product such as steel and automobile, or production in any industry against year, one obtains a S-shaped curve. An obvious implication of the S-shaped growth of an individual product/industry is that the economy enjoys high growth if it successfully keeps introducing new products or industries for which demand grows fast, and allocates capital to growing sectors. The ordinary TFP raises the growth rate by making production function “shift up.” In the Aoki–Yoshikawa model, technical progress raises the growth rate by creating new products and industries for which demand grows fast.<sup>15</sup> The Aoki–Yoshikawa model suggests that the fundamental cause of the poor growth performance of the Japanese economy is basically demand deficiency, or more precisely a lack of creation of sectors or industries which enjoy high growth of demand.

In this chapter, we proposed another explanation of the long stagnation of the Japanese economy. When the degree of uncertainty rises, the economy may be trapped into “bad” equilibrium, and the effectiveness of macroeconomic policies weakens. The model presented in the second section is highly abstract, but is generic.

Once the economy is trapped into bad equilibrium as the degree of uncertainty rises, monetary policy, which corresponds to a change in the  $g(x)$  function in the model, is not really effective. Many economists argue that the BOJ facing the zero nominal interest rate bound can still lower the real interest by generating inflationary expectations. In our model, it would change the  $g(x)$  function, and induce more economic agents to find a shift from bear to bull advantageous. When uncertainty is insignificant, and the minimum of the potential function is almost equivalent to the zero of the  $g(x)$  function, it certainly helps. This is a normal situation. However, when the combinatorial aspect cannot be ignored as the degree of uncertainty rises, policies which are effective in normal circumstances may not help.

Tobin (1975), in his “Keynesian models of recession and depression,” suggests that “the system might be stable for small deviations from its equilibrium but unstable for large shocks.” The same point was also made by Fisher (1933) long time ago.

In our analysis, *uncertainty* plays the key role. When uncertainty is insignificant, the economy would fluctuate around the (unique) “natural” equilibrium, and policies are effective. However, when the degree of uncertainty rises above a critical level, the economy may be trapped into a “bad” equilibrium, and if not, policies necessarily become ineffective.

It is generally agreed that the performance of the postwar economy is better than that in the prewar period. Baily (1978) argues that better safety nets provided by the government in the postwar period have contributed to this outcome. Our analysis suggests that uncertainty is indeed a very serious hindrance to the macroeconomy, and that once the economy faces mounting uncertainty, then the textbook remedies may not so readily work as we would wish.



## Appendix

This appendix offers microeconomic foundations for the transition rate  $\eta_1(x)$ , equations (6) and (7) in “The model” section. In other words, it explains how  $g(x)$  and  $\beta$  are obtained, and shows that  $\beta$  is a measure of uncertainty.

We offer two interpretations for our specifications of the function  $\eta$ . The first is based on approximate calculations of the perceived difference of the expected utilities, or advantages of one choice over the other. The second interpretation is based on discrete choice theory such as Anderson *et al.* (1993), or McFadden (1974).

### Representation of relative merits of alternatives

Denote by  $V_1(x)$  the expected “return” from choice 1, given that fraction  $x$  has selected choice 1. For definiteness, think of the discounted present value of benefit stream based on the assumption that fraction  $x$  remains the same over some planning horizon. Define  $V_2(x)$  analogously. Let

$$\eta_1(x) = \Pr\{V_1(x) \geq V_2(x)\}$$

We omit  $x$  from the arguments of  $V$  from now on.

Assume that the difference  $\Delta V = V_1 - V_2$  is approximately distributed as a normal random variable with mean  $g(x)$  and variance  $\sigma^2$ . We calculate the probability that the difference is nonnegative, namely choice 1 is preferred to choice 2

$$\eta_1(x) = \Pr\{\Delta V \geq 0\} = \frac{1}{2}[1 + \text{erf}(u)]$$

where the error function is defined by

$$\text{erf}(u) := \frac{2}{\sqrt{\pi}} \int_0^u e^{-y^2} dy$$

with  $u = g(x) / (\sqrt{2}\sigma)$ . See Abramovitz and Stegun (1968), for example. Then, we follow Ingber (1982) to approximate the error function by

$$\text{erf}(u) \approx \tanh(\kappa u)$$

with  $\kappa = 2/\sqrt{\pi}$ . This approximation is remarkably good and useful. For example for small  $|x|$ , we note that

$$\text{erf}(x) = \kappa \left( x - \frac{x^3}{3} + \frac{x^5}{5} + \dots \right)$$

and

$$\tanh(\kappa x) = \kappa \left( x - \frac{x^3}{2.36} + \frac{x^5}{4.63} + \dots \right)$$

By letting  $\beta$  to be  $\sqrt{2/\pi\sigma^{-1}}$ , we have deduced the desired expression

$$\eta_1 = \Pr\{\Delta u(x) \geq 0\} \approx X^{-1} \exp[\beta g(x)]$$

where  $X = \exp[\beta g(x)] + \exp[-\beta g(x)]$ .

This offers one interpretation of  $\beta$  that appears in the transition rates. Large variances mean large uncertainty in the expected difference of the alternative choices. Such situations are represented by small values of  $\beta$ . Small variance means more precise knowledge about the difference in the values of two choices, represented by large values of  $\beta$ . This situation is represented by small  $\beta$ . Alternatively put, we may interpret  $g(x)$  as the conditional mean of a measure that choice 1 is better than choice 2, conditional on the fraction  $x$  has decided on choice 1.<sup>16</sup>

### ***Discrete choice theory and extreme value distributions***

Next, suppose that we calculate the probability that the discounted present value one,  $V_1$ , is higher than value two, associated with alternative choices 1 and 2 respectively. Suppose further that we represent some of the incompleteness and impreciseness of information or uncertainty of consequences surrounding the value calculation by adding random terms to the present values as

$$\hat{V}_1 = V_1 + \epsilon_1$$

and

$$\hat{V}_2 = V_2 + \epsilon_2$$

One interpretation is that these  $\epsilon$ s are noises to account for inevitable fluctuations in the present values. A second interpretation is to think of them as (additional) evidence to support a particular choice. Other interpretations are certainly possible. For example, McFadden (1973) speaks of common or community preference and individual deviations from the common norm in the context of utility maximization.

One quick assumption to obtain a Gibbs distribution expression in the case of two alternative choices is to assume that,  $\epsilon = \epsilon_2 - \epsilon_1$  is distributed according to

$$\Pr\{\epsilon \leq x\} = \frac{1}{1 + e^{-\beta x}}$$

for some positive  $\beta$ . With this distribution, a larger value of  $\epsilon$  supports more strongly the possibility that  $V_1 > V_2$ . Parameter  $\beta$  controls how much of changes in  $x$  translate into changes in probabilities. With a smaller value of  $\beta$ , a larger increase in  $x$ , that is, in “evidence” is needed to increase the probability that favors choice 1. The larger the value of  $\beta$ , the smaller the increase in  $x$  needed to change the probability by a given amount.

With this distribution, then, it immediately follows that

$$P_1 = \Pr\{\hat{V}_1 \geq \hat{V}_2\} = \frac{e^{\beta V_1}}{e^{\beta V_1} + e^{\beta V_2}} = \frac{e^{\beta g}}{e^{\beta g} + e^{-\beta g}}$$

with  $g = (V_1 - V_2)/2$ . We obtain also  $P_2 = 1 - P_1$ , of course.

To reiterate, a smaller value of  $\beta$  implies a smaller difference of  $|P_1 - P_2|$ . In other words, with a larger value of  $\beta$ , one of the alternatives tends to dominate.

This type of approach, which involves explicit calculations of probabilities of relative sizes of present values can be pursued further, but is omitted here to save space. See Aoki (2002: Section 6.2) and Aoki (1996: Section 3.7, 3.8).

## Acknowledgments

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## Notes

- 1 Many economists attribute the end of the high growth era to the first oil shock in 1973–74. However, the fall of the growth rate around 1970 was actually *not* caused by the oil shock, but rather by a change in the internal structure of the Japanese economy. For details, see Yoshikawa (1995: Chapter 2).
- 2 The recession which started in May 1997 officially ended in January 1999. According to the government, the Japanese economy subsequently entered the expansionary phase during February 1999–October 2000. A recession then started in November 2000.
- 3 We can formally show that by historical standard, consumption has been *unusually* weak throughout the 1990s. See Table 2 of Motonish and Yoshikawa (1999).
- 4 Taylor (1989), for example, emphasizes the role of *Shunto* for wage flexibility in Japan.
- 5 For details, see Yoshikawa (1995), Chapter 5.
- 6 McKinnon and Ohno (1997) advanced the argument that what they called “fears of ever higher yen” was the fundamental cause of the long stagnation of the Japanese economy, and that the introduction of the adjustable peg was the key solution. Their argument rests on the premise that fluctuations of the exchange rates was the basic cause of the troubles. They even attribute the fall in the growth rate in the early 1970s to the end of the Bretton Woods system and flexible exchange rates. However, at least for the Japanese economy, the contribution of net exports, which are naturally most significantly affected by exchange rates, to growth was much *higher* in the 1970s and 1980s when exchange rates were flexible than in the 1950s and 1960s when the exchange rate was fixed (Yoshikawa 1995, Chapter 2).

McKinnon and Ohno emphasize a possibility of misalignments (deviations from the PPP) under the flexible exchange rate regime. The misalignment does occur. However, for the Japanese economy, the most important misalignment was the overvaluation of the dollar or *the undervaluation of the yen* under the Reagan Administration in the 1980s. This misalignment is, therefore, not consistent with “fears of ever higher yen.”

Finally, they argue that responding to the appreciation of the yen, the BOJ initially eases money, but is, in the medium run, prone to tighten money to produce deflation. This simply contradicts the facts. The BOJ does ease-money responding to the yen appreciation not only in the short run but also in the medium run.

- 7 Some of the public expenditures are believed to be so inefficient as almost equivalent to “digging holes.” Construction industry is a symbolic case. Orders of public investment, which exceeds ¥30 trillion or 6 percent of GDP, are required by legislation to be made to small firms on quota. Many small firms which receive orders, pass them (namely, “sell” the contracts with the government) to larger firms. In 1985, for example, there were 520,000 construction firms, 99.9 percent of which were very small. Out of 520,000, only 250,000 firms were actually engaged in any construction at all: Another example is agriculture. The public expenditures for agriculture sharing 4.2 percent in the 1999 budget almost amounts to a half of the value added of agriculture. These inefficient public expenditures are made at the sacrifice of necessary infrastructures for large cities, and information and other new technologies.

Questionable income transfers are not confined to expenditures. The tax system is also inflicted with serious problems. Take personal income tax which shares 20 percent of the revenue, for example. Income taxes for employees are automatically deducted out of their salaries and wages. However, for the self-employed who declare their earnings, incomes are usually significantly understated. This problem exists in every country, but in Japan it is particularly serious; The declared incomes of the self-employed are estimated to be only 50 percent of true incomes. As a result, income taxes are disproportionately borne by employees; 85 percent of employees pay income taxes, whereas only 45 percent of the self-employed in non-agricultural sectors, and only 14 percent of farmers do.

In 1999, for the purpose of encouraging consumption, the government distributed ¥0.7 trillion consumption coupons which were to expire within months. The politicians who promoted the idea argued that temporary coupons would effectively encourage consumption whereas tax cuts might only increase savings. On second thought, it is clear that this naive logic is wrong because coupons may simply replace cash and other means of payment, and, therefore, it may not result in an increase in consumption expenditures. In this sense, coupons are equivalent to tax cut. However, there is one difference. Tax cuts benefit those who pay income tax. Remember that the relatively few self-employed pay income tax. Politicians who get votes from the self-employed are understandably in favor of coupons even by appealing to a wrong logic.

The problem is not confined to personal income tax. Whether the economy is in boom or recession, about two-thirds of “corporations” consecutively declare losses, and pay no corporate income tax at all. Most of the firms which declare losses and do not pay any tax are small inefficient firms, particularly in the non-manufacturing sector. As a result, corporate income taxes are borne disproportionately by large firms.

- 8 The background of Japanese monetary policy during the period, see Cargill, Hutchison and Ito (1997), and Bank of Japan (2001).
- 9 Kiyotaki and Moore (1997) offer a theoretical model which suggests this kind of interpretation.
- 10 The *Tankan* DI of lending attitude of banks normally deteriorates at the time of tight money, whereas, it improves at the time of easy money.
- 11 Blanchard (2000) recommends for the Bank to jump *base money* initially. This is basically what the BOJ did during 1997–2002.

- 12 The analysis of the section “The Modern” draws heavily on Aoki and Yoshikawa (2003).
- 13 For derivation of equation (10), see Aoki (1996, 1998).
- 14 Krugman (1998) suggests that the demography has made the equilibrium real interest rate negative and caused troubles for Japan.
- 15 We maintain that in addition to the standard TFP growth, namely an “upward shift” of production function, technical progress creates demand. That TFP does not necessarily capture technological progress is pointed out by (Wright 1997: 1562):

The identification of “technological progress” with changes in total-factor-productivity, or with the “residual” in a growth-accounting framework, is so widely practised that many economists barely give it a passing thought, regarding the two as more-or-less synonymous and interchangeable. . . . Even with extensive quality adjustments, TFP is not generally a good index of technology. If a genuine change in technological potential occurs in a firm, an industry, a sector, or a country, in any plausible model this change will affect the mobilization of capital and labour in whatever unit is involved. In the new equilibrium, inputs as well as outputs will have changed; the ratio between these may convey little if any useful information about the initiating change in technology. We share Wright’s concern. The economy always mobilize resources and accumulates capital whenever it finds goods or sectors for which demand grows rapidly. Technical progress creates goods/sectors for which demand grows fast and thereby sustains economic growth.

- 16 Aoki (1996, Chapters 3 and 8) shows how  $\beta$  arises as a Lagrange multiplier to incorporate macrosignals as constraints. Parameter  $\beta$  is related to the elasticity of the number of microeconomic configurations with respect to macrosignals. Small values of  $\beta$  mean that the number of microeconomic configurations respond little when macroeconomic signals change. This is in accord with the interpretation that agents face large uncertainty in their choices. See Aoki (1996: 216). Similar interpretation may be offered from the viewpoint of hazard function. See Aoki (2002, Section 6.2).

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# 10 Monetary policy, the labor market, and pegged exchange rates

A study of the German economy

*Peter Flaschel, Gang Gong, and Willi Semmler*

## Introduction

In Europe for a long time period, from 1979 to 1999, a pegged exchange rate system was the dominant exchange rate arrangement. In January 1999, the European Monetary System (EMS), under which the currencies of the member states of European Union (EU) were pegged within a band, was replaced by a single currency, the Euro. For the time period from 1979 to 1999, the German monetary policy, when it was confronted with a secular rise of unemployment in the 1980s and 1990s, operated under the EMS. Germany was the dominant country in Europe and other countries had, to a great extent, to follow Germany's monetary policy. Kenen (2002) calls this the leader-follower model. On the other hand, German monetary policy, operating under the EMS, was restricted by an open economy dynamic.

It is worthwhile to take stock of the experience of EMS and to learn how the pegged exchange rate system for Germany and the EU has operated, and how successful monetary policy can be to simultaneously achieve price and output stability as well as pegging the exchange rate in an open economy. One of the major reasons for a pegged exchange rate system has been that countries with strongly integrated trade save considerable transaction costs when moving from highly volatile flexible to pegged exchange rates. Yet, frequently it is argued that the countries under a pegged exchange rate system will lose monetary policy as stabilization instrument because monetary authorities are obliged to use monetary instruments to keep the exchange rate constant. As usually stated, money becomes endogenous because it has to be devoted to this task and one cannot pursue a stabilization policy (McCallum 1996, Chapter 7).

Yet, the experience of the EMS from 1979–99, with the exception of the serious disturbance 1992, seems to have shown that pegged exchange rates can work and demonstrate that monetary policy can, though with some difficulties, be conducted even by being devoted to three goals: exchange rate stabilization and stabilization of inflation and output. Surely, there are disadvantages with these three goals of monetary policy, yet one might want to demonstrate (1) how the macroeconomic dynamics work,<sup>1</sup> and (2) how monetary policy can be inacted even under pegged exchange rates.



To study these questions is important since many regions that are nowadays highly integrated through trade naturally tend to adopt pegged exchange rate systems between the integrated economies. Yet, for a country under pegged exchange rates there are essential restrictions under which monetary policy operates.

We will develop a prototype Keynesian macroeconomic framework<sup>2</sup> for an open economy with pegged exchange rates and study those earlier mentioned questions. In the context of a Keynesian open economy macrodynamic model, in the spirit of James Tobin's work, we explore (1) the implication of pegged exchange rates on the macroeconomic dynamics of a large economy—the German economy, and (2) study how successfully monetary policy can be conducted under pegged exchange rates. We allow for disequilibria in the product and labor market, sluggish wage, price and output adjustments, and the trade account responding—given that the nominal exchange rates are fixed within a band—to real exchange rates. A major core equation of our model will be an open economy Phillips curve for the labor market.

More specifically, we consider Germany as an example of an open economy with pegged exchange rates. We presume that (1) intermediate goods as well as private and public consumption demand respond to real exchange rates and (2) a wage and price Phillips curve is impacted by real exchange rates. In this context then, macroeconomic dynamics as well as effectiveness of monetary policy are studied. Concerning monetary policy, we consider two rules—the monetary authority targeting the money growth rate or directly targeting the inflation rate (and output) through the Taylor rule. We need to note that in one of his last papers, James Tobin gives an evaluation of these two rules, where he shows that the Taylor rule in fact permits a discretionary monetary policy (see Tobin 1998). Yet, we remark that our study goes a bit further and also beyond the usual studies. Usually, the working of monetary policy rules are studied only for a closed economy. Ball's study (see Ball 1999), is a notable exception.<sup>3</sup>

The remainder of this chapter is organized as follows. First section introduces the open economy model of a country under pegged exchange rates with product-market disequilibrium, wage and price Phillips curves for an open economy and balance of payment adjustment mechanism. Second section transforms the model into an intensive form so that the existence of the equilibria as well as the macroeconomic dynamics can be studied. In the third section, the dynamics are more specifically studied for the earlier two monetary policy rules. The next section estimates the model for time series data of a prototype economy of the EMS, namely the German economy. Fifth section studies impulse response functions, and the final section concludes the chapter. The appendix demonstrates the working of the current account under a pegged exchange rate system and lists the symbols and the sources of data.

### **The model in extensive form**

Our model is explained best by successively introducing modules for the different components of the model. Module 1 that follows, provides some definitions of basic variables of the model: the real wage  $\omega$ , the expected rate of return on

capital  $\rho^e$  ( $\delta$ , the depreciation rate), real financial wealth  $W$  (consisting of money, domestic and foreign bonds, and equities) and the real exchange rate  $\eta$ .<sup>4</sup> The expected rate of return on physical capital is based on expected sales from which depreciation, real wages, and real imports of firms have to be deducted. Firms, therefore, make use of a three-factor technology, where besides capital  $K$  and labor  $L^d$ , imports  $J^d$  are used to produce real output  $Y$ . In addition to the measure of the currently expected returns on capital we use normal returns  $\rho^n$  in the investment function of the model, which are based on the normal utilization of capacity  $y_o = \bar{U}y^p$  and the normal sales to capital ratio  $y_o^d$ .<sup>5</sup> Due to the historical background chosen, the exchange rate  $e$  is an exogenous magnitude of the model, which implies that domestic and foreign fix price bonds (prices set equal to one in each currency for simplicity) can be considered as perfect substitutes if they earn the same nominal rate of interest.

*Module 1 Definitions (income distribution, real wealth, real exchange rate):*

$$\omega = w/p, \quad \rho^e = (Y^e - \delta K - \omega L^d - J^d/\eta)/K, \quad \eta = p/(ep^*) \quad (1)$$

$$W = (M + B_1 + eB_2 + p_e E)/p, \quad p_b = p_b^* = 1, \quad e = \text{const.} \quad (2)$$

$$\rho^n = y_o^d - \delta - \omega y_o/x - j y_o/\eta, \quad y_o^d = \bar{U}^c y^p / (1 + n\beta_{it}), \quad y_o = \bar{U}^c y^p \quad (3)$$

Module 2 provides the equations for the household sector, consisting of workers and asset holders, with lump-sum taxes,  $T_w$ , concerning wage and interest income of workers and  $T_e$ , concerning the dividend and interest income received by asset holders, held constant net of interest per unit of capital, see the government module below, since fiscal policy is not a topic in the present chapter.<sup>6</sup> Asset demand is shown in general terms in equations (4) and (5), where only money demand is explicitly specified.<sup>7</sup> The wealth constraint for asset reallocations is (4). Its implications are explicitly considered only in the case of money demand (5) which allows the usual LM-determination of the domestic nominal rate of interest.

Domestic bonds and foreign bonds exhibit the same rate of interest rule. In our case it is based on the dominance of the domestic, German, money supply rule or rate of interest rule.<sup>8</sup> Domestic equities are also considered as perfect substitutes as seen in equation (30), where equity prices are assumed to adjust such that returns are equalized with those on short-term domestic bonds. The reallocation of interest-bearing assets may thus be ignored, since asset holders accept any composition of such assets if money demand has adjusted to money supply by movements of the short-term rate of interest  $r$ .

Equations (6), (7) define the real disposable income of pure asset holders and workers, respectively interest rate reaction function of the Taylor type is inacted. The consumption of the two groups of the domestic goods,  $C_1$ , and the foreign goods,  $C_2$ , depends both in the case of asset owners and of workers on the real exchange rate  $\eta$  in the usual way, which is here formalized by means of the consumption ratio  $\gamma(\eta)$  namely as fraction of their total consumption expenditures, based on given saving ratios  $s_w, s_e$  of these two groups of agents. Note that consumption of foreign goods is based on real income in domestic terms and

must thus be transformed by means of the real exchange rate  $\eta$ . Aggregate domestic consumption  $C$  is defined in equation (10).

Note finally that workers save in the form of money and domestic bonds, while asset holders also save in the form of foreign bonds and domestic equities. We thus assume that only bonds are traded internationally. This is not a severe restriction in the present formulation of the model, since financial asset accumulation does not yet feed back here into the real part of the economy, due to neglecting wealth and interest rate effects in the consumption functions of both workers and asset holders. The model that we are investigating here thus still exhibits only a very traditional type of real-financial interaction, basically based on the assumed simple LM-theory of the money market or a Taylor interest rate policy rule. Note, however, that the model allows for saving of workers and the accumulation of money and short-term domestic bonds by them. Note furthermore that we assume with respect to asset holders that all expected profits are paid out as dividend to which interest income here and abroad must be added to obtain their before tax total income.

Private saving  $S_p$  of asset holders and workers together absorb the change in money supply caused by the open market operations of the Central Bank, the new equity issue of firms, part of the domestic new bond issue and in general also foreign bonds to some extent. We have to check later on that there is consistency in the absorption of flows and thus no obstacle for the supply of new money, new domestic bonds, and the issue of new equities. Note that the flows shown in equation (11) need not all be positive, since we also allow for flows out of the stocks of domestic and foreign bonds held domestically. Finally, labor supply  $L$  grows at a constant rate  $n_l$ , which—augmented by Harrod neutral technical change—is assumed to determine the trend growth rate in investment, sales expectations and inventories (in order to avoid the introduction of further laws of motion).

*Module 2 Households (workers and asset-holders)*

$$W = (M^d + B_1^d + eB_2^d + p_e E^d)/p \quad (4)$$

$$M^d = h_1 p Y + h_2 p W(r_o - r), \quad W \text{ reduced to } K \text{ later on} \quad (5)$$

$$Y_w^D = \omega L^d + rB_{1w}/p - T_w, \quad s_w Y_w^D = \dot{M}_w + \dot{B}_{1w} \quad (6)$$

$$Y_c^D = \rho^e K + rB_{1c}/p + er^* B_2/p - T_c, \quad (7)$$

$$s_c Y_c^D = \dot{M}_c + \dot{B}_{1c} + e\dot{B}_2 + p_e \dot{E}$$

$$C_1 = \gamma(\eta)[(1 - s_w)Y_w^D + (1 - s_c)Y_c^D], \quad (8)$$

$$\gamma(\eta) = \gamma_o + \gamma_1(\eta_o - \eta) \in (0, 1)$$

$$C_2 = \eta[1 - \gamma(\eta)][(1 - s_w)Y_w^D + (1 - s_c)Y_c^D] \quad (9)$$

$$C = C_1 + (ep^*/p)C_2 = C_1 + C_2/\eta \quad (10)$$

$$S_p = Y_w^D + Y_c^D - C = s_w Y_w^D + s_c Y_c^D = (\dot{M} + \dot{B}_1 + e\dot{B}_2 + p_e \dot{E})/p \quad (11)$$

$$\hat{L} = n_l = \text{const.} \quad (12)$$

The third module concerns firms, modeled here with respect to their output and employment decision  $Y, L^d$  and their needs of imports for production. We thus have a 3-factor production technology and assume fixed proportions in production and thus strictly proportional relationships between capital  $K$  and potential output  $Y^p$ , output  $Y$ , and employment  $L^d$  as well as the imported intermediate good factor  $J^d$ . On this basis we can also define unambiguously the capacity utilization rate of firms  $U^c$  and the rate of employment of the labor force  $V$ . Next, in equation (16) we describe the net investment decision of firms which is based on medium run values for the return differential between normal nominal profitability  $\rho^n + \hat{p}$  and the nominal rate of interest  $r$ , with  $\hat{p}$  the rate of inflation.

Excess returns  $\epsilon = \rho^n + \hat{p} - (r + \xi) = \rho^n - (r + \xi - \hat{p})$  of firms, with  $\xi$  a given risk premium, transformed to such medium run values  $\epsilon^m$ , interpreted as the currently prevailing investment climate, are one driving force for the investment decision, while the deviation of capacity from its normal value provides the short run influence of the state of the business cycle on the investment decisions of firms. We assume that the medium run values  $\epsilon^m$  follow their short run analogs in an adaptive fashion, representing the way how the medium run climate expression is updated in the light of the current experience on their short run analogs. In later propositions on the model, we will basically make use of the short run excess variable in the investment function solely and leave the delayed influence of excess real profitability over the real rate of interest for the empirical investigation of the model.

The excess of expected sales  $Y^e$  over aggregate demand  $Y^d$  for the domestic commodity is shown later. Here, the index 1 is used in the usual way to denote the domestically produced commodity (also demanded by foreigners in the amount of  $Y_1^{f*}$ ). Furthermore, we use  $*$  to denote foreign demand and supply. In equation (18), we state that the saving of firms are equal to their voluntary production of inventories, which in turn is equal to the excess of their production over their expected sales by definition. Finally, we have the financing condition of firms (equation (20)), which states that all investment and all unintended inventory changes (windfall losses) are financed by the issue of new equities, which means that we do not yet allow for credit financing and the like. If  $\dot{N} - I$  is negative, firms do have windfall gains in the place of windfall losses and are using them for their investment financing and thus do not have to issue as many equities as their investment decision would in fact demand. Note again that expected profits are paid out as dividends and are thus not available for the financing of investment plans.

The last equation of module 3, finally, states that we consider only Keynesian regimes as temporary positions of the economy, where in particular all investment orders are always fulfilled, that is, firms never run out of inventories and indeed always serve aggregate demand (see module 6 of the model). Note that the present formulation of the sector of firms considers imported goods only as intermediate goods in production, not as part of the investment efforts of firms which are solely based on domestic commodities. This is an assumption that may be justified in particular with regard to the German economy.

Module 3 Firms (production units and investors):

$$Y^p = y^p K, \quad y^p = \text{const.}, \quad U^c = Y/Y^p = y/y^p \quad (y = Y/K) \quad (13)$$

$$L^d = Y/x, \quad n_x = \hat{x} = \dot{x}/x = \text{const.}, \quad V = L^d/L = Y/(xL) \quad (14)$$

$$\mathcal{J}^d = jY, \quad j = \text{const.} \quad (15)$$

$$I/K = i_1 \epsilon^m + i_2 (U^c - \bar{U}^c) + n, \quad n = n_l + n_x \quad (16)$$

$$\dot{\epsilon}^m = \beta_{\epsilon m} (\epsilon - \epsilon^m), \quad \epsilon = p^n + \hat{p} - (r + \xi) = \rho^n - (r + \xi - \hat{p}) \quad (17)$$

$$\Delta Y^c = Y^c - C_1 - Y_1^{d*} - I - \delta K - G_1 = Y^c - Y^d \quad (18)$$

$$Y_f = S_f = Y - Y^c = \mathcal{I} \quad (19)$$

$$p_c \dot{E}/p = I + \Delta Y^c = I + (\dot{N} - \mathcal{I}) \quad (20)$$

$$\hat{K} = I/K \quad (21)$$

Module 4 describes the government sector of the economy in a way that allows for government debt in the steady state and for a simple monetary policy rule (to be modified later on). Government taxation of workers and asset holders income is such that taxes net of interest receipts are held constant per unit of capital. This simplification allows to treat tax policies as parameters in the intensive form of the model, since our stress is on the role of monetary policy rules, and removes in addition the impact of interest payments on the consumption decisions of both types of households.

Government consumption per unit of capital is also assumed a parameter of the model, but is divided into domestic demand and demand for the foreign commodity at the same ratio as for the sector of households, which is thus uniform across consuming sectors.<sup>9</sup> The definition of government saving is an obvious one, as is the growth rate for the money supply, assumed to equal the domestic steady-state rate of real growth  $n$  augmented by the steady-state rate of inflation of the foreign country.

Finally  $\dot{B}$  describes the law of motion for government debt, which results from the decision on taxation  $T$ , government consumption  $G$ , and the money supply  $\dot{M}$ . Note that the Central Bank is not to be involved in foreign exchange market operations, since we can show later on that the balance of payments is balanced in this model without any intervention from the monetary authority.

Module 4 Government (fiscal and monetary authority):

$$T = T_w + T_c \quad (22)$$

$$t_w = \frac{T_w - rB_{1w}/p}{K} = \text{const.}, \quad t_c = \frac{T_c - (rB_{1c} + er^*B_2)/p}{K} = \text{const.} \quad (23)$$

$$G = gK, \quad g = \text{const.} \quad (24)$$

$$G_1 = \gamma(\eta)G, \quad G_2 = \eta[1 - \gamma(\eta)]G \quad (25)$$

$$S_g = T - rB/p - G \quad (26)$$

$$\hat{M} = n + \bar{\pi} = n + \hat{p}_0^* = \text{const.} \quad \text{at first} \quad (27)$$

$$\dot{B} = pG + rB - pT - \dot{M} \quad (28)$$

The fifth module lists the equilibrium conditions for the four financial assets of the model: money, domestic and foreign bonds, and equities. Due to the perfect substitutability assumptions (30), (31) it suffices to specify money demand explicitly, as wealth owners are indifferent to the allocation of the remaining terms, their domestic and foreign bond holdings, which only have interest returns, and their equity holdings (whose return consists of dividend returns as well as capital gains).

Note that we have assumed in equation (31), that the domestic economy dominates the other economies included in the pegged exchange rate system with respect to interest rate formation (here, based on its still simple money supply rule). We thus presume that the other economies will always adjust the nominal interest rate achieved by the domestic economy so as to keep the nominal exchange rates constant. Such a behavior of the other countries to adjust their interest rate within a pegged exchange rate region has been called the leader-follower model (Kenen 2002). This may not always be convenient for the other economies, but this was what in fact has happened under the EMS.

We stress that the model cannot be considered as being completely specified, since there may be more than one path for the accumulation of bonds as the model is formulated which however does not matter for the real dynamics in its present formulation. Macroeconometric studies frequently assume, for example, that there is a fixed proportion according to which domestic and foreign bonds are accumulated in order to allow for a unique path in the accumulation of assets. Here, we simply avoid this problem by stating again that the accumulation of financial assets does not yet matter for domestic consumption demand.

*Module 5 Equilibrium conditions (asset-markets):*

$$M = M^d = h_1 pY + h_2 pK(r_o - r) \quad (29)$$

$$r = \frac{\rho^* pK}{p_e E} + \hat{p}e \quad (30)$$

$$r^* = r \quad (31)$$

Our description of the asset markets<sup>10</sup> of an open economy with four types of financial assets is already very complex, but it is still restrictive, and can be improved, see Köper (2000) for an attempt into this direction.

Module 6 describes the adjustment process of output and inventories toward aggregate demand and desired inventories and is formulated following Chiarella and Flaschel (2000, Chapter 6), there, however, for a closed economy. The only difference

here is that actual saving is no longer identical to actual investment in capital goods and inventories, but are now obtained by adding the surplus of the current account (including the balance of the interest payment account), equal to the negative value of the capital account as we shall show in the following paragraphs.

Such accounting identities are added as consistency checks—in equation (37)—to the disequilibrium adjustment process that is considered in module 6 of our macrodynamic model. Note again that investment goods are only purchased from domestic production, while all other components of private domestic demand depend on the real exchange rate as described earlier. We thus only have index 1 commodities in this quantity adjustment process and the demand of foreigners for the domestic product  $Y_1^{d*}$  in addition.

The module 6 considers desired inventories,  $N^d$  as proportion of adaptively adjusted expected sales  $Y^e$  and determines on this basis, intended inventory changes as an adjustment of actual inventories  $N$  towards desired inventories, augmented by a term that accounts for trend growth. Production is then determined by the sum of expected sales and intended inventory changes, sales expectations  $Y^e$  being revised in a straightforward adaptive fashion, also augmented by a term that accounts for trend growth. Finally, actual inventory changes  $\dot{N}$  are simply given by the excess of actual output over actual demand, which closes our description of the output and inventory adjustment mechanism of firms.<sup>11</sup>

*Module 6 Disequilibrium situation (goods-market):*

$$Y^d = C_1 + I + \delta K + G_1 + Y_1^{d*} \quad (Y^e \neq Y^d \text{ in general}) \quad (32)$$

$$\dot{Y}^e = \beta_y(Y^d - Y^e) + nY^e \quad (33)$$

$$\mathcal{I} = \beta_n(N^d - N) + nN^d, \quad N^d = \beta_n Y^e \quad (34)$$

$$Y = Y^e + \mathcal{I} \quad (35)$$

$$\dot{N} = Y - Y^d = Y - Y^e + (Y^e - Y^d) = \mathcal{I} + \Delta Y^e \quad (36)$$

$$\begin{aligned} S &= S_p + S_f + S_g \\ &= I^a + (e\dot{B}_2 - B_1^*)/p = I^a + NCX/p \\ &= I^a + [Y_1^{d*} - (ep^*/p)(C_2 + G_2 + J^d)] + (er^*B_2/p - erB_1^*/p) \\ &= I^a + NX + NFX/p, \quad I^a = I = \dot{N} \end{aligned} \quad (37)$$

Module 7 models the dynamics of the wage-price module with two separate Phillips curves for nominal wage and price inflation,  $\hat{w}$  and  $\hat{p}$ , in the place of only one of reduced form type (for price inflation solely). This module represents a considerable generalization of many other formulations of wage-price inflation, for example, of models, which basically only employ cost-pressure forces on the market for goods or a single across markets Phillips curve.

Since workers consume both the domestic and foreign goods, we have to use a weighted average  $\hat{p}_c$  of domestic and foreign price inflation as cost-pressure term

in the money wage Phillips curve. This weighted average is shown in equation (40). Here and everywhere, the weight is assumed to be given by the steady state value of  $\gamma(\eta)$ , which is  $\gamma_o$ , and thus not allowed to vary with the real exchange rate  $\eta$  (or the variable cost structure within firms). Also, note here that the foreign inflation rate is assumed to be steady. Forming a concept of medium run cost of living inflation as shown in equation (40), therefore, requires no change as far as foreign price inflation is concerned. Altogether, we have formulated here two Phillips curves which take into account the real exchange rate dynamics in a specific way, as seen in the following paragraphs.

With respect to medium run inflation at home we use—as in the case of the investment climate—a measure  $\pi^m$  that is updated in an adaptive fashion, measuring the inflationary climate in which current price inflation (which is perfectly foreseen) is operating. The average in the money wage equation (38), with weight  $k_w$ , indeed assumes that the cost of living pressure in this Phillips curve is given by a weighted average of current, perfectly anticipated, cost of living inflation and the inflationary climate into which this index is embedded. Due to the openness of the considered economy we, therefore, now employ a cost of living index in the money wage Phillips curves and this in a way that does pay attention not only to its current rate of change. Besides cost pressure we have furthermore based the Phillips curve equation (38) also on demand pressure  $V - \bar{V}$  in the usual way, where  $\bar{V}$  is the Nairu rate of employment.

In the price Phillips curve, we use as measure of demand pressure of course, the rate of capacity utilization  $U^c$  in its deviation from the normal rate of capacity utilization  $\bar{U}^c$ , which is given exogenously. Cost pressure is here given by wage inflation (minus productivity growth) and import price inflation (no productivity growth) where we again form a weighted average. For analytical simplicity, we use as weight the same parameter as for the consumer price index in the wage Phillips curve (Asada *et al.* 2002) for a justification. Furthermore, the inflationary climate in which the price Phillips curve is operating is given by a corresponding weighted average of domestic inflationary climate and the foreign one, again with the general weight  $\gamma_o$  for simplicity. The weight  $\gamma_o$  is, therefore, uniformly applied and might—because of this—be reinterpreted as the general accepted measure by which domestic rates of inflation and foreign ones are translated into averages driving domestic wage and price inflation (see Asada *et al.* 2002) for further details.

More general concepts for such averaging procedures can easily be adopted from the numerical as well as the empirical perspective, for example by paying attention to the fact that the input cost-structure is in fact variable and given by  $c = (wL^d + e\beta^*j^d)/pY = w/x + j/\eta$ . Note also that labor productivity growth  $n_x = \hat{x}$  has been added to the wage and price Phillips curve in an appropriate way.

*Module 7 Wage–Price module (adjustment equations and definitions)*

$$\hat{w} = \beta_w(V - \bar{V}) + \kappa_w(\hat{p}_c + n_x) + (1 - k_w)(\pi_c^m + n_x) \quad (38)$$

$$\hat{p} = \beta_p(U^c - \bar{U}^c) + \kappa_p\hat{c} + (1 - \kappa_p)\hat{c}^m \quad (39)$$

$$\hat{p}_c = \gamma_0\hat{p} + (1 - \gamma_0)\hat{p}_0^*, \quad \pi_c^m = \gamma_0\pi^m + (1 - \gamma_0)\hat{p}_0^* \quad (40)$$



$$\hat{c} = \gamma_0(\hat{w} - n_x) + (1 - \gamma_0)\hat{p}_0^*, \quad \hat{c}^m = \gamma_0\pi^m + (1 - \gamma_0)\hat{p}_0^* \quad (41)$$

$$\dot{\pi}^m = \beta_{\pi^m}(\hat{p} - \pi^m) \quad (42)$$

$$\hat{p}_0^* = \text{const.} = \bar{\pi} \quad (43)$$

The remaining modules concern the openness of the economy. Since the exchange rates<sup>12</sup> for the EMS was pegged we do not need to consider any Dornbusch type exchange rate dynamics in module 8.<sup>13</sup>

*Module 8 Exchange rate dynamics*

$$e = \text{constant} \quad ([\text{DM}]/[\text{ECU}]) \quad (44)$$

Module 9, finally, describes the balance of payments  $\mathcal{Z}$ . We first present real net exports  $\mathcal{NX}$ , measured in terms of the domestic commodity, and then net capital exports, the export of liquidity, in nominal terms. Note here again that—though we specify all flows in and out of financial assets—they are not yet of relevance in the present model type, since interest and wealth effects are still suppressed in the consumption behavior.

Concerning nominal net interest payments,<sup>14</sup> we assume that they cross borders and thus appear as an item in the current account and in the balance of payments. We stress that the balance of payments must be balanced in our model, due to the assumptions to be made later concerning the flow restrictions of households, firms, and the government. They essentially state that the new issue of money and equities are indeed (by assumption) absorbed by domestic households which means that the remainder of asset holders' savings goes into the purchase of domestic and foreign bonds, supplied by the government and foreigners, the latter in the amount necessary for flow consistency. Should domestic households demand more domestic bonds by their savings decision, these bonds are assumed to be supplied out of the stock that foreign asset holders hold, so that domestic households can always realize their concrete saving plans.

Since new asset flows are regulated in this way we can show in the succeeding paragraphs that the balance of payments is always balanced, the current account is always the negative of the capital account, without any interference from the monetary authority due to the consistency assumptions made on new money and equity issue. By contrast, the trade account need not be balanced even in the steady state, due to the fact that only domestic prices can adjust in the real exchange rate, which may be too little to achieve a balanced trade account. There is, therefore, no need to intervene in foreign exchange markets of the part of the world that is here under consideration, if the foreign economy always supplies the amount of bonds that is demanded by asset holders.

*Module 9 Balance of payments:*

$$\mathcal{NX} = Ex - Im = \mathcal{Y}_1^{d*} - (C_2 + G_2 + \mathcal{J}^d)/\eta \quad (45)$$

$$\mathcal{NCX} = e\dot{B}_2 - \dot{B}_1^*, \quad \mathcal{NFX} = er^*B_2 - rB_1^* \quad (46)$$

$$\begin{aligned} \zeta &= pNX + NFX - NCX \\ &= [pY_1^{d*} - ep^*(C_2 + G_2 + J^d)] + (er^*B_2 - rB_1^*) - (e\dot{B}_2 - e\dot{B}_1^*) \\ &= 0 \end{aligned} \tag{47}$$

Finally, we collect the data needed from the “foreign” economy. We already have assumed that inflation rates abroad are steady, fully anticipated, and consistent with the inflationary target of the domestic Central Bank, that is,  $\hat{p}_o^* = \pi_o^* = \bar{\pi} = \text{const}$ . We assume finally for  $Y_1^{d*}$ , the demand of foreigners and thus for the export of the home country, that it is only a function of  $\eta$  if expressed per unit of capital, that is,

$$y_1^{d*} = Y_1^{d*}/K = y_1^{d*}(\eta) = \gamma_o^* + \gamma_1^*(\eta_o - \eta)$$

This closes the description of the equations of our Keynesian dynamics with under- or overemployment of labor and capital, with labor *and* goods-market in disequilibrium, but money-market in equilibrium, for a large open economy within the EU, with a delayed adjustment of quantities as well as wages and prices.

### Intensive form, steady-state determination, and stability analysis

The extensive form model described in second section can be reduced to an autonomous seven-dimensional dynamic system in the state variables  $u = \omega/x$  ( $\omega = w/p$ ), the wage share,  $l = xL/K$ , the full employment output–capital ratio,  $m = M/(pK)$ , real balances per unit of capital,  $\pi^m$ , the inflationary climate,  $y^e = Y^e/K$ , sales expectations per unit of capital,  $v = N/K$ , inventories per unit of capital and finally  $\epsilon^m$  the investment climate variable.<sup>15</sup> The resulting system is set out in equations (48)–(54).

$$\begin{aligned} \hat{u} &= \kappa[(1 - \gamma_o\kappa_\rho)\beta_w(V - \bar{V}) + (\gamma_o\kappa_w - 1)\beta_\rho(U^c - \bar{U}^c)] \\ &\quad + \kappa(\kappa_w - \kappa_\rho)\gamma_o(1 - \gamma_o)(\hat{p}_o^* - \pi^m), \quad \kappa = (1 - \gamma_o^2\kappa_w\kappa_\rho)^{-1} \end{aligned} \tag{48}$$

$$\hat{l} = -i_1\epsilon^m - i_2(U^c - \bar{U}^c) \tag{49}$$

$$\hat{m} = \hat{M} - \hat{K} - \hat{p} = \bar{\pi} + \hat{l} - \hat{p}, \quad m = \frac{M}{pK} \quad \text{with} \tag{50}$$

$$\begin{aligned} \hat{p} &= \kappa[\beta_\rho(U^c - \bar{U}^c) + \gamma_o\kappa_\rho\beta_w(V - \bar{V})] \\ &\quad + \kappa(1 + \gamma_o\kappa_\rho)(1 - \gamma_o)(\hat{p}_o^* - \pi^m) + \pi^m \\ \dot{\pi}^m &= \beta_{\pi^m}(\hat{p} - \pi^m) \end{aligned} \tag{51}$$

$$\dot{y}^e = \beta_{y^e}(y^d - y^e) + \hat{y}^e \tag{52}$$

$$\dot{v} = y - y^d - (n - \hat{l})v \tag{53}$$

$$\dot{\epsilon}^m = \beta_{\epsilon^m}(\epsilon - \epsilon^m), \quad \epsilon = \rho^n - (r + \xi - \hat{p}) \tag{54}$$

Here, output per unit of capital  $y = Y/K$  and aggregate demand per unit of capital  $y^d = Y^d/K$  are given by

$$y = y^e(1 + n\beta_{n^e}) + \beta_n(\beta_{n^e}y^e - \nu) = b_1y^e + b_2\nu \quad (55)$$

$$y^d = \gamma(\eta)[(1 - s_w)(uy - t_w) + (1 - s_c)(\rho^e - t_c) + g] + y_1^{d*}(\eta) \\ + i_1\epsilon^m + i_2(U^r - \bar{U}^r) + n + \delta, \quad \gamma(\eta) = \gamma_o + \gamma_1(\eta_o - \eta) \quad (56)$$

In the preceding equations, we have employed the following abbreviations  $V = y/l$ ,  $U^c = y/y^b$ , the employment rate and the rate of capacity utilization,  $\rho^e = y^e - \delta - uy - jy/\eta$ , the currently expected rate of return on capital,  $\rho^n = y_o^d - \delta - uy_o - jy_o/\eta$ , the normal rate of return on capital,  $\epsilon = \rho^n + \hat{p} - (r + \xi)$  normal excess profitability,  $r = r_o + (h_1y - m)/h_2$ , the nominal rate of interest,  $\eta = p/ep^*o = m^*/m$ ,  $m^* = M/(ep^*xL) = \text{const.}$ , the real exchange rate, and  $\kappa = (1 - \gamma_o^2\kappa_w\kappa_p)^{-1}$ .<sup>16</sup>

With respect to the aggregate demand function  $y^d$  we have the partial derivatives, at the steady state:

$$y_{y^e}^d = \gamma_o[(s_c - s_w)u_o(1 + n\beta_{n^e}) + (1 - s_c)(1 - j)(1 + n\beta_{n^e})/\eta_o] \\ + i_2(1 + n\beta_{n^e})/y^b + i_1\beta_p(\cdot)_{y^e} - i_1r_{y^e} \\ y_\eta^d = -\gamma_1(c_o + g) - \gamma_1^* + [\gamma_o(1 - s_c)]jy_o/\eta_o^2 + i_1jy_o/\eta_o^2$$

in the case, where  $\epsilon = \epsilon^m$  holds true. In the case  $\beta_{\epsilon^m} < \infty$ , however, the  $i_1$ -terms have to be removed from these partial derivatives, since the influence of  $y^e$ ,  $\eta$  on  $i_1(\cdot)$  is then a delayed one. We assume throughout this chapter that this latter case is characterized by  $y_{y^e}^d < 1$  for  $i_2 = 0$  and  $y_\eta^d < 0$  which are natural assumptions from a Keynesian perspective.

However, the parameters  $h_2$ ,  $\beta_p$  can be used in the case  $\beta_{\epsilon^m} = \infty$ :  $\epsilon^m = \epsilon$ , to enforce either  $y_{y^e}^d < 1$  for  $i_2 > 0$  or  $y_\eta^d < 1$ , if this is desirable in certain more general situations. We also assume throughout the chapter that the expected rate of profit  $\rho^e$  depends positively on the expected sales volume  $y^e$  close to the steady state.

This dynamical system represents in its first block [equations (48), (49)] the real growth dynamics, describes with its second block [equations (50), (51)] the nominal or inflationary dynamics, provides third [equations (52), (53)] the inventory dynamics and last [equation (54)] the adjustment of the investment climate.

Since prices concern the denominator in the real wage and wage share dynamics, the dependence of  $\hat{u}$  on the rate of capacity utilization must obviously be negative, while the rate of utilization of the labor force acts positively on the real wage and wage share dynamics. This law of motion, as well as the one for  $\hat{p}$  (see equation (50)), can easily be derived from the wage and price Phillips curve of module 7 (see Asada *et al.* (2002) in this regard). Equation (49) describes the evolution of the full employment output–capital ratio  $l = xL/K$  as determined by the difference between natural growth with rate  $n$  and net investment per unit of capital  $\hat{k} = I/K$ . Taken together, equations (48), (49), describe growth and income distribution dynamics in a way closely related to the long run dynamics considered in

Chiarella and Flaschel (2000, Chapter 6). Their real origin is however in Rose's (1967) analysis of the employment cycle.

The subdynamics of equations (50), (51) are the monetary dynamics of our model and represents a general representation of Tobin (1975) type dynamics.

Equation (52) describes the change in sales expectations as being governed by trend growth and by the observed expectational error (between aggregate demand  $y^d$  and expected sales  $y^e$ , both per unit of capital). Similarly, equation (53) states that actual inventories  $\mathcal{N}$  change according to the discrepancy between actual output  $y$  and actual demand  $y^d$ , which in our Keynesian context is never rationed. These subdynamics represent an extension of Metzlerian ideas to a growing economy.

We stress that we want and have kept the model as linear as possible, since we intend to concentrate on its intrinsic nonlinearities at first. In view of the linear structure of the assumed technological and behavioral equations, the earlier presentation of our model shows that its nonlinearities are, on the one hand, due to the necessity of using growth laws in various equations and, on the other hand, to multiplicative expressions for some of the state variables of the form  $uy$ ,  $y/l$ , and  $\hat{y}$ . Though, therefore, intrinsically nonlinear of the kind of the Rössler and the Lorenz dynamical systems, our 7D dynamics may, however, still be of a simple type, since these nonlinearities do not interact with all of its seven equations.

Equation (48) shows that the impact of demand pressures on wage share dynamics is influenced by  $\gamma_0$ , the share of domestic consumption goods in domestic consumption in the steady state. This influence tends to make the wage share more volatile (as compared to the closed economy), since  $\kappa$  tends to be close to "1", both for the open and the closed economy from the empirical perspective, (see following paragraphs). Lost pressure, as arising from import prices, is passed through into wage share dynamics in equation (48) in a fairly integrated way and only positively affecting these dynamics if workers are more short-sighted than firms ( $\kappa_w > \kappa_p$ ). The pass-through of import price inflation on the domestic price level is, however, always positive and (likely to be) less than one (since  $\kappa \approx 1$  holds from the empirical perspective). Demand pressure on the labor market, representing indirectly cost pressure (with weight  $\kappa_p$ ) for firms, is also diminished by the share  $\gamma_0$  in this respect. Our reduced form equations therefore clearly show the extend of pass-through of import price inflation  $\hat{p}_0^*$ .

This ends the description of the intensive form of our Keynesian monetary growth model, which exhibits sluggish adjustments of prices, wages, and quantities in view of the occurrence of over- or under-utilized labor and capital in the course of the cycles that it may generate.

Proposition 1 *The dynamical system (48)–(54) has a unique interior steady state given by:*

$$V_o = \bar{V}, \quad U_{co} = \bar{U}^c \tag{57}$$

$$y_o = \bar{U}^c y^b \quad l_o = y_o / \bar{V} \tag{58}$$

$$\pi_o^m = \bar{\pi} = \hat{w}_o - n_x = \hat{p}_o = \hat{p}_o^* \tag{59}$$

$$y_o^e = y_o^d = y_o / (1 + n\beta_n), \quad v_o = \beta_n y_o^e \quad (60)$$

$$r_o = \rho_o^n + \bar{\pi}, \quad m_o = h_1 y_o \quad (61)$$

$$\eta_o = m^* l_o / m_o \quad (62)$$

$$u_o = \frac{\gamma_o [-(1 - s_w)t_w + (1 - s_c)(y_o^e - \delta - jy_o/\eta_o - t_c) + g] + y_o^{d*}(\eta_o) + n + \delta}{(s_c - s_w)y_o} \quad (63)$$

$$\rho_o^n = \rho_o^e = y_o^e - \delta - u_o y_o - jy_o/\eta_o, \quad \epsilon_o = \epsilon_o^m = 0 \quad (64)$$

We assume throughout this chapter that parameters are chosen such that all steady-state values shown are economically meaningful. A plausible first condition into this direction is that  $s_w < s_c$  holds true which we assume to be the case. We stress that  $\eta_o = m^* l_o / m_o$ ,  $m^* = M / ep^* xL$  is basically supply-side determined and is in particular not related to goods-market equilibrium conditions (which—dependent on  $\gamma_o$ ,  $\eta_o$ —determine domestic income distribution).

Proposition 1 states that the steady-state dynamics of equations (48)–(54) is basically of supply-side nature. Income distribution is adjusted, however, such that the goods market clears which also provides the steady-state value of the real rate of return on capital and the interest rate. Demand-side aspects thus only concern the determination of the rate of return on capital, the wage share, and the rate of interest and are therefore of secondary importance as far as the steady-state behavior of the considered dynamic model is concerned.

We state without proof that the steady state just considered tends to be locally asymptotically stable if price adjustments, inventory adjustments, and adjustment of the inflationary climate term are sufficiently sluggish, the Keynes effect sufficiently strong ( $h_2$  small), and if sales expectations are adjusted sufficiently fast. It will, however, lose this stability property by way of Hopf limit cycle bifurcations when these conditions are made less stringent. Details and proofs for the statements just made are provided in Asada *et al.* (2002).

We now start to introduce flexible monetary policy rules into the framework just considered, removing thereby the assumption of a constant growth rate of the money stock so far used for describing the dynamics of the nominal and the real stock of money (the latter per unit of capital in addition).

The question arises whether for our open economy with pegged exchange rates that we are considering, the empirically observed adjustment speeds support the asymptotic stability state in proposition two or whether monetary policy rules that react to inflation and output gaps are needed in addition in order to allow for shocks to be absorbed and thus for convergent impulse-response reaction schemes. These topics will be studied in the remainder of the chapter.

Let us first consider the case where the monetary authority attempts to control the rate of inflation (and economic activity) by steering the growth rate  $\mu$  of

the money supply. Here we assume general reaction function such as<sup>17</sup>

$$\begin{aligned} \dot{\mu} &= \beta_{\mu_1}(\bar{\mu} - \mu) + \beta_{\mu_2}(\bar{\pi} - \hat{p}) + \beta_{\mu_3}(\bar{U}^c - \bar{U}^c), \\ \bar{\pi} = \bar{\mu} - n &= \hat{p}_0^* \end{aligned} \tag{65}$$

With this rule, the Central Bank attempts to steer the actual inflation rate  $\hat{p}$  towards the target rate  $\bar{\pi}$  by lowering the growth rate of money supply if  $\hat{p}$  exceeds  $\bar{\pi}$  (and vice versa). This restrictive policy is the stronger, the higher economic activity is at present, measured by the (negative of the) capacity utilization gap  $U^c - \bar{U}^c$ . In order to avoid too strong fluctuations in the growth rate of the money supply, there is also some smoothing of these fluctuations measured by the adjustment parameter  $\beta_{\mu_1}$ . Of course, the monetary authority, possibly in cooperation with the other member states of the pegged currency system, must also be concerned to keep the nominal exchange rate constant.<sup>18</sup>

Yet, concentrating on the domestic task of the monetary authority, the immediate consequence of a changing growth rate  $\mu$  of money supply  $M$  is that the expression  $M/(ep^*xL) = m^*$ —so far a constant—is no longer constant in time, but now changing according to the law

$$\dot{m}^* = \mu - \hat{p}_0^* - n$$

The 6D dynamics considered above (with  $\epsilon^m = \epsilon$ ) is thus now 8 dimensional through the earlier adoption of a money supply rule, by the addition of the new state variables  $m^*$  and  $\mu$  which influence the 6D dynamics through the real exchange rate  $\eta = p/(\bar{e}p^*) = m^*/l/m$ . This situation suggests that it may now be reasonable to use the state variable  $\eta$  in the place of  $m$ , since  $\eta$  is representing inflation more directly than  $m = M/pK$  (where also capital accumulation is involved). We therefore now use the definition  $m = m^*/\eta$  in the place of  $\eta = m^*/l/m$  in the 6D dynamics initially considered, which enters these dynamics by way of the *LM* curve  $r = r_0 + (h_1y - m)/h_2$ .

The evolution of the real exchange rate  $\eta = p/(\bar{e}p^*)$  is in this case given by the following reduced form expression

$$\dot{\eta} = \frac{1}{1 - (1 - \gamma_0)(1 - \kappa)} \{ \kappa[\beta_p(U^c - \bar{U}^c) + \kappa_p\beta_w(V - \bar{V})] + \pi_c^m - \hat{p}_0^* \}$$

This law of motion replaces the law of motion for  $m$  in the recent dynamic system.

**Proposition 2** 1. Assume that  $\beta_{\mu_2} = \beta_{\mu_3} = 0$  holds. Then: The eigenvalue structure  $\lambda_1, \dots, \lambda_6$  of the 6D dynamics is augmented by  $\lambda_7 < 0, \lambda_8 = 0$  in the 8D dynamic system.

2. The same holds true, with  $\lambda_8 < 0$  now, if  $\beta_{\mu_2}, \beta_{\mu_3}$  are made slightly positive, that is, for a fairly passive monetary rule.

*Proof:* See Asada et al. (2002).

We thus can observe that a too active monetary policy of the type as described by equation (65) may be destabilizing. We also want to note that due to the high dimensional nature of the considered dynamics, we cannot determine the maximum size of the considered policy parameters for which Proposition 2 still holds. We know, however, from numerical simulations of the dynamics that there is a limit for them beyond which monetary policy of this type will imply instability.

Next, we consider a Taylor interest rate policy rule—in the light of the earlier formulation of monetary policy—of the following closely related type:

$$\dot{r} = \beta_{r_1}(r_0 - r) + \beta_{r_2}(\hat{p} - \bar{\pi}) + \beta_{r_3}(U^c - \bar{U}^c). \quad (66)$$

This rule states that a positive inflation gap  $\hat{p} - \bar{\pi}$  is counteracted by an increase in the nominal rate of interest  $r$  (and vice versa). This is the stronger, the more overheated the business climate measured by  $U^c - \bar{U}^c$ . There is again a smoothing term, here interest rate smoothing, that attempts to prevent too large fluctuations in the nominal rate of interest  $r$ .

In the case of the earlier interest rate policy rule, we have to consider the dynamics  $\hat{u}, \hat{l}, \hat{\pi}^m, \hat{y}^e, \hat{v}$  as provided earlier (with  $\epsilon = \epsilon^m$ ), now again with  $\hat{\eta} = (\hat{p} - \hat{p}_0^*)$  in the place of  $\hat{m}$  and

$$\dot{r} = \beta_{r_1}(r_0 - r) + \beta_{r_2}(\hat{p} - \bar{\pi}) + \beta_{r_3}(U^c - \bar{U}^c) \quad \text{in the place of } \hat{m}^*, \mu \quad (67)$$

and  $m = m^*/\eta$  as an appended equation (or simply  $m = h_1 y + h_2(r_0 - r)$ ). Stability results are similar to the ones obtained for the money supply policy rule, but now less restrictive. This result was again obtained to some extent by numerical simulations of the earlier dynamics using equation (67) instead of equation (65), see also the empirical studies in the remainder of this chapter.

It is, finally, useful to consider the extent of pass-through of import price inflation (or exchange rate dynamics in the case of a flexible exchange rate) on consumer prices  $p_c$ . Here we obtain by means of the definitional relationship

$$\hat{p}_c = \hat{p} - (1 - \gamma_0)\hat{\eta}$$

the expression ( $\kappa = (1 - \kappa_w \kappa_p)^{-1}$  now):

$$\hat{p}_c = \pi_c^m + \kappa[\beta_p(U^c - \bar{U}^c) + \kappa_p \beta_w(V - \bar{V})] - \kappa(1 - \gamma_0)\hat{\eta}$$

and also

$$\hat{w} = \pi_c^m + \kappa[\beta_w(V - \bar{V}) + \kappa_w \beta_p(U^c - \bar{U}^c)] - \kappa \kappa_w (1 - \gamma_0)\hat{\eta} + n_x$$

where  $\hat{\eta} = \hat{p} - \hat{p}_0^*$  holds true. There is thus (nearly) complete pass-through of  $\hat{p}_0^*$  on  $\hat{p}_c$  and  $\hat{w}$  if  $\kappa \approx 1$  is again assumed. Besides the trade channel influence of the real exchange rate  $\eta$  on the demand for domestic goods we have here finally

provided reduced-form cost-pressure expressions of import price inflation on consumer price and wage inflation. Note finally that the inflationary climate expression for  $p_c$  follows the law of motion

$$\dot{\pi}_c^m = \beta_{\pi^m}(\hat{p}_c - \pi_c^m)$$

which is of the same type as the one for domestic price inflation.

## Estimation of the model parameters

This section discusses how we estimate the structural parameters of the model. These parameters are also used to simulate the model. We first remark that it is technically impossible, and also not necessary, to estimate all the parameters according to the reduced intensive form as expressed in equations (48)–(54). The system includes many expected variables which are not observable. Although the equations are all expressed in linear form, the parameters often appear in multiplicative form and hence are nonlinearly related. What facilitates our estimation is the fact that we treat the entire system as being recursive or block recursive. This allows, whenever possible, to estimate the parameters by a single equation, either in reduced form or in structural form. Only for those parameters that appear in a simultaneous system, such as in the price–wage dynamics, we use the standard method, for example two stage least square (2SLS) to estimate the parameters.

We can divide all the estimated structural parameters into the 7 subsets. Table 10.1 provides the estimates and the standard errors.

Before we elaborate on how we have estimated these parameters, we shall make several remarks about the estimation. First, most estimates are statistically significant except the parameter  $\beta_n$ ,  $\beta_{\mu_2}$ , and  $\beta_{\mu_3}$ . We believe the insignificance of  $\beta_n$  is more likely due to the data issue. Here we calculate the inventory change only according to the GDP residual while all investment is assumed to be in capital stock. This certainly ignores the inventory investment which have been introduced in our model. The insignificance in  $\beta_{\mu_2}$  and  $\beta_{\mu_3}$ <sup>19</sup> is also consistent with the well-known argument that the German Central Bank, the Bundesbank, was not directly concerned with inflation targeting nor unemployment when targeting its money supply. What the Central Bank targets, according to this argument, is a growth rate of money supply that could match the demand for money when the economy is at the steady-state growth path. In this respect, we consider an alternative reaction function of money supply as below:

$$\mu_t - \mu_{t-1} = \beta_m(\bar{\mu} - \mu_{t-1}) \quad (68)$$

The estimation of  $\beta_m$  is discussed later.

Second, in contrast to previous estimations (see Flaschel et al. 2001, 2002), where closed economies are considered,<sup>20</sup>  $\beta_p$  becomes statistically significant. We thus expect that the standard demand-supply force could play a role, along with the cost-push force, in determining prices and wages when we are considering an



Table 10.1 The estimates of structural parameters (standard errors are in parentheses)

|       |   |   |  |
|-------|---|---|--|
| Set 1 | Sales expectation                                 | $\beta_y = 0.8814$<br>(0.1042)<br>$\beta_{n^d} = 0.5435$<br>(0.2304)  | $\beta_n = 0.0031$<br>(0.0041)   |
| Set 2 | Price–wage dynamics                               | $\beta_w = 0.0892$<br>(0.0207)<br>$\beta_x = 0.8223$<br>(0.0415)<br>$\kappa_p = 0.0327$<br>(0.0230)<br>$\alpha = 0.9254$<br>(0.0377)  | $\beta_p = 0.0279$<br>(0.0081)<br>$\kappa_w = 0.9773$<br>(0.4540)<br>$\beta_\pi = 0.3218$<br>(0.0609)  |
| Set 3 | Consumption function                              | $c_0 = 0.0169$<br>(0.0011)<br>$s_w = 0.2573$<br>(0.0437)<br>$\gamma_1 = 0.9544$<br>(0.0233)   | $s_c = 0.5062$<br>(0.0313)<br>$\gamma_0 = 0.0371$<br>(0.0223)<br>$\gamma_2 = -1.1591$<br>(0.9036)  |
| Set 4 | Investment function                               | $i_1 = 0.5388$<br>(0.0930)<br>$\xi = 0.0471$<br>(0.0046)  | $i_2 = 0.0131$<br>(0.0115)   |
| Set 5 | Money demand function<br>(money supply rule only) | $h_1 = 0.06638$<br>(0.0034)   | $h_2 = 0.8144$<br>(0.3012)   |
| Set 6 | Reaction functions of<br>monetary authority       | $\beta_{r_1} = 0.0854$<br>(0.0331)<br>$\beta_{r_2} = 0.0811$<br>(0.0339)<br>$\beta_{r_3} = 0.0111$<br>(0.0045)<br>$\beta_m = 0.6397$<br>(0.0774)  | $\beta_{\mu_1} = 0.6402$<br>(0.0781)<br>$\beta_{\mu_2} = 0.0013$<br>(0.2127)<br>$\beta_{\mu_3} = -0.0027$<br>(0.0309)  |
| Set 7 | Other parameters                                  | $n_0 = 0.0140$<br>(0.0061)<br>$\bar{\pi} = 0.0109$<br>(0.0211)<br>$\bar{U} = 0.8405$<br>(0.0403)<br>$\delta = 0.0121$<br>(0.0058)<br>$n_x = 0.0058$<br>(0.0159)<br>$\bar{y}_d^* = 0.0317$<br>(0.0031) | $y_p = 0.1432$<br>(0.0246)<br>$\mu = 0.0195$<br>(0.0159)<br>$\bar{V} = 0.9515$<br>(0.0350)<br>$n_l = 0.0027$<br>(0.0273)<br>$n = 0.0086$<br>(0.0149)<br>$\bar{p}_0^* = 0.0132$<br>(0.0083) |

open economy. Also in contrast to our estimation with US data where the estimated  $\beta_x$  is less than half, the estimate here is close to 1, indicating that benefits from labor productivity growth is significantly absorbed by the growth of wages. This result is consistent with the well-known difference of labor market structure between US and German economies.

### Estimating parameters—Sets 7, 6, and 5

Next we explain how we have obtained those estimates as expressed in Table 10.1. We start from below. The parameters in Set (7) are those parameters that can be either expressed in terms of an average, or are defined in a single structural equation with a single parameter. This allows us to apply the moment estimation by matching the first moments of the model and the related data. The parameters in Set (6) are estimated by applying OLS directly to equations (68) and (67).

To estimate the parameters in Set (5), we use equation (29) and divide both sides by  $p_t K_{t-1}$ . This allows us to obtain

$$r_{t+1} - r_0 = a_1 y_t + a_2 m_t \quad (69)$$

where  $r_0$  is given in Set 7. The OLS regression on (69), gives us the estimated parameters  $a_1$  and  $a_2$ . By setting  $a_1 = h_1/h_2$  and  $a_2 = -1/h_2$ , we then obtain the estimated  $h_1$  and  $h_2$ . Since the structural parameters  $h_1$  and  $h_2$  appear multiplicatively in  $a_1$  and  $a_2$ , we are not able to obtain the standard deviations directly from the OLS regression. We therefore treat these estimates of  $h_1$  and  $h_2$  as being nonlinear least square (NLS) estimates and use the method as discussed in Judge *et al.* (1988: 508–10) to derive their standard errors. We use the Gauss procedure GRADP to calculate the derivative matrix that is necessary to derive the variance–covariance matrix of the estimated parameters. We shall remark that the same principle is also applied to other similar cases whenever parameters appear in multiplicative form or NLS is applied.

### Estimating the output function

The remaining parameters are more complicated to estimate. For their estimations, we need, either directly or indirectly, the expectation variables that are not observables. Let us first discuss how we estimate the parameters related to sales expectation, that is, Set (1). We estimate this parameter set based on the consideration that actual and predicted  $y_t$  can be matched as close as possible via equation (55). This gives

$$y_t = b_1 y_t^e + b_2 v_t \quad (70)$$

Here we should regard the time series  $y_t^e$  as being a function of  $\beta_{y^e}$  via the adaptive rule (52)<sup>21</sup>, given the initial condition  $y_0^e$ , which we set here to be  $y_0$ . We, therefore, can construct an objective function  $f(\beta_{y^e})$ :

$$f(\beta_{y^e}) = e_y(\beta_{y^e})' e_y(\beta_{y^e}) \quad (71)$$

where  $e_{3t}(\beta_{y^c})$  is the error vector of OLS regression on equation (70) at the given  $\beta_{y^c}$ , and hence the series  $y_t^c$ . Minimizing  $f(\beta_{y^c})$  by applying an optimization algorithm,<sup>22</sup> we obtain the estimate of  $\beta_{y^c}$ . Given the estimate of  $\beta_{y^c}$  and hence the series  $y_t^c$  the OLS is applied to equation (70). This gives us the estimates of  $b_1$  and  $b_2$ . By setting  $b_1 = 1 + (n + \beta_n)\beta_{n^d}$  and  $b_2 = \beta_n\beta_{n^d}$  with  $n$  given in Set (7), one then obtains the estimates of  $\beta_n$  and  $\beta_{n^d}$ . Apparently, all these estimates can again be regarded as NLS estimates, and therefore the standard errors can be derived in a similar way as discussed in Judge *et al.* (1988: 508–10).

### Estimating price–wage dynamics

Next, we discuss how we estimate the parameter set in price–wage dynamics. The corresponding structural equations can be expressed as the following form of discrete time dynamics:

$$\hat{w}_t = \beta_w(V_{t-1} - \bar{V}) + \kappa_w(\hat{p}_{c,t} + \beta_x \hat{x}_t) + (1 - \kappa_w)(\pi_{c,t} + \beta_x \hat{x}_t) \quad (72)$$

$$\hat{p}_t = \beta_p(U_{t-1} - \bar{U}) + \kappa_p \hat{w}_{c,t} + (1 - \kappa_p)\pi_{c,t} \quad (73)$$

where

$$\hat{p}_{c,t} = \alpha \hat{p}_t + (1 - \alpha)\hat{p}_{0,t}^* \quad (74)$$

$$\hat{w}_{c,t} = \alpha \hat{w}_t - \beta_x + (1 - \alpha)\hat{p}_{0,t}^* \quad (75)$$

$$\pi_{c,t} = \alpha \pi_{t-1} + (1 - \alpha)\hat{p}_{0,t-1}^* \quad (76)$$

$$\pi_t = \pi_{t-1} + \beta_\pi(\hat{p}_{t-1} - \pi_{t-1}) \quad (77)$$

All the notation follows the third section, except here we use a time subscript. Also note that  $\hat{x}_t$  is referred to the growth rate of labor productivity.

Note that the time series  $\hat{p}_{c,t}$ ,  $\hat{w}_{c,t}$ ,  $\pi_{c,t}$ , and  $\pi_t$  are all unobservable. Yet they can be computed given the observable series  $\hat{p}_t$ ,  $\hat{w}_t$ ,  $\hat{p}_{0,t}^*$  and the parameters  $\alpha$  and  $\beta_\pi$ . Let us first assume that we know the parameters  $\alpha$  and  $\beta_\pi$ . The other structural parameters can thus be estimated via the method of two-stage least square (2SLS). The first stage is to estimate, separately via OLS, the following reduced form equations:

$$\begin{aligned} \hat{w}_t &= w_1(V_{t-1} - \bar{V}) + w_2(U_{t-1} - \bar{U}) \\ &\quad + w_3\pi_t + w_4\hat{p}_{0,t}^* + w_5\hat{p}_{0,t-1}^* + w_6\hat{x}_t \end{aligned} \quad (78)$$

$$\begin{aligned} \hat{p}_t &= p_1(V_{t-1} - \bar{V}) + p_2(U_{t-1} - \bar{U}) + p_3\pi_t \\ &\quad + p_4\hat{p}_{0,t}^* + p_5\hat{p}_{0,t-1}^* + p_6\hat{x}_t \end{aligned} \quad (79)$$

This will yield the instrument variables for  $\hat{w}_t$  and  $\hat{p}_t$  in the right side of the following structural equations to which our second stage of OLS regression

will be applied:

$$\hat{w}_t - \pi_{c,t} = \beta_w(V_{t-1} - \bar{V}) + \kappa_w(\hat{\rho}_{c,t} - \pi_{c,t}) + \kappa_w \beta_x \hat{v}_t \quad (80)$$

$$\hat{\rho}_t - \pi_{c,t} = \beta_\rho(U_{t-1} - \bar{U}) + \kappa_\rho(\hat{w}_{c,t} - \pi_{c,t}) \quad (81)$$

However, all these estimations are based on the assumption of given and  $\alpha$  and  $\beta_{\pi^m}$ , which we shall first estimate. Next, we discuss how we estimate  $\alpha$  and  $\beta_{\pi^m}$ . Note that this time the objective is to match both  $\hat{w}_t$  and  $\hat{\rho}_t$  simultaneously, and thus a weighting matrix is required. In this exercise, we shall follow Gallant (1975) to conduct a two-step nonlinear least square (2SNLS) estimation. The estimation uses the following objective function:

$$f(\alpha, \beta_{\pi^m}) = e'(\Sigma^{-1} \otimes I_T)e \quad (82)$$

where

$$e = \begin{bmatrix} e_{\hat{w}}(\alpha, \beta_{\pi^m}) \\ e_{\hat{\rho}}(\alpha, \beta_{\pi^m}) \end{bmatrix} \quad (83)$$

with  $e_{\hat{w}}(\cdot)$  and  $e_{\hat{\rho}}(\cdot)$  to be the two error vectors after the second stage of OLS;  $\Sigma$  is the covariance matrix of the two innovations in the structural equations (80) and (81);  $\otimes$  refers to Kronecker product; and  $I_T$  is the  $T \times T$  identity matrix with  $T$  to be the number of the observations. Since we do not know  $\Sigma$  in advance, we therefore shall take a two-step estimation. The first step is to minimize the objective function:

$$f(\alpha, \beta_{\pi^m}) = e'e \quad (84)$$

based on which we construct  $\hat{\Sigma}$ , the estimated  $\Sigma$ .<sup>23</sup> The second stage is to find  $\alpha$  and  $\beta_{\pi^m}$  that optimize  $e'(\hat{\Sigma}^{-1} \otimes I_T)e$ . As proved by Gallant (1975), the estimate is consistent and asymptotically efficient when the innovations are normally distributed. To derive the standard deviation of the estimates, we denote  $\hat{\psi}$  to the vector that contains the 2SNLS estimators  $\hat{\alpha}$  and  $\hat{\beta}_{\pi^m}$ . An estimate of the asymptotic covariance matrix for  $\hat{\psi}$  is given by

$$\hat{\Sigma}_{\hat{\psi}} = \left[ \frac{\partial e'}{\partial \psi} (\hat{\Sigma}^{-1} \otimes I_T) \frac{\partial e}{\partial \psi'} \right]^{-1} \Big|_{\psi = \hat{\psi}} \quad (85)$$

We remark that for these two steps of estimation, we apply a global optimization algorithm, called simulated annealing,<sup>24</sup> to minimize  $f(\alpha, \beta_{\pi^m})$ .

**Estimating consumption and investment functions**

On the assumption that all import goods are used either by private consumption  $c_t$  or by government consumption  $g_t$ , we can regard  $(1-\gamma_t)(c_t + g_t)$  as being the total amount of imports (relative to capital stock), where  $\gamma_t = \gamma(\cdot)$ . Since we do have import data, we thus can compute the time series  $\gamma_t$ . This will allow us to estimate  $\gamma(\cdot)$ . Assume that

$$\gamma_t = \gamma_0 + \gamma_1\gamma_{t-1} + \gamma_2\eta_{t-1} \tag{86}$$

The OLS regression of (81) will produce the parameters  $\gamma_0$ ,  $\gamma_1$ , and  $\gamma_2$  as reported in Table 10.1. Note that  $\gamma_1$  is highly significant, whereas  $\gamma_2$  has the correct sign but is not significant. We presume as in Krugman (1991) that the short run impact of the real exchange rate on imports is rather weak, there may be, however, a long run effect of the exchange rate on trade, for example, exerting itself with a delay.

Concerning exports, we estimate the following export equation, with  $Ex_t$ , exports

$$Ex_t = b_0 + b_1Ex_{t-1} + b_2\eta_{t-1}$$

The following are the estimated parameters:

$$b_0 = 0.0069 \text{ (0.0019)}$$

$$b_1 = 0.8152 \text{ (0.0483)}$$

$$b_2 = -0.1672 \text{ (0.1241)}$$

The numbers in parentheses are the standard errors. Note that  $b_2$  is not significant. The change of  $\eta_{t-1}$  into  $\eta_t$  does not change the result,  $b_2$  is still nonsignificant. Here too we see that in the short run export does not depend on the real exchange rate.

The estimation of the other structural parameters in Set 3 will not require the time series  $\gamma_t$  and estimated by

$$c_t + g_t = c_0 + c_1y_t^e + c_2u_t\gamma_t \tag{87}$$

Note that we have already estimated  $\beta_y$  and thus are able to compute the time series  $y_t^e$ . The structural parameters are obtained by setting  $c_1 = 1 - s_c$  and  $c_2 = s_c - s_w$ .

The OLS regression equation for the investment function takes the form:

$$i_t - (n + \delta) = i_1[\rho_t^m - \xi - (r_t^m - \pi_t^m)] + i_2(U_t - \bar{U}) \tag{88}$$

For the equation (88),  $n$ ,  $\delta$ , and  $\bar{U}$  are given in Set 7.  $\xi$  is estimated by the method of moments, that is, setting the mean of  $\rho_t^m - \xi - (r_t^m - \pi_t^m)$  to 0. Note that  $\pi_t^m$  here is the medium run expectation, which is different from the short run expectation  $\pi_t$  that has been used in estimating the price–wage dynamics. Also the sample period for estimating the investment function becomes shorter due to our construction of all these medium run time series.

## Evaluating the model and the monetary policy rules

Employing our estimated parameters, we report in Figures 10.1 and 10.2 the actual and predicted macroeconomic time series generated from some key behavioral functions.<sup>25</sup> One can observe that most macroeconomic variables are well predicted.

The fit, however, is less successful for investment. It is even less successful for the interest rate derived from the money demand function. This may create a difficulty for the exercise to simulate the impact of the money supply rule, which shall be discussed later. However, we shall remark that the parameters that we estimate here for the money demand function are statistically significant. This indicates that the explanatory variables,  $y_t$  and  $m_t$ , do have some power to explain the interest rate  $r_{t+1}$ . Yet, admittedly there may be a better explanation for it (which may take, e.g. a nonlinear form). The same argument may also be applied to the investment function.

Yet, whereas the fit for the interest rate derived from the money demand function does not replicate the variation in the interest rate but solely the trend of the interest rate, the estimated investment function at least partially captures the variation in investment. Given that empirical estimates notoriously fail to properly capture money demand and investment functions, we may view our estimates for those two functions still a relative success given our limited aim to study the effects of monetary policy rules in a simple model. Note, however, that the fraction of domestic consumption in total consumption, the  $\gamma$ -series, is predicted well (Figure 10.2).

If we simulate our macroeconometric model with the estimated parameters for both policy rules (the money supply rule here is represented by equation (68) rather than (65)) so that the actual interest rate is either determined by the money supply rule or the Taylor rule, we obtain Figures 10.3 and 10.4. For both policy rules the macroeconomic variables exhibit instability.

When we slightly increase the interest rate reaction to the output gap and inflation gap, the Taylor rule will lead to a convergence result although cyclically fluctuating (see Figure 10.5). However, if we assume the money supply rule as expressed by (68), there is no possibility to obtain a stable result even for a very active monetary policy that means even if we strongly increase the reaction of money supply,  $\beta_m$ . This indicates that a simple money supply rule that does not have a feedback to inflation and output gaps is not enough to stabilize an economy when it is out of its steady state. We still obtain instability and thus do not include the corresponding figure here.

The possible instability generated by monetary policy rules have much been the topic of recent studies on monetary policy (see the various contributions in

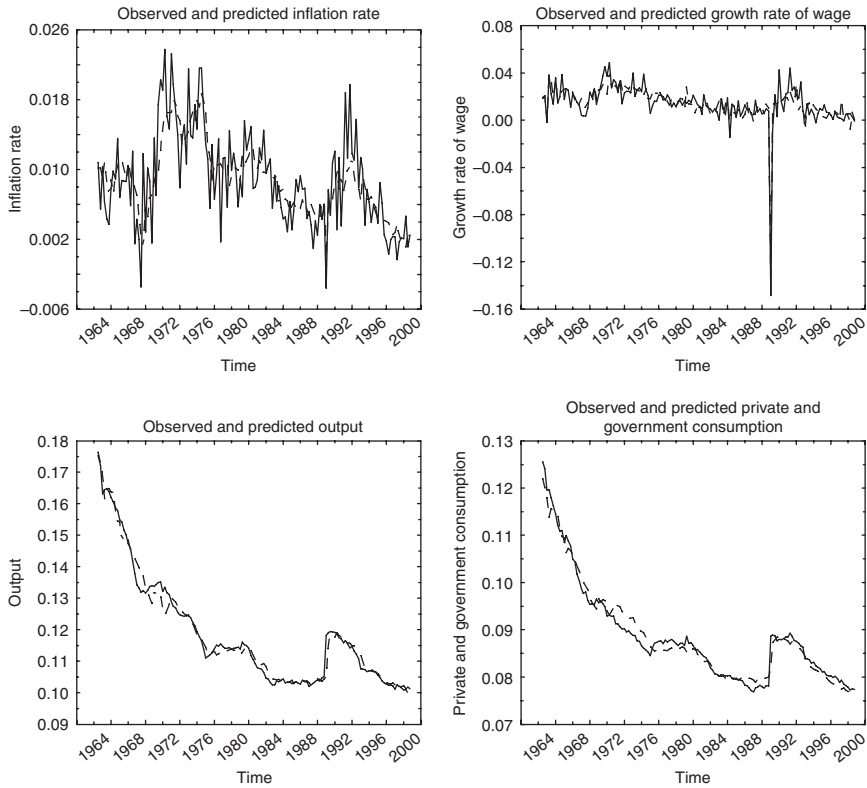


Figure 10.1 Observed (solid) and predicted (dashed) variables.

Taylor (1999)). Christiano and Gust (1999), for example, show, although in an optimizing framework that if the Taylor rule puts too much emphasis on the output gap, indeterminacy and instability of macroeconomic variables may be generated. Instability also occurs under their version of the money supply rule. Yet, in their formulation of the money supply rule they use an AR(2) process to stylize a money supply process. There is thus, as in our equation (68), no feedback of the money supply to other economic variables such as, for example, in our case to the inflation and output gaps. We also have, for reason of comparison, employed such an AR(2) process for the money supply and indeed obtained two completely unstable paths of the macrovariables. This complete instability can only be overcome by feedback rules as we have formulated earlier for our money supply and Taylor interest rate policy rules.<sup>26</sup>

Finally, we want to study whether our model exhibits typical impulse-response functions well-known from many recent macroeconomic studies, see for example Christiano, Eichenbaum and Evans (1994), and Christiano and Gust (1999). In those studies macrovariables respond to liquidity shocks as follows. In the short

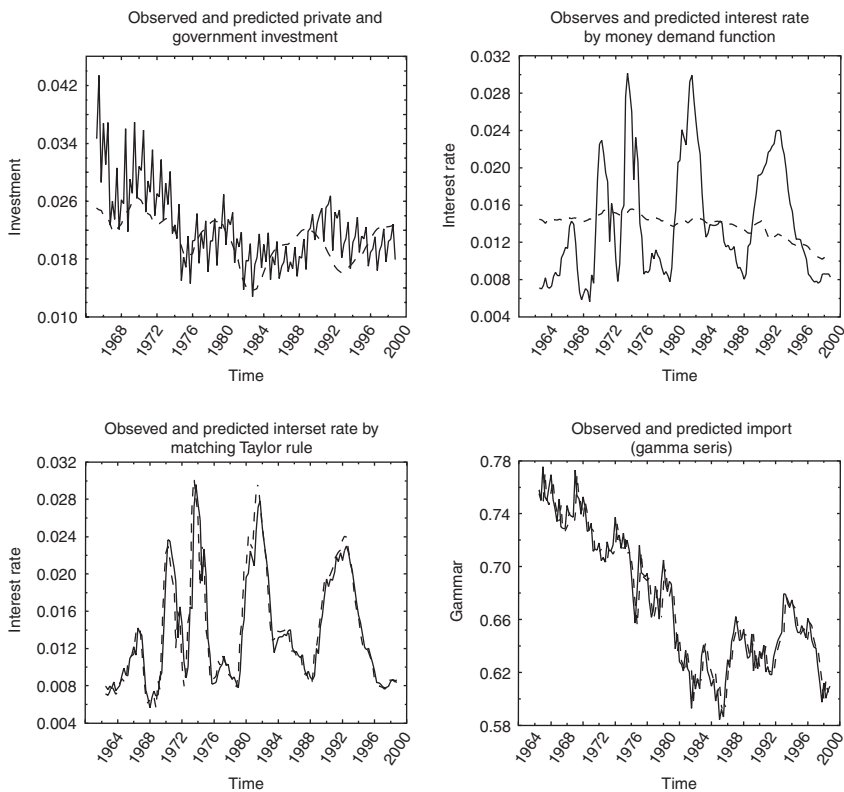


Figure 10.2 Observed (solid) and (dashed) predicted variables.

run, with liquidity increasing the interest rate falls, capacity utilization and output rises, employment rises and, due to sluggish price responses, prices only rise with a delay. Very similar responses can be seen in the context of our model variants for both interest rate shocks (through the Taylor rule, Figure 10.6) and money supply shocks (Figure 10.7). Although, as discussed earlier, the case of the money supply rule produces instability in the long run, we take a short period for an impulse-response simulation so that we can observe the direction of change of variables if the money supply is changed.

Note that we here show the trajectories in deviation form from the steady state. For the Taylor rule, depicted in Figure 10.6, we displace the interest rate through a shock from its steady-state value. By impact, the interest rate is decreased but it moves back in the direction of its steady-state value. The other variables also respond as one would expect from VAR studies of macroeconomic variables.<sup>27</sup> With the fall of the interest rate there is a rise in capacity utilization, output, employment, investment and consumption and, again with a delay, a rise in the inflation rate. The latter can be observed from the fact that the inflation rate peaks later than the utilization of capacity, output, and employment.



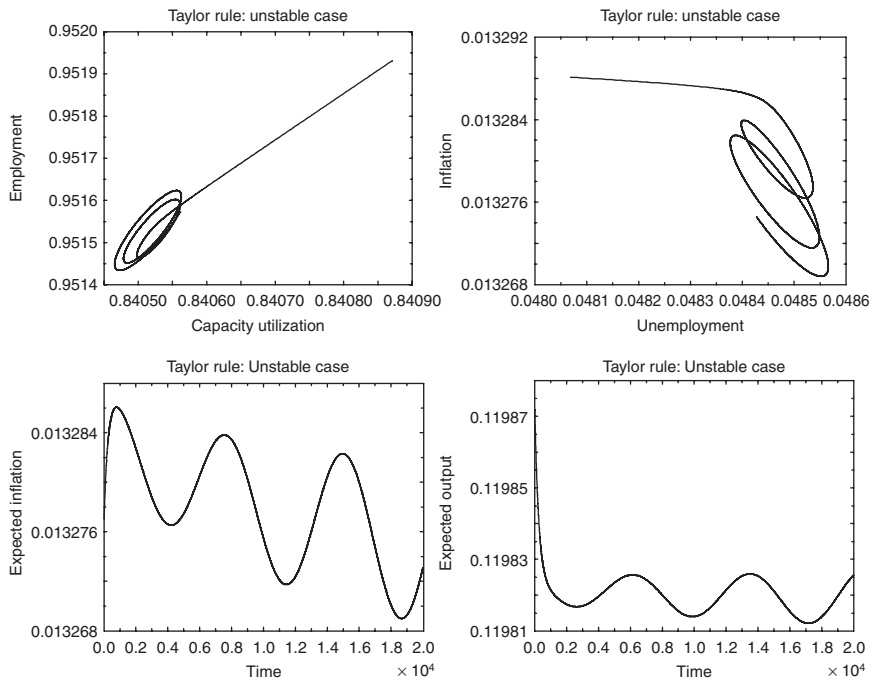


Figure 10.3 Simulation of the model with Taylor rule (unstable case).

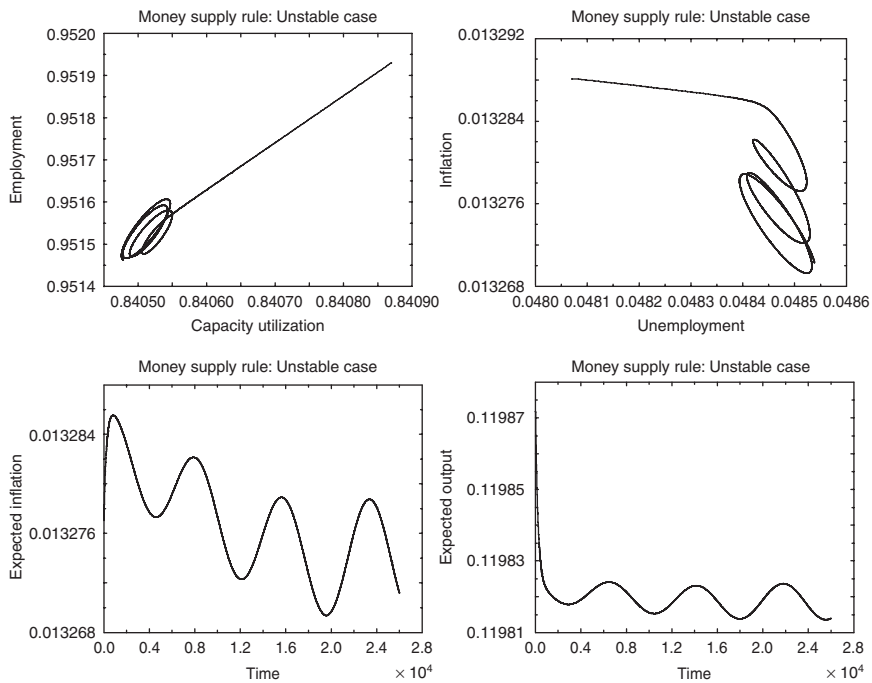


Figure 10.4 Simulation of the model with money supply rule (unstable case).

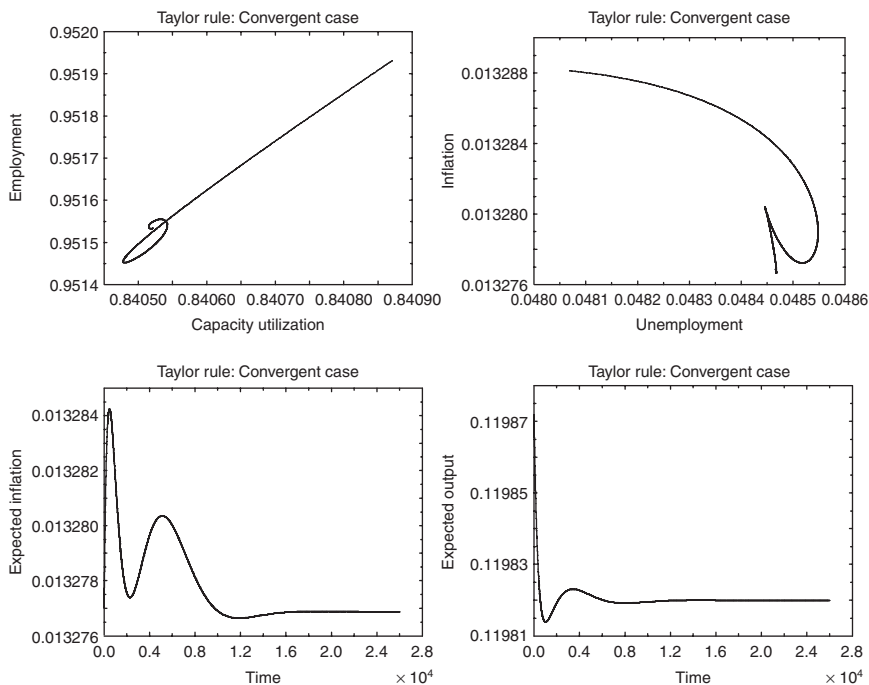


Figure 10.5 Simulation of the model with Taylor rule (stable case).

Similar results can be observed in Figure 10.7, for the money supply rule. For the money supply rule,<sup>28</sup> we have assumed that first there is an out of steady-state increase in the growth of money supply. This gives rise to an interest rate fall, rise of employment, utilization of capacity, investment, consumption and, with a delay, a rise in the inflation rate. Finally in the long run all variables, although cyclically, move back to their steady-state levels.

Another interesting impulse-response study is undertaken for (negative) import shocks, as reported in Figures 10.8 and 10.9. Here we assume a shock to the domestic price level. The price level is assumed to fall by 5 percent on impact and thus  $\gamma$  is assumed to move up, thereafter the real exchange rate is again set equal to its equilibrium value. As can be observed from the Figures 10.8 and 10.9 both for the Taylor rule and the money rule holds that, if the import share in consumption goods decreases domestic consumption as well as all other nominal and real variables first rise and then reverting back to their respective equilibrium values. Overall, our model is roughly able to replicate well-known stylized facts obtained from VAR studies of macroeconomic variables.

In sum, as our study shows, the results of the two variants of the monetary rules are not so different concerning inflation and output stabilization. This holds, however, only if the money supply rule is a feedback rule responding to inflation and output, and money growth. It does not hold for a simple money supply rule. The

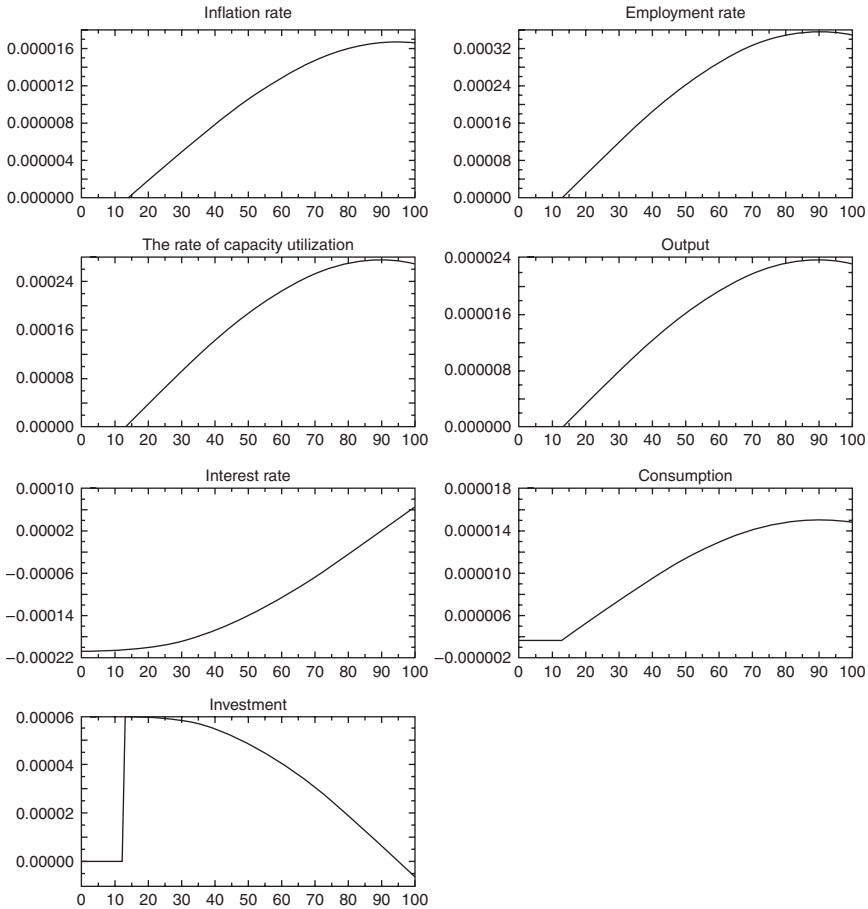


Figure 10.6 Impulse-responses for Taylor rule.

Bundesbank has claimed that it has pursued a simple money supply rule and maintains that this rule of the Central Bank has gained reputation of stabilizing inflation rates in Germany. The Bundesbank has thus suggested to adopt its rule for the European Central Bank (ECB). Yet, as has been shown by Bernanke and Mihov (1997) even the Bundesbank does not seem to have solely pursued the simple money rule, but also had followed an interest rate reaction function. Even though the simple money rule might have worked well for Germany it might not work for the ECB and the Euro-area countries. Also, one can guess that the money demand for the Euro will be more unstable than it had been for Germany in its entire monetary history. The ECB thus recently has indicated that it employs the two pillar concepts, namely to directly targeting inflation rates (through interest rates) as well as targeting the inflation indirectly through the instrument of money supply.

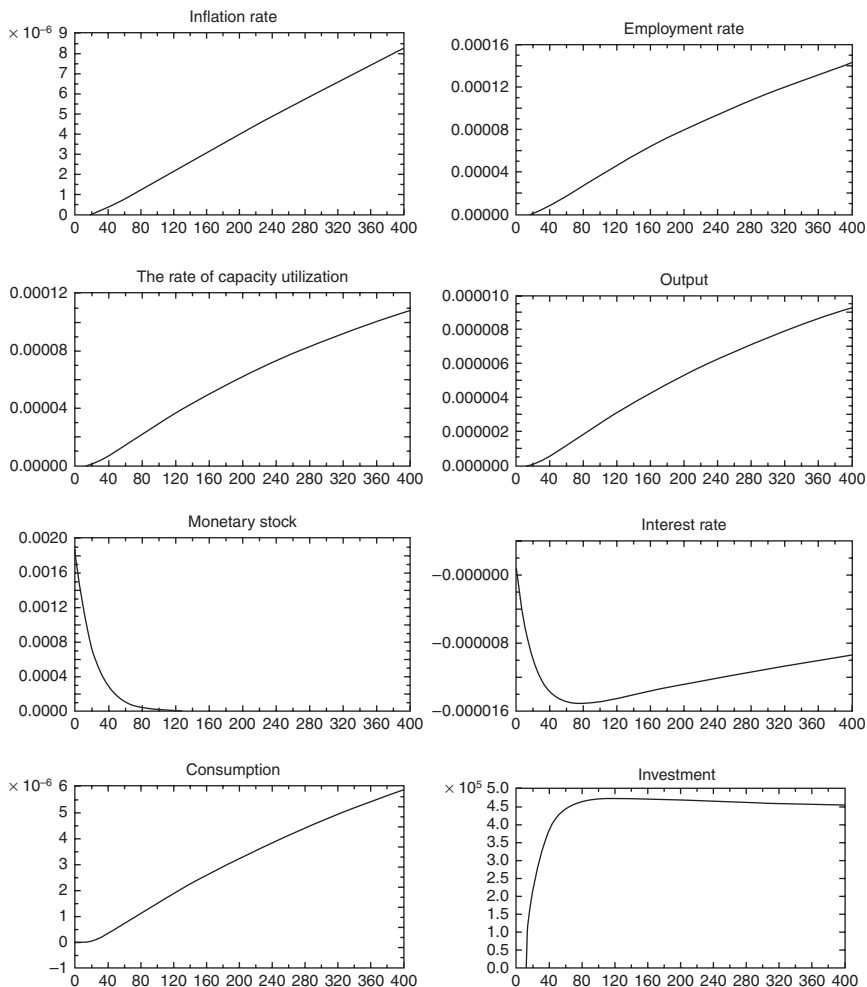


Figure 10.7 Impulse-responses for money supply rule.

An important recent study on the two policy rules can be found in Rudebusch and Svensson (1999a) who compare the two policy rules for US time series data. They also show that the Taylor feedback rule is superior in its stabilizing properties. They draw this specific lesson for the ECB from the US experience. As we have shown, based on our model, and German time series data we come to similar conclusions. In our study, the Taylor rule performs superior concerning stability and a money growth rate rule exerts stabilizing effects only if there are sufficient feedbacks to output and inflation.

We want to note that those stabilizing effects of a more active monetary policy for both monetary feedback rules may hold on the basis of our parameter estimates.

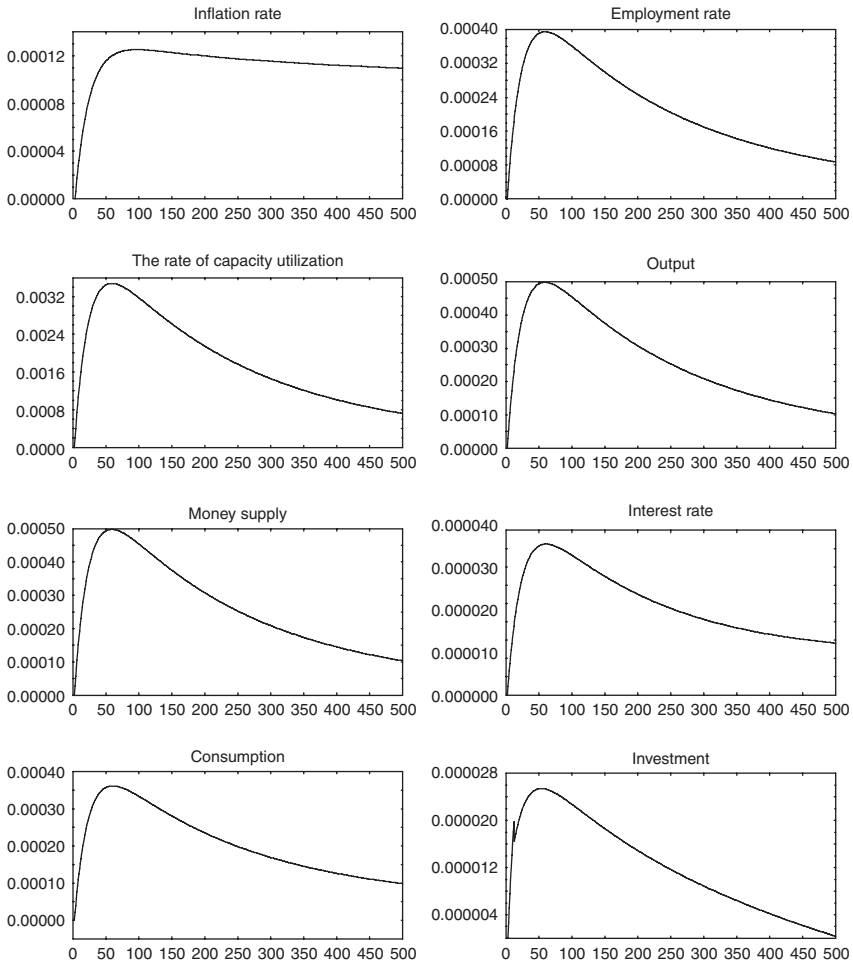


Figure 10.8 Impulse-responses: domestic price fall and negative import shock (money supply rule).

As, however, shown in second section, monetary policy feedback rules may also be destabilizing when monetary policy reactions are too strong. Thus our conclusion is that one can expect stabilizing effects of monetary policy feedback rules if the parameters of the feedback rules stay within a certain corridor.

Finally, we want to note that in the context of the pegged exchange rate system, the EMS, the German monetary policy was the dominating one and the other countries had to react with monetary policy, mostly with short-term interest rate changes to keep the nominal exchange rate constant which of course created also restrictions for the German monetary policy. Under the condition of a single currency now, the Euro, and a single monetary authority, the ECB, the burden of the other countries

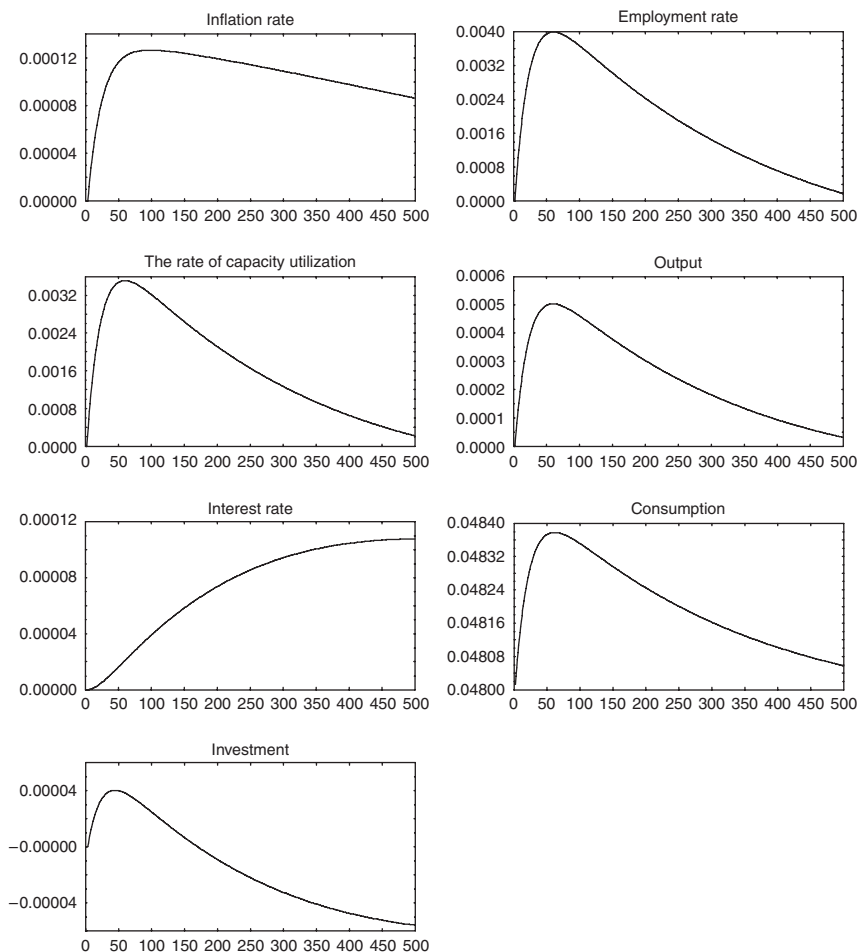


Figure 10.9 Impulse-responses: domestic price fall and negative import shock (Taylor rule).

to retroactively respond to the German monetary policy has been removed by becoming full members of the decision-making body of the monetary authority.

## Conclusions

In the chapter, we have chosen a Keynesian disequilibrium open economy framework for studying monetary policy for a large country—for the German economy—under pegged exchange rates. Disequilibrium is allowed in the product and labor markets whereas the financial markets are always cleared. There are sluggish price and quantity adjustments and expectations are a combination of adaptive and forward-looking ones. The main objective of the chapter was to study the effects of recently discussed alternative monetary policy rules, in the context of an open

economy model, where real exchange rates affect the wage and price Phillips curves and the macroeconomic dynamics. These policy rules are (1) the money supply rule, and (2) the interest rate targeting by the monetary authority. We demonstrate the implication of those policy rules for macroeconomic dynamics, estimate the model employing German macroeconomic time series data from 1970:1–1991:1, and study impulse-response functions for our macrodynamic model.

Based on the estimation of the parameters, obtained partly from subsystems and partly from single equations, we study, using VAR methodology, the proper comovements of the variables by employing either the money supply or the Taylor rule. The results largely confirm what one knows from other, low dimensional, VAR studies. As we could also show, with respect to containing instabilities, the model variant with the Taylor feedback rule is superior in terms of stabilizing inflation rates and output. Yet, as shown in theoretical study in the third and fifth sections too strong policy reactions may be destabilizing too.

Finally we want to note that in this chapter we were mostly interested in comparing the stabilizing properties of the two monetary policy rules<sup>29</sup> and, as Tobin (1975), in the macrodynamics of a large economy resulting from the pegged exchange rate system. We did not enter the controversy whether, from a normative point of view, the monetary policy of the Euro-area countries, given the dominant German monetary policy, has pursued a too tight interest rate policy, (see also Tobin 1998). In fact for the 1990s, even with a much higher rate of unemployment in Europe, compared to the United States, the nominal short-term interest rate in the Euro-area was about 6.1 and for the United States, 5.1 percent. The real interest rate in Europe was 3.2 and for the United States, 1.8 percent. In Semmler, Greiner, and Zhang (2002) it is shown that if the Euro-area countries had applied US response coefficients in the interest rate reaction function the interest rate would have been lower, the output gap smaller, and thus unemployment lower, at roughly the same inflation rate of the Euro-area countries. Such an evaluation of the monetary policy of the Euro-area countries is, however, still subject to current academic discussions. A more elaborate view on this topic can be found in the chapter by Blanchard in this volume.

## Acknowledgments

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## Appendices

### Appendix 1: Notations

|                    |  |
|--------------------|--|
| $Y > 0$            | Output   |
| $Y^e > 0$          | Expected sales                                 |
| $Y_w^D, Y_c^D > 0$ | Disposable income of workers and asset-holders |

|                               |   |
|-------------------------------|---|
| $L^d > 0$                     | Employment  |
| $C_1 > 0$                     | Consumption of the domestic good (index 1: good originates from country 1 = domestic economy)                             |
| $C_2 \geq 0$                  | Consumption of the foreign good (index 2: good originates from country 2 = foreign economy)                               |
| $I$                           | Intended (= realized) fixed business investment   |
| $\mathcal{I} \geq 0$          | Planned inventory investment (existing stock = $\mathcal{N}$ )  |
| $I^p$                         | Planned total investment $I + \mathcal{I}$  |
| $I^a = I + \dot{\mathcal{N}}$ | Actual total investment   |
| $r > 0$                       | Nominal rate of interest (price of bonds $p_b = 1$ )  |
| $p_e > 0$                     | Price of equities   |
| $S = S_p + S_f + S_g$         | Total savings   |
| $S_p > 0$                     | Private savings   |
| $S_f$                         | Savings of firms (= $Y_f$ , the income of firms)  |
| $S_g$                         | Government savings  |
| $T > 0$                       | Real taxes  |
| $G > 0$                       | Government expenditure  |
| $\rho^e$                      | Expected rate of profit (before taxes)  |
| $V = L^d/L$                   | Rate of employment ( $\bar{V}$ the employment-complement of the Nairu)  |
| $K > 0$                       | Capital stock   |
| $w > 0$                       | Nominal wages   |
| $p > 0$                       | Price level   |
| $p_c > 0$                     | Consumers' price index  |
| $\pi$                         | Expected rate of inflation  |
| $e$                           | Exchange rate (units of domestic currency per unit of foreign currency)   |
| $\epsilon$                    | Expected rate of depreciation of the exchange rate $e$  |
| $M > 0$                       | Money supply (index d: demand, growth rate $\mu_0$ )  |
| $L > 0$                       | Labor supply  |
| $B > 0$                       | Domestic bonds, of which $B_1$ and $B_1^*$ are held by domestic and foreign asset-holders, respectively (index d: demand) |
| $B^* > 0$                     | Foreign bonds, of which $B_2$ and $B_2^*$ are held by domestic and foreign asset-holders, respectively (index d: demand)  |
| $E > 0$                       | Equities (index d: demand)  |
| $W > 0$                       | Real domestic wealth  |
| $\omega > 0$                  | Real wage ( $u = \omega/x$ the wage share)  |
| $R \geq 0$                    | Stock of foreign exchange   |
| $\Delta Y^e = Y^e - Y^d$      | Expectations error on the goods-market  |
| $Ex \geq 0$                   | Exports in terms of the domestic good   |
| $Im \geq 0$                   | Imports in terms of the domestic good   |
| $NX = Ex - Im$                | Net exports in terms of the domestic good   |
| $NFX$                         | Net factor export payments  |
| $NCX$                         | Net capital exports   |
| $\zeta$                       | Surplus in the balance of payments  |
| $\eta = p/(ep^*)$             | Real exchange rate (measured in Goods*/Goods)   |



$$\begin{aligned}
 T_c &= \tau_c(\rho K + rB_1/p) + \tau_c^* e_0^* B_2/p \\
 p^u &= (T_c - rB_1/p - e_0^* B_2/p)/K \\
 &\text{Taxes on domestic capital income net of domestic interest} \\
 &\text{receipts per unit of capital} \\
 nx = NX/K &\text{ Net exports per unit of capital}
 \end{aligned}$$

### Appendix 2: Proof of flow consistency

We here consider and prove the following identities:

$$\begin{aligned}
 1 \quad S &= I + \dot{N} + NCX/p \\
 2 \quad S &= I + \dot{N} + NX + NFX/p, \text{ that is,} \\
 3 \quad \mathcal{Z} &= NX + NFX/p - NCX/p = 0
 \end{aligned}$$

on the basis of the budget constraints provided in the modules on household, firm, and government behavior. We first consider the relationships between real saving and its allocation to financial asset, and consider thereafter the sources of aggregate savings and its relationships to total investment and the current account. With respect to the definitions of  $NX$ ,  $NFX$ ,  $NCX$  the reader is referred to module 9 referred earlier. We stress that  $\mathcal{Y}^d$  denotes the total demand for the domestically produced good and  $\mathcal{Y}$  the domestic output of this commodity.

$$\begin{aligned}
 S_p &= \mathcal{Y}_w^D + \mathcal{Y}_c^D - C \\
 &= s_w \mathcal{Y}_w^D + s_c \mathcal{Y}_c^D \\
 &= (\dot{M} + \dot{B}_1 + e\dot{B}_2 + p_e \dot{E})/p \\
 S_f &= \mathcal{Y}_f = \mathcal{Y} - \mathcal{Y}^e = \mathcal{I} = I + \dot{N} - p_e \dot{E}/p \\
 S_g &= T - rB/p - G = -(\dot{M} + \dot{B})/p \\
 S &= S_p + S_f + S_g = I + \dot{N} + [e\dot{B}_2 - (\dot{B} - \dot{B}_1)]/p \\
 &= I + \dot{N} + NCX/p \\
 &= \text{Actual investment} + \text{Capital Account Balance} \\
 S_p &= \omega L^d + \rho^e K - T + rB_1/p + e r^* B_2/p - (C_1 + C_2/\eta) \\
 &= \mathcal{Y}^e - \delta K - T - \mathcal{J}^d/\eta + rB_1/p + e r^* B_2/p - C \\
 S_f &= \mathcal{Y} - \mathcal{Y}^e \\
 S_g &= T - rB/p - G \\
 S &= S_p + S_f + S_g \\
 &= \mathcal{Y} - \mathcal{Y}^d + \mathcal{Y}^d - C - G - \delta K - \mathcal{J}^d/\eta + e r^* B_2/p - r(B - B_1)/p \\
 &= \dot{N} + I + \mathcal{Y}_1^{d*} - (C_2 + G_2 + \mathcal{J}^d)/\eta \\
 &\quad + e r^* B_2/p - r(B - B_1)/p \\
 &= \text{Actual investment} + \text{Current Account Balance} \\
 &= I + \dot{N} + NX + NFX/p
 \end{aligned}$$

**Appendix 3: Sources of macroeconomic time series data**

The time series data for the variables employed in the model are available at the web-site: [www.wiwi.uni-bielefeld/~cem](http://www.wiwi.uni-bielefeld/~cem). The data set contains also time series data for France, United Kingdom, and Italy.

| <i>ASCII-file</i> | <i>Time series data</i>   | <i>Source</i>                |
|-------------------|---|------------------------------|
| eu_cs.txt         | Business capital stock,<br>quarterly<br>mn. currency units  | OECD 1997, BSDB              |
| eu_cu.txt         | Capacity utilization (in percent)<br>quarterly  | OECD Statistics,<br>ISY 1997 |
| eu_e.txt          | Total employment, persons,<br>quarterly   | OECD 1997, BSDB              |
| eu_exc.txt        | Exchange rate index,<br>1990 = 100, quarterly   | IMF Statistics, ISY 1997     |
| eu_gd.txt         | GDP—Deflator, quarterly<br>Western Germany<br>(before 3. Okt. 1990)   | OECD 1997, BSDB              |
| eu_gdp.txt        | GDP at market prices,<br>quarterly<br>mn. currency units  | OECD 1997, BSDB              |
| eu_id.txt         | Indirect taxes, annual<br>mn. currency units  | ISY 1997                     |
| eu_m1.txt         | Monetary aggregate M1,<br>quarterly<br>mn. currency units   | OECD Statistics, ISY 1997    |
| eu_nc.txt         | Private consumption,<br>half year<br>mn. currency units   | BSDB, OECD 1997              |
| eu_pfi.txt        | Private fixed investments,<br>excl. stockbuild.<br>mn. currency units, quarterly,<br>Western Germany (before 3.<br>Okt. 1990) | OECD 1997, BSDB              |
| eu_rc.txt         | Deflator private consumption,<br>quarterly  | OECD 1997, BSDB              |
| eu_tax.txt        | Annual tax receipts as<br>percent of GDP  | ISY 1997                     |
| eu_tbr.txt        | Treasury bill rates as percent<br>per year, quarterly   | IMF Statistics, ISY 1997     |
| eu_wage.txt       | Wage index, 1990 = 100,<br>quarterly  | IFS Statistics, 12.97        |
| eu_exp.txt        | Exports of goods and services,<br>quarterly<br>Constant prices, mn. 1991 currency<br>units, seas. adjusted                    | ISY 1997                     |
| eu_imp.txt        | Imports of goods and services,<br>quarterly (see eu_exp.txt)  | ISY 1997                     |
| eu_ge.txt         | Government expenditures,<br>percentage of GDP annual  | OECD 1997, BSDB              |

Whereby, ISY 1997 stands for the “International Statistical Yearbook,” CD-release 1997, OECD 1997 includes the “OECD—Statistical Compendium,” CD-release 1997, and IFS 1997 are the “International Financial Statistics.” The following databases of the named CD-Roms were used: BSDB<sup>30</sup> of the OECD 1997, Eurostatistics, IMF Statistics and OECD Statistics of the ISY<sup>31</sup> 1997 CD-Rom.

**Notes**

- 1 This is a question in which James Tobin was particularly interested in, see, for example, Tobin (1975).
- 2 For more details of such a framework, see Flaschel *et al.* (1997) and Chiarella *et al.* (2000).
- 3 Of course, we want to note that our analysis appears to be valid only if there are no major currency attacks which can lead either to major realignments of the currencies or to the abolition of the pegged system. Such a major currency attack has occurred for the EMS in September 1992 and produced a considerable currency crisis for the EU member states with subsequent realignment and a larger band.
- 4 Measured as the amount of foreign goods currently traded for one unit of the domestic good.
- 5 See the steady-state calculations in third section for the derivation of the expressions for  $y_o^d, y_0$ .
- 6 See Rødseth (2000) for the same type of assumption. We could discuss fiscal policy in the context of our model. Yet we will focus on monetary policy since this is the more controversial issue in the context of pegged exchange rates.
- 7 The formulation of money demand can be derived from a money demand function of type  $M^d/p = m^d(\mathcal{I}, W, r)$ , assumed as homogeneous of degree one in  $(\mathcal{I}, W)$ . A Taylor expansion of  $M^d/(pW) = m^d(\mathcal{I}/W, r)$  would yield (5). For analytical simplicity, we replace  $W$  by  $K$  in (5) in the developments later.
- 8 Or, alternatively one could assume that the interest rate is steered through an assumed EU-wide Taylor rule controlling the nominal rate of interest for the EU countries.
- 9 We, however, neglect any influence of the real exchange rate on investment plans and thus the import of investment goods in this chapter.
- 10 In fact, only a traditional LM-equation for the domestic rate of interest.
- 11 We note that demand for foreign goods  $Y_2^d = C_2 + \mathcal{J}^d + G_2$  is well defined, but does not feed back into the domestic dynamics and can thus be neglected in their investigations.
- 12 Note that the under the EMS, the national currencies were converted into ECU as a Euro-wide unit of account.
- 13 Yet we want to note that sometimes realignment were necessary and, after the currency attack in September 1992, the exchange rate band was widened.
- 14 These are normally interpreted as net “factor” exports NFX.
- 15 We note that  $\epsilon^m$  is measured as a 12-quarter moving average of  $\epsilon = \rho - (r + \xi - \hat{p})$  in the empirical application of the model,  $\rho$  the actual rate of profit, see also the following.
- 16 We have assumed that  $y_1^{d*}(\eta)$  is given by  $\gamma_0^* + \gamma_1^*(\eta_0 - \eta)$ .
- 17 Choosing  $\beta_{\mu_1} = \beta_{\mu_2} = \beta_{\mu_3} = 0$  and  $\mu = \bar{\mu}$  leads us back to the 6D dynamics considered initially.
- 18 For this purpose the monetary authority could also use a sterilizing monetary policy, for an extensive discussion on this point, see Krugman and Obstfeld (1994, Chapter 18).
- 19 Note that  $\beta_{\mu_2}$  is even negative.
- 20 There,  $\beta_p$  is negative and statistically insignificant when we use US time series. In the case of using German time series,  $\beta_p$  is close to zero while statistically insignificant.
- 21 With  $i(\cdot)$  set to 0, a steady-state condition.
- 22 Since there is only one parameter  $\beta_j$ ,<sup>e</sup> here, we employ a grid search algorithm.
- 23 This indicates that the weighting matrix takes the form of  $I_{ST}$ . Considering that both  $\hat{w}_i$  and  $\hat{p}_i$  are measured in terms of growth rates, it may not be quite unreasonable to assume an equal weight in matching  $\hat{w}_i$  and  $\hat{p}_i$ .
- 24 For description of simulated annealing, see Semmler and Gong (1996).
- 25 Note that in this exercise the fitted line is obtained by simulating not the entire system of equations, but the corresponding behavioral functions using the estimated parameters.

- 26 We want to note, however, that strong feedback rules resulting in a very active monetary policy can also lead to (local) instability. This is demonstrated in Benhabib *et al.* (2001). Yet, this is shown in a model where the Taylor rule only responds to inflation rates.
- 27 See for example, Christiano *et al.* (1994) and Christiano and Gust (1999).
- 28 Note that here we use the money supply rule as represented by (65).
- 29 For an evaluation of these two policy rules in the context of macroeconomic theory, see Tobin (1998).
- 30 BSDE=Business Sector Database.
- 31 International Statistical Yearbook.

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## **Part IV**

# **Monetary policy rules, fiscal policy, and unemployment**





# 11 The constitutional position of the Central Bank

*Charles Goodhart*

## **Independence for Central Banks**

In the course of the almost worldwide move towards granting Central Banks operational independence, there have been several interrelated strands of argument. The first arose as a reaction in New Zealand from Prime Minister Muldoon's ham-fisted interference with, and political manipulation of, every aspect of that country's economy, but particularly of its public sector, during the 1980s, an episode which illustrates that government interference in the economy can emanate from right-wing governments as much as from those on the left. Anyhow, the question which the then incoming Labor government, and its Finance Minister, Roger Douglas, sought to answer was how to minimize constant political interference in the public sector, and yet at the same time to achieve commonly agreed objectives in the provision of public services; in the case of monetary policy that service being primarily price stability. Note that if such objectives could be obtained through competition and the pursuit of profit maximization, then the correct answer was, of course, privatization. In other cases, the general answer that was found was to specify, as closely as possible, the objectives to be attained by the public sector bodies responsible for achieving them, in a contract with the government, and then to leave the managers with the freedom to make the necessary operational decisions, subject to strict accountability for the achievement of outcomes (though not for processes or methods, as those of us in Universities who have suffered from the appalling QAA studies on teaching methods would wish to emphasize). In this context operational independence for the Reserve Bank of New Zealand (RBNZ) was not primarily about the specifics of monetary policy, but rather the application to the RBNZ of a generalized approach to public sector bodies, which had already been applied to numerous other New Zealand public sector industries and services.

The second strand of argument relates to the danger that an executive, and the legislature, having together established the underlying laws and regulations by which a country should be run, might then be tempted to bend or to subvert the subsequent legal and operational rulings in their own short run political interest. This danger is all the greater because the executive, especially when it dominates the legislature, as it is designed so to do here in the United Kingdom, has great power. It is this concern that leads to the separation of the judiciary, the least

dangerous of the three main arms of government, from the executive and legislature, so that the interpretation and enforcement of the rules of law are carried out through an independent judiciary, though here, as elsewhere, accountability and transparency are essential to maintain democratic legitimacy. The people have a right to know the legal grounds on which a case has been settled.

Within the field of monetary policy, the potential subversion of the underlying objective of price stability goes under the jargon terminology of “time inconsistency,” which harks back to the famous Kydland–Prescott paper. That demonstrated how long-term commitments would often be foregone in pursuit of short-term (electoral) expediency. Much of that literature, following certain strands of American thought, exaggerates political venality, suggesting, for example, that politicians consciously try to fool the public by covertly expanding monetary growth prior to elections. Considering that the monetary policy instrument involves setting interest rates, which is a highly visible process, and that the effects of this on the economy require long and variable lags, the implausibility of instigating a covert political business cycle via monetary manipulations is clear. The same holds true, more or less, when the policy instrument is some form of monetary base or monetary aggregate control, the data for which are usually rapidly available.

Nevertheless, there are milder forms of time inconsistency. Because of those very same lags, interest rate increases now need to be made to counterforecast inflation threats in the future, say 18–24 months hence. But, forecasts of the likely onset of inflation at such a future date are inherently uncertain, and increases in interest rates, which thereby also tend to depress asset prices, are widely unpopular. Hence, politicians are loathe to raise interest rates just on the basis of forecasts, but would rather wait until there is clear and present evidence of rising inflation. However, by then it is too late to nip the inflationary pressure in the bud. The shortcomings of policy, in this country at least, have been “too little, too late,” not a conscious attempt to rig elections. Indeed, we have recently seen, even within our own independent Monetary Policy Committee (MPC), the tensions that can occur when a forecast of rising future inflation coincides with current low present values of that same variable.

These two arguments for operational independence were in turn greatly strengthened by the claim, nowadays widely if not quite universally accepted, that demand management cannot on its own enhance either the medium and longer term growth rate, or the sustainable level of employment, beyond the limits enforced by more fundamental supply-side considerations; or in other words that the long-term Phillips curve, relating inflation to the output gap, was vertical. This is not to deny, however, that badly judged demand-side management could depress the economy below potentially attainable levels for very long periods, as Argentina over many decades and Japan more recently have evidenced.

However, if the medium and longer-term Phillips curve is vertical, then over this same horizon the only objective that the Central Bank can achieve is price stability. Indeed for a variety of reasons such price stability will also provide the best nominal background for growth; though I shall refrain on this occasion from setting out the arguments why price stability is better treated in practice as involving a small positive rate of inflation, rather than zero or perhaps even deflation.

The key result of this line of analysis is that a Central Bank should have a single, measurable, and quantifiable, primary policy objective, to wit the rate of inflation. Hence, accountability and visibility are enhanced. There are no trade-offs; no discretionary judgments between competing objectives. Moreover, when the government is involved in establishing the objective, by defining the proposed path for the inflation target, there is no democratic deficit either. Indeed, the public accountability of monetary policy has been greater in this country since 1997, when the incoming Labour government changed the regime, than in any previous period.

Milton Friedman dissented from this policy proposal in his 1962 paper on “Should there be an independent Monetary Authority” on the grounds that,

the objectives [of price stability that] it specifies are ones that the monetary authorities do not have the clear and direct power to achieve by their own actions. It consequently raises the earlier problem of dispersing responsibilities and leaving the authorities too much leeway. There is unquestionably a close connection between monetary actions and the price level. But the connection is not so close, so invariable, or so direct that the objective of achieving a stable price level is an appropriate guide to the day-to-day activities of the authorities.

(Friedman, M. 1968: 193)

You will not be surprised that I disagree. Most outcomes in life are not under the complete control of the relevant decision-maker, for example, promotion for football managers, financial returns for fund managers, profits for company CEOs and growth for Economic Ministries. Yet they are judged, and rightly so, by such outcomes.

### **Independent fiscal authorities?**

Delegation of decision-making is, however, far more difficult when trade-offs among competing objectives are involved. It is possible to argue that the role of politics is to try to resolve and reconcile instances in which there are such inherent trade-offs. For example, so great has been the success of delegating monetary policy to an independent Central Bank that many ask why the same trick cannot be turned with fiscal policy. Thus Alan Blinder, in his Robbins lectures on Central Banking in Theory and Practice, commented that, and I quote,

Having briefly presented the basic arguments for central bank independence, let me now raise a curmudgeonly thought. When you think deeply about the reasons for removing monetary policy decisions from the “political thicket,” you realise that the reasons apply just as well to many other aspects of economic policy—and, indeed, to non-economic policy as well. Consider tax policy as an example.

Decisions on the structure of the tax code clearly require a long time horizon, just as monetary policy decisions do, because their allocative and distributional

effects will reverberate for years to come. There is a constant temptation—which needs to be resisted—to reach for short-term gain that can have negative long run consequences. Capital levies are a particularly clear example. Tax design and incidence theory are complex matters, requiring considerable technical expertise, just as monetary policy is. And decisions on tax policy are probably even more susceptible to interest-group politics than decisions on monetary policy.

Yet, while many democratic societies have independent central banks, every one leaves tax policy in the hands of elected politicians. In fact, no one even talks about turning over tax policy to an independent agency. Why? I leave this question as food for thought, perhaps for another day.

(Blinder, A. 1998: 57–9)

My own answer to this conundrum is that, unlike monetary policy which has one single overriding objective, that is, price stability, fiscal policy is intrinsically concerned with at least three objectives, these being allocative efficiency, income distribution, and macroeconomic stabilization and adjustment. I would contend that any fiscal package will tend to affect each of these in different ways, so trade-offs are almost inevitable, and the resolution of such trade-offs would seem to require a political decision-making process.

There have, however, been occasional attempts to reduce the dimension of such political horse-trading in the fiscal arena by seeking to separate decisions on the overall macroeconomic magnitudes, that is, to force a decision on the aggregate size of the fiscal deficit, separate from subsequent, second-round decisions on the individual elements of the budget. This is particularly common, and indeed necessary, when several states with independent fiscal powers share a single, federal monetary system. Otherwise spillovers from the individual states' fiscal decisions onto the common monetary system could all too easily lead to an untenable tension between the fiscal policies of the separate states and the single federal monetary policy, and, in particular, to concern whether a federal government might be induced to bail out a bankrupt subsidiary state. While the possibility of such a bail-out would surely be denied in advance, there would be enormous pressure to do so after the event, a clear case of likely "time inconsistency." Hence the balanced budget constitutional requirement in most states in the USA; the Amsterdam Stability and Growth Pact; and the serious problems which have been evident recently in Argentina, and previously in Brazil, until they resolved this matter.

Nevertheless, in most such federal cases, for example in the USA, externally imposed limits on the fiscal deficit of the subsidiary states, have been accompanied by a discretionary and politically determined federal budget deficit, which is typically much larger than the subsidiary state budgets. The Euro-zone is an exception in this respect. Even so, as Geoffrey Wood has reminded me, the checks and balances in the budgetary process in the USA at least, and the long time lags involved, have meant that the quasi-automatic fiscal stabilizers have usually played a more successful role in stabilization than conscious discretionary policy.

This does raise the question of whether, besides the appropriate limitation on subsidiary state budgets, there should be independent decisions, or outside constraints, on the aggregate budget deficit either of unitary, or of federal, countries. There are many considerations. For example, the macro-economic effect of a given overall deficit is not independent of the composition of its component items. Again, how should one respond to the working of the automatic stabilizers in influencing the deficit? Next, given the penchant of politicians for believing that a cyclical upturn is due to their own genius in generating a better trend, so that no need is then seen for achieving a surplus during the good times, a noncyclically adjusted constraint is likely to lead to the stabilizers being switched off just when they are most needed. However, the measurement of such cyclical adjustment factors is an arcane mystery, and accounting practices in the public sector have been every bit as creative as Arthur Andersen's helpful hints in the private sector.

One final point that I would raise is to query what the objective for a putatively independently determined, aggregate fiscal deficit would be, so that *ex post* accountability could be applied? It cannot be the level of employment, because the vertical Phillips curve analysis indicates that that is the province of underlying supply-scale factors. It cannot be price stability because that is the task of monetary policy. Presumably then the function of aggregate fiscal policy is to help to determine the balance between public and private sector expenditures, between tradeables and nontradeables, and thus the level of exchange rates and (real) interest rates consistent with price stability. Therefore, if public sector expenditures, and the overall deficit, are bigger, real interest rates then have to be higher, with a more appreciated exchange rate, in order to maintain the mandated level of price stability. However, that would seem to bring us right back to issues of allocative efficiency, and of income distribution. If so, the idea that we could seek to avoid trade-offs and conflicts between objectives by separating off decisions about the aggregate fiscal deficit from detailed assessment of its component parts, would seem to be a mirage.

### **Competing objectives in monetary policy**

One of the arguments pressed most strongly by the Treasury in this country against operational independence had been that the various arms of demand management, notably, but not only, fiscal and monetary policies, needed to be coordinated, and could not be so if monetary policy was delegated to the Central Bank. While this sounds superficially sensible, in practice one arm of policy has always been first-mover, aiming at internal stability, whereas the other arm has had more responsibility for the exchange rate and the composition of expenditures between tradeables and nontradeables. In previous decades, fiscal policy was first-mover and monetary policy had the compositional role. Now the responsibilities have just been reversed, but coordination remains no more difficult or problematic than it ever was.

A corollary of this analysis is that, once the Central Bank has been given the target of achieving price stability, attempts to influence the level of exchange rates

and interest rates effectively falls on fiscal policy. This is not widely recognized, but leads to some uncomfortable questions. How far would the public have wanted to enjoy lower exchange rates and interest rates in recent years if the quid pro quo for doing so was accepted to be lower public expenditures or higher taxes? This is the way that most central bankers think that this key economic trade-off should be discussed, but it does not yet appear in this format to the average person. One question that I would ask is, why this relationship, so clear in the view of central bankers, has not been more widely appreciated by the general public?

Therefore, under a system of inflation targets, the internal-external balance is essentially an issue for fiscal policy to address. But that does not mean that monetary policy can be very innocent of trade-offs, despite its one objective, one instrument format. In particular, there is a short run trade-off between inflation and output; over that horizon the Phillips curve is downward sloping, though the precise position of this relationship remains subject to unpredictable and elusive variation. Indeed, one of the main routes by which the Central Bank aims to achieve its medium-run sole inflation target is by trying to adjust current real output relative to its (imprecisely) estimated equilibrium level; and by the same token, nominal interest rates changes have real effects on expenditures and output in the short run.

Does that not get one back into the realm of value judgments over trade-offs between alternative objectives? Not really, in the UK case at least. The point here is that the clash between output and inflation objectives only really arises when there are supply shocks. With a demand shock, the adjustment required to stabilize inflation will at the same time bring output back into line with equilibrium, *ceteris paribus*. It is supply shocks that cause the difficulty, driving inflation, and output in different directions away from their desired levels. But any major adverse supply shock, especially if unexpected, such as a conflict-driven oil price increase, or destruction of output capacity, is likely to drive inflation outside the 1 percent band around the target which triggers a public letter from the MPC to the Chancellor. In that letter the MPC is expected not only to explain what has happened, but also to present its plans for returning inflation to target, which will involve, at least implicitly, a forecast path for output as well as for inflation, in other words how the MPC intends to address that trade-off.

What has not, in my view, been widely enough appreciated is that this letter gives the Chancellor an opportunity to write back; there could be an exchange of letters. If the Chancellor dislikes how the MPC plans to handle the trade-off in this circumstance, he can always respond by asking, for example, the Bank to accelerate the return to the inflation target, thereby raising the coefficient and weighting placed on reducing the variability of inflation, around target, relative to that on output. Alternatively, he can do the opposite, asking the Bank to give more weight to output smoothing rather than inflation smoothing, in that conjuncture. So, very cleverly, the current regime of inflation targeting in the United Kingdom has an inbuilt mechanism for restoring the decision-making process to the political arena whenever the short-term trade-offs look to become really difficult and potentially contentious.

There are those who query whether such safety valve or override mechanisms may not do more harm than good, notably by reducing the economic credibility of a Central Bank's independence. Chris Huhne made this point in a *Financial Times*' personal opinion piece in the summer of 2002. My own response to that is that Central Bank independence is essentially a political construct, so that if too large a head of steam develops on the political front, then that independence could be blown away. Credibility has a most important political dimension. Of course, a Central Bank's independence can be further protected, and shored up, against political involvement by being incorporated in a Constitution or a binding Treaty; and that does mean that safety valves, and overrides, may be seen as less necessary. Even so, I rather doubt whether it would be either intrinsically desirable, or sensible in its own self-interest, for a Central Bank to flout the democratically expressed value judgments of the people, and of their representatives in government, about the balance between competing objectives too far and for too long.

### **The Central Bank and financial stability**

Central banking is not just about maintaining an anchor for price stability; it has historically also had a vital concern for the stability of the financial system as a whole, and particularly for the banking and payments systems within that. The achievement of systemic financial stability is a much more complex issue than that of trying to hit an inflation target. The measurement of financial stability is conceptually much more difficult; there is no single obvious instrument to adjust, if unilateral adjustment can be done expeditiously at all; and in the case of financial stability, one is concerned about extreme, and hence improbable, events rather than central tendencies. For all such reasons, accountability, except in a rather trivial *ex post* sense, is much more difficult. I intend to write more about such issues over the next few years.

What I want to do now is to note that commercial banks, and banking, are more intimately connected with assets and asset prices, than with the course of goods and services prices, more widely. Bank lending is primarily for asset purchases, and when it is collateralized, the collateral involves assets, not goods and services. In this context, domestic real estate, housing and property, has been and remains much more important than either equities, or foreign assets, in the nexus between banking and asset prices. If one worries about systemic stability in banking, one should worry most about property prices rather than the FTSE or the Dow.

That raises the question of whether there can be a trade-off between maintaining stability in asset prices, in particular property prices, and hence also in systemic stability in the financial system on the one hand, and in controlling (retail price index excluding those items directly affected by interest rate changes) RPIX, goods and services inflation on the other. Some of the practical problems of trying to take account of asset prices are well illustrated by the contrasting trends in housing and equity prices in the United Kingdom so far this year. More generally, however, there is usually little conflict between the policy needs indicated by asset prices, and for systemic stability, on the one hand, and the needs indicated by

goods and services prices, and for price stability on the other. Long periods of asset price deflation, and financial fragility, typically go hand in hand with falling or sluggish output and deflation; witness Japan now and the United States in the 1930s. Similarly, booming asset prices usually occur on the back of strongly growing economies and inflationary upsurges. But there are exceptions. The stock market crash in 1972–74 in London was far worse than anything seen recently, and this occurred at a time of sharply worsening inflation. In the last decade, the very success of monetary policy in lowering inflation, inflationary expectations and hence nominal interest rates, and in presiding over one of the longest cyclical economic upturns ever, played some part in encouraging the boom in asset prices, especially of equities.

If we had known what was coming in 2001 and 2002, would we have wanted to raise interest rates a bit more, and a bit earlier in 1999 and 2000, perhaps especially in the USA? In my view, the answer to this is “yes,” though even so I doubt whether the perfect hindsight, 20/20 vision, interest rate path would have been much higher then. The point of this counterfactual is to contend that the main problem in trying to take asset prices into account in setting monetary policy is not so much the principle of whether it is desirable to do so, but rather the difficulty of assessing the extent of any current disequilibrium, and of forecasting the future path of such prices over the policy horizon.

Alan Greenspan’s famous comment about irrational exuberance occurred in 1996 when the Dow was still in the 6000s. It is arguable that, if you make the appropriate adjustments for inflation, real interest rates, dividend payments, etc., that values have finally fallen back in 2002 to less exuberant levels. But it took 6 years. Would he, even with perfect hindsight, have been right to raise interest rates before, say, 1999? The argument that the authorities can stabilize output and inflation by preventing a boom–bust bubble cycle in asset prices depends on their ability to forecast that asset price cycle. This is not an easy exercise. After all, in the short and even the medium-term, asset prices tend in most cases (though not in real estate), to follow a random walk. Only in the long run, of 5 to 10 years or more, is there mean reversion; and monetary policy, and inflation control, has a horizon of a year, or two, not of decades.

At this point, some of my European Central Bank (ECB) friends and colleagues might surmise that their first pillar for assessing policy, watching the appropriate trends in broad money, might protect against longer term monetary policy errors, especially given the close links between asset prices and bank lending developments. While I do believe that monetary variables often contain useful information, rather an unfashionable position nowadays in Anglo-Saxon Central Banks, the ongoing structural shifts in banking, which regulatory changes also affect, sometimes make it extremely difficult to decipher the message in the monetary data.

So, where does that leave me on the broad question of whether it is right to take asset price developments, and the associated effect on financial stability, into account in trying to set monetary policy? My own answer to this is that it is correct to do so in principle, but that the practical problems of forecasting the



current disequilibrium and future time path of asset prices are so severe that one is talking at most about shading monetary policy decisions on this account; and this, I guess, is what tends to happen already, though probably more often in response to asset price declines than to increases, for rather obvious reasons.

### **Structure of Central Bank**

Let me end with a few thoughts about the relationship between Central Bank independence and the putative problem of a democratic deficit. These are based on the counterfactual thought experiment, suggested to me by my colleague Professor Geoffrey Miller at NYU, of the possibility of individuals presenting themselves for a contested democratic election to positions in the MPC, or even to be Governor of the Bank. After all quite a sizeable proportion of the US judiciary, at the state level, is elected, not appointed; and that is an independent arm of government. If you can elect attorney generals and local judges, why not members of the MPC?

Let us start with the case of an independent Central Bank which had a modicum of goal independence; that is to say, its remit allows it some room to choose between alternative policy objectives, to make value judgments between trade-offs. In that case, a democratic election for central bankers would give them greater legitimacy to maintain and support their own preferences in value judgments relative to that of the separately elected government. But that would exacerbate conflict, and harm coordination, between the two separate centers of economic policy and control. As I noted earlier, in a system in which the single objective of the MPC is mandated by the central government, there is neither a democratic deficit nor any real coordination problems. In a world where the MPC could juggle several objectives, and also received a separate mandate from the electorate through direct elections, that would be a recipe for rivalry between power centers and coordination failure. It is difficult to see how any such discordant system could last for long.

Let us shift from the example where the Central Bank has some partial goal independence to the more normal, and in my view more appropriate, case where it has operational independence only. In this instance, the Central Bank has no, or very limited, scope for value judgments; its job is to achieve a pre-selected target. That requires, above all, technical professional ability, and not a set of preferences over objectives that match that of the electorate. In the case of operational independence, the desideratum must surely be for professional competence. There is no good reason to believe that this can best be ascertained by an appeal to a democratic election, whereas, there is no better way of aligning preferences over value judgments between the ruled and their government. So, once a democratically elected government has decided on a Central Bank's objective, there is then no case for democratic election to the Central Bank itself. By the same token there would seem little, or no, case for seeking to make an MPC representative in its makeup of the community at large. Few would require that surgeons in

a particular hospital should reflect the geographical, gender, ethnic, religious, and sectoral split of the community more widely (though at the same time all should have a fair chance of entry into each profession, and none should be barred because of their personal background from establishing and using their professional skills). Moreover, the choice of someone as representative of some fraction of the community might make that person feel that they had to shade their arguments, and their vote, on behalf of their own group; and that would tend to cause others to shift to an offsetting bias. This could, indeed, politicize what should be a technical decision. For that same reason the decision of the Governing Council of the ESCB not to reveal the individual arguments and positions of its members, especially the National Central Bank governors, would have my full support, should anyone ask me, which of course they will not.

If the touchstone for selection to work in an operationally independent MPC should be professional competence, then appointment would appear to be preferable to election by a nonprofessional electorate. That raises the question of how such an appointment should be made, and whether it should be subject to confirmation, for example, by a Select Committee of Parliament, but that is a much wider and more general question, and one much more suited to a political scientist than to a monetary economist.

In this chapter, I have focused on institutional and constitutional issues. This is because, in the long run such issues determine how well the overall system performs. In the short run a brilliant individual, for example an Alan Greenspan, can make even a poorly designed institution work well; an example could be Benjamin Strong in the early years of the Fed. But what one wants is an institution sufficiently well-designed to work with ordinary mortals.

## **Conclusions**

In my view, for the reasons that I have tried to explain, an operationally independent, inflation-targeting Central Bank has been an excellent innovation in institutional design, and I feel proud to have played some small role in its widespread adoption. My hope is that this constitutional advance will become embedded in the context of the modern democratic state, somewhat akin to the independent judiciary.

Of course, there are differences in detail between the precise design of such new independent Central Banks in our various countries, and these differences, though second order in comparison with the basic concept, are not without some importance. For example, transparency and accountability are of paramount importance. They both encourage good decision-making and entrench the independence of the Central Bank against attacks on its democratic legitimacy. I believe that the design of the Bank of England Act puts the MPC at the forefront of good practice in this respect. For this, and other reasons, I felt highly privileged to have participated in the initial years of the MPC in this country. This new regime is a credit to its various progenitors. It is straightforward, transparent, and accountable. Long may it last.

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# 12 **Activist stabilization policy and inflation**

The Taylor rule in the 1970s

*Athanasios Orphanides*

## **Introduction**

There is widespread agreement that the objective of monetary policy in the United States over the past several decades has been the pursuit of price stability and maximum sustainable growth over time. Recent studies have suggested that activist stabilization policy rules that respond to inflation and the level of economic activity can achieve these objectives and attain both a low and stable rate of inflation as well as a high degree of economic stability.<sup>1</sup> A critical aspect that differentiates these rules from alternative guides to policy, such as policies that concentrate on inflation or stable money and nominal income growth, is the emphasis they place on the level of economic activity in relation to a concept of the economy's potential—that is the “output gap” or the related “unemployment gap.” A prominent example of such a strategy is the policy rule proposed by Taylor (1993). Unfortunately, as a practical matter, the informational requirements of implementing these activist policies, especially the measurement of the “output gap” or “unemployment gap” present substantial difficulties. As a result, activist stabilization strategies that might appear promising when these difficulties are ignored may instead prove counterproductive when implemented in practice.

This observation is not new. Indeed, it is at the very center of the monetarist criticism regarding activist control of the economy—the old “monetarists” vs “activists” debate. At least since the late 1940s, Milton Friedman and later others including Allan Meltzer and Karl Brunner warned that, since the reliable information required to make activist countercyclical policies useful is not typically available, such policies should be avoided. Instead, they favored simple policy rules such as a constant rate of money growth which do not require such concepts as the output gap. (See e.g. Friedman 1947, 1968; Brunner 1985; and Meltzer 1987.) This debate, needless to say, was not satisfactorily resolved by the 1970s or even later.

As is well known, macroeconomic policy in the United States during the 1960s and 1970s appeared to have been guided by activist stabilization objectives. The “New Economics” which was arguably introduced in 1961 with the first Kennedy Council of Economic Advisers—Walter Heller, Kermit Gordon, and James Tobin—was at first remarkably successful in engineering a period of great prosperity in

the Nation.<sup>2</sup> But this success did not last. By the end of the 1960s (especially after Heller, Gordon, and Tobin, and the remarkable economic team they had originally assembled was no longer formulating policy), prosperity was tempered by worsening inflation. Although macroeconomic policy-makers apparently attempted to keep up with the earlier success, and continued to rely for guidance on the “output gaps” and “unemployment gaps” that had proven useful in the early 1960s, inflation became the dominant and worsening problem. Indeed, the Great Inflation which started in the late 1960s and intensified during the 1970s, is generally viewed as one of the most significant failures of monetary policy since the founding of the Federal Reserve.<sup>3</sup>

In light of this experience, it is instructive to examine whether the recently proposed activist monetary policy rules that emphasize policy reactions to the level of economic activity relative to the economy’s potential, would have provided better guidance to policy-makers during that period relative to the framework that guided policy at the time. A detailed recent evaluation along these lines has been provided by Taylor (1999b). Taylor examined the policy prescriptions from two baseline rules for the federal funds rate, the rule he proposed in 1993, and an alternative placing greater emphasis on the output gap. For the 1970s, Taylor demonstrated that actual policy was systematically easier than what his baseline rules would have prescribed. He interpreted the results as suggesting that the Taylor rule would have guided policy away from the inflationary policies of the 1970s. Taylor’s favorable interpretation, however, is based on information that was not available to policy-makers when policy decisions were made. As a result, this analysis merely demonstrates that the Taylor rule would have avoided the inflationary outcomes of the 1970s if policy could be set with the benefit of hindsight. Arguably, this exercise does not adequately address whether this rule is robust to the informational problems that are at the center of the monetarist critique of activist policies.

In this Chapter, I revisit this issue by examining the policy prescriptions that would have been suggested by the Taylor rule in real time during the 1970s. To this end, I rely exclusively on data that were available to the general public, drawing extensively from publications of the US Commerce Department. The resulting reconstruction of the Taylor rule suggests that the prescriptions obtained by the rule without the benefit of hindsight do not greatly differ from the actual setting of the federal funds rate during the 1970s. This outcome suggests that the Taylor rule is perhaps as susceptible to informational problems as other activist stabilization strategies that attracted criticism from monetarists over the past half century. The analysis also indicates that policy frameworks such as the Taylor rule, do not appear to be more “rule-like” than similar policies that others, for example Tobin, termed “discretionary.” Indeed, on the one hand, Taylor (1993) stressed that an element of discretion is an important part of the rule-based policy framework he proposed. On the other hand, the description of discretionary policy provided by Tobin (1983) maintains some of the important attributes of Taylor’s rule-like approach.<sup>4</sup> It is therefore hard to draw a clear distinction between “rules” and “discretion” in this case. In the end, my analysis suggests that

the unfavorable macroeconomic outcomes of the 1970s do not fundamentally reflect differences in the existing framework from Taylor's rule-based framework. Rather, the analysis identifies misperceptions regarding the state of the economy in conjunction with an activist stabilization objective as the important factors leading to the inflationary experience of the 1970s.

### **An overview of the Taylor rule**

The Taylor rule originated in a collection of studies examining the comparative performance of alternative simple interest rate policy rules across a variety of different models (Bryant *et al.* 1993). A particularly promising rule in those studies prescribed that the Federal Reserve should set policy so that the deviation of the short-term nominal interest rate,  $R$ , from a baseline equilibrium value,  $R^*$ , respond linearly to the deviation of inflation,  $\pi$ , from its desired target,  $\pi^*$ , and to the output gap,  $y$ .

$$R - R^* = \theta(\pi - \pi^*) + \theta y \quad (1)$$

Taylor (1993) proposed a particular parameterization of this rule that has attracted considerable attention. He set the sum of actual inflation and the equilibrium short-term real interest rate,  $r^*$ , as a proxy for  $R^*$ , and used the values  $r^* = \pi^* = 2$  and  $\theta = 1/2$ . (Throughout, the interest and inflation rates are stated in percent annual rates and the output gap in percent.) This parameterization attracted attention as a guide to policy decisions, because in addition to its encouraging performance in alternative models, as reported in Bryant *et al.* (1993), and several subsequent studies, it also appeared to accurately describe actual policy decisions in the 1987–92 period that Taylor had originally examined. Since, monetary policy over this period was considered successful, the confluence of the two results suggested that the Taylor rule may represent a useful and reliable guide for monetary policy decisions. In recent years, prescriptions from a Taylor rule have been regularly provided to Federal Open Market Committee (FOMC) members. Further, since January 1998 the Federal Reserve Bank of St Louis has published monthly updates of prescriptions from the Taylor rule in the publication *Monetary Trends*.

As is well known, despite its apparent simplicity, implementation of the Taylor rule in practice is not straightforward (see e.g. Orphanides 2001, 2003a). In addition to the parameters specified earlier (including the difficult to determine equilibrium real interest rate), implementation requires an exact definition of the inflation and output gap inputs to the rule. As is common practice in this literature, for his analysis, Taylor employed the latest vintage of historical data available. He used the log difference in the GDP deflator over four quarters ending with the current quarter for inflation. For the output gap, he adopted the log difference between actual real output in the current quarter and a smooth trend estimate of potential output. An immediate difficulty, emphasized by McCallum (1994), is that rules that rely on within-quarter reactions to data about that

quarter are not operational since the data needed for the rule are not available within the quarter. As a result, in practice, the Taylor rule has been operationalized either by using within-quarter forecasts or by specifying that policy react to inflation and the output gap for the previous quarter. In model-based policy evaluation studies, both approaches have been extensively examined with similar results. (See e.g.—Levin *et al.* 1999; and McCallum and Nelson 1999.) For policy prescriptions that rely exclusively on data available to the public, only the latter option applies. For instance, the Taylor rule published by the Federal Reserve Bank of St Louis employs this one-quarter-lag timing. To focus attention on the Taylor rule as could be applied with data available to the general public, I also adopt this timing in the following paragraphs.

A second difficulty, emphasized by Orphanides (2001, 2002), is that the data and key assumptions employed to construct the rule change over time. These changes reflect a number of sources, such as conceptual changes in the definitions of actual output, potential output, and price indexes, re-estimation of historical time series (including seasonal definitions), incorporation of previously incomplete or unavailable historical data, and the evolution of underlying modeling practices. As a consequence of this difficulty, historical examination of the Taylor rule requires close attention to the vintage of data employed. A reconstruction based on current data can provide information regarding the setting of a rule that a policy-maker could have achieved with the benefit of hindsight but not regarding the setting of a rule that could have been actually implemented, nor the setting of a rule that would have been implemented, had the rule been adopted over history.

Figure 12.1 provides a birds-eye view of the federal funds rate and the Taylor rule from 1966 to 1998 using “current” data.<sup>5</sup> To fix notation, for any variable  $x$ , let  $x_{i|j}$  be the value of the variable for quarter  $i$  as provided by the relevant agency in quarter  $j$ . (I use the subscript  $T$  to denote the current data vintage.) Let  $d$  be the log of the output deflator,  $q$  the log of real output, and  $q^*$  the log of potential output. For the rule shown in the figure, I employ the chain-weighted GDP deflator as published by the US Commerce Department and construct the measure of inflation used for quarter  $t$  as  $\pi_{t-1|T} = d_{t-1|T} - d_{t-5|T}$ . To construct the output gap, I use the Commerce Department estimates of real GDP and the potential output estimates published by the Congressional Budget Office (CBO), both measured in chain-weighted 1992 dollars.<sup>6</sup> The output gap measure for quarter  $t$  is then  $y_{t-1|T} = q_{t-1|T} - q_{t-1|T}^*$ .

Comparison of the federal funds rate and the Taylor rule shown in Figure 12.1 provides the basis for the favorable historical assessment of the rule when examined with the benefit of hindsight. Since the late 1980s, the rule broadly follows the contours of actual policy. In the earlier years policy appears to have been systematically easier and more volatile than the rule in the 1970s and considerably tighter subsequently. The systematic difference of actual policy from the rule in the late 1960s and 1970s, in particular, is taken as evidence that had the rule been followed, the Great Inflation could have been averted. This finding, in turn, has been interpreted as indicating that the rule may be robust to the problems that led to policy errors during the 1970s.

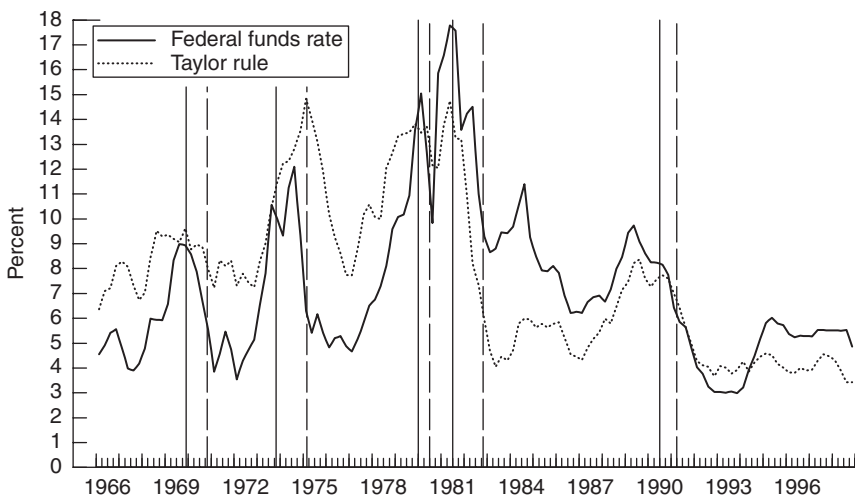


Figure 12.1 Federal funds rate and Taylor rule with current data.

#### Notes

The solid and dashed vertical lines represent NBER business cycle peaks and troughs, respectively.

### A closer look at the 1970s

To examine the Taylor rule in a more realistic way for the 1970s, I reconstructed the prescriptions of the Taylor rule using data as available in each quarter from 1968:4 to 1979:4. That is, I computed the rule replacing the current inflation and gap measures,  $\pi_{t-1|T}$  and  $y_{t-1|T}$  in the rule with their equivalent measures available to the public in quarter  $t$ ,  $\pi_{t-1|t}$  and  $y_{t-1|t}$ . The continuing conceptual and definitional changes of the underlying data, of course, requires greater specificity about the exact data that should be used for this purpose. The guideline I follow is to use in every quarter published data that would most closely correspond to the key concepts required for the Taylor rule, that is, the concepts “real output,” “output deflator,” and “output gap” or “potential output” as were available and used at the time.

Some details are in order. The headline concept for aggregate output during the 1970s was GNP instead of the current choice of GDP. Further, instead of the current chain-weighted concept for the output deflator, and associated estimates of real output, a fixed-weight constant-dollar concept was employed at that time. In my sample, the deflator and associated real output were stated in 1958 constant dollars until 1975:4 and in 1972 constant dollars from 1976:1 on. Data for nominal and real output from which one could construct the output deflator inflation were published with a one quarter lag by the Commerce Department, for instance, in the monthly publication *Survey of Current Business*. I use these data to construct the inflation measure  $\pi_{t-1|t} = d_{t-1|t} - d_{t-5|t}$ . During this period, in



addition to estimates of actual GNP, an official estimate of potential GNP was published by the government. This series was constructed and updated by the Council of Economic Advisers. Starting with 1962, these estimates were regularly provided in the *Annual Report of the Council of Economic Advisers* which was published with the *Economic Report of the President*. (The publication of this official series continued until 1981.) From 1968:4 to 1976:4, in particular, the Commerce Department employed these data to publish updated estimates of actual GNP, potential GNP, and the associated output gap in the monthly publication *Business Conditions Digest*. (This publication has been discontinued.) I use the data published there for the latest output gap data available in each quarter  $t$ , defined as  $y_{t-1|t} = q_{t-1|t} - q_{t-1|t}^*$ . From 1977:1 to 1979:4, I did not find monthly or quarterly Commerce Department publications with estimates of potential output. As a result, for these 3 years, I relied on the data presented in the 1977, 1978, and 1979 *Economic Report of the President* for estimates of potential output. I constructed first estimates of the output gap by combining these estimates with the first GNP estimates published by the Commerce Department in the *Survey of Current Business*.<sup>7</sup>

Figure 12.2 compares the resulting real-time Taylor rule with its current rendition, reproduced from Figure 12.1, and the actual setting of the federal funds rate. As can be seen from this figure, prescriptions implied by the Taylor rule at the time policy decisions were made appear surprisingly close to actual policy throughout the 1970s. The rule captures quite accurately the two major policy-easing episodes

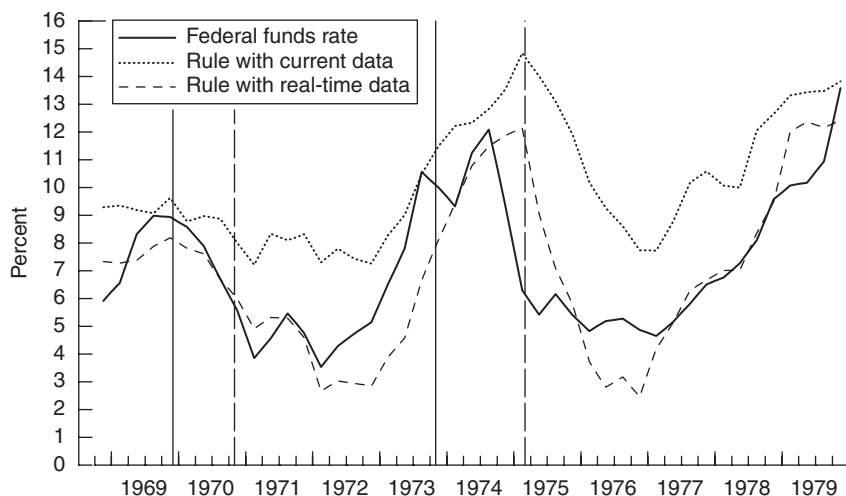


Figure 12.2 The Taylor rule with real-time and current data.

Notes

The real-time rule is based on information as available in quarter  $t$  based on first published data for quarter  $t - 1$ . The current rule is based on current estimates of the historical data for the corresponding quarter. See also notes to Figure 12.1.

associated with the recessions of 1970 and 1974 and the subsequent policy tightenings. And in stark contrast to the current rendition, it does not suggest that policy was consistently more expansionary than the Taylor rule. These findings cast considerable doubt on the hypothesis that the macroeconomic outcomes of the 1970s would have been dramatically different if policy were set according to the rule, using information available to the public at the time.<sup>8</sup>

### Accounting for the differences

The size of the discrepancy between the current and real-time renditions of the Taylor rule warrants further explanation. Since the difference can be attributed to discrepancies between the current and real-time measures of the two inputs to the rule, inflation and the output gap, a detailed accounting of this difference is immediate.

Figure 12.3 shows the underlying data for these two variables. The upper panel compares the two inflation measures,  $\pi_{t-1|t}$  and  $\pi_{t-1|T}$  and shows that these measures differ substantially at times. During the two crucial years preceding the 1974 acceleration of inflation, for instance, the real-time measures consistently understated inflation by over 1 percentage point, as compared to current estimates. In terms of the Taylor rule which prescribes a change of 1.5 percentage point in the federal funds rate for every percentage point change in inflation, this suggests that the rule prescription in real-time would have been over 150 basis points lower than the current data suggest for those 2 years.

Most of the systematic difference between the current and real-time renditions of the Taylor rule, however, is due to the difference between the real-time and current estimates of the output gap,  $y_{t-1|t}$  and  $y_{t-1|T}$ , shown in the lower panel of Figure 12.3. From the current perspective, the real-time output gap series for this period appears to have been systematically biased. This bias, which at the start of the sample in 1969 was about 2 percentage points, increased considerably during the early 1970s—exceeding 10 percentage points by 1975—before improving towards the end of the 1970s. In terms of the Taylor rule which assigns a weight of one-half on the output gap, this suggests that the rule prescription during the 1970s would have been anywhere from 100 basis points to over 500 basis points lower than what current data would suggest.

Mismeasurement of the output gap can be attributed to either mismeasurement of the level of actual output or the level of potential output. Attempting an exact decomposition of these errors into these two sources can be quite involved. Figure 12.4 provides some indicative estimates for the contribution of actual output mismeasurement to these errors. The upper panel compares the quarterly growth rates of real output with current data,  $(q_{t-1|T} - q_{t-2|T})$ , to their real-time counterparts,  $(q_{t-1|t} - q_{t-2|t})$ . (These estimates are in percent quarterly rates.) As is evident, differences in these growth rates can at times exceed 1 percent. On their own, these one quarter errors do not appear that unusual. However, this obscures a potentially important problem associated with the measurement of the

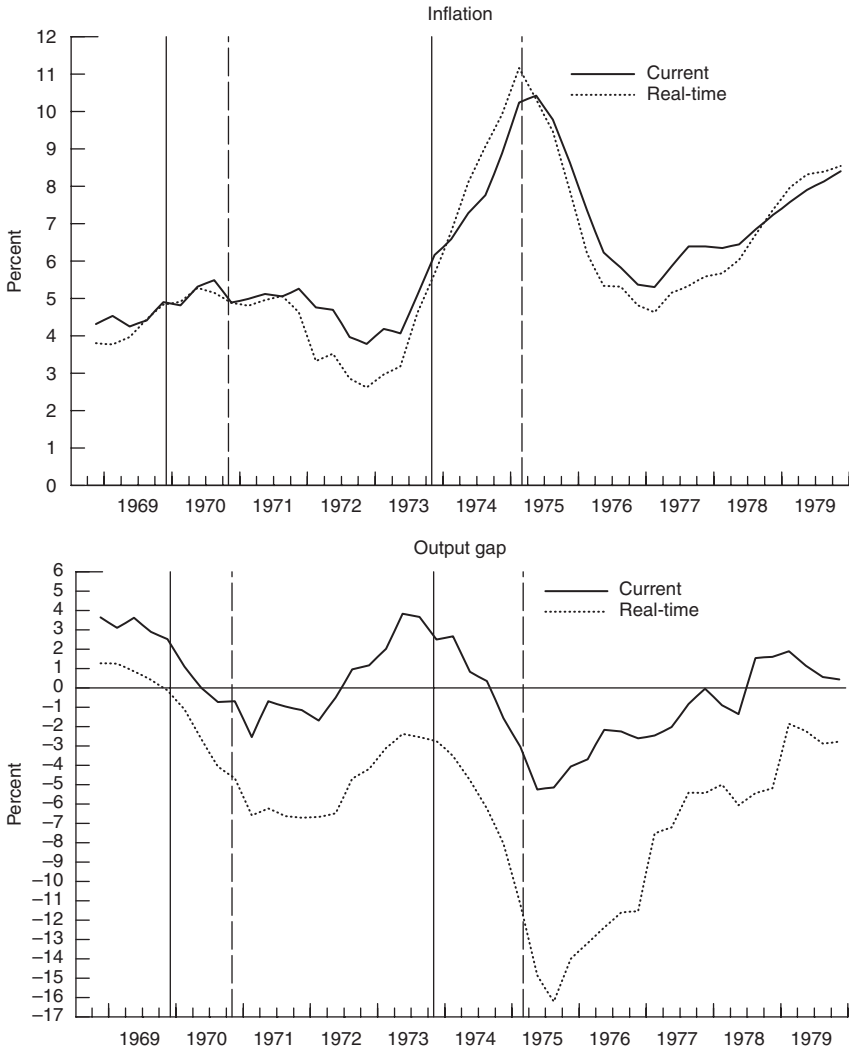


Figure 12.3 Underlying current and real-time data.

Notes

Inflation is the log change in the output deflator over four quarters ending with  $t - 1$ , in percent. The output gap is the log difference between real output and potential output, in quarter  $t - 1$ , in percent. See also notes to Figures 12.1 and 12.2.

level of a variable such as output. An accumulation of even small errors in the growth rates could, at times, generate an error of several percentage points in the measurement of the level. Compare, for instance, the cumulative output growth for the previous 3 years as seen in 1975:1,  $(q_{1974:4|1975:1} - q_{1971:4|1975:1})$ , with the

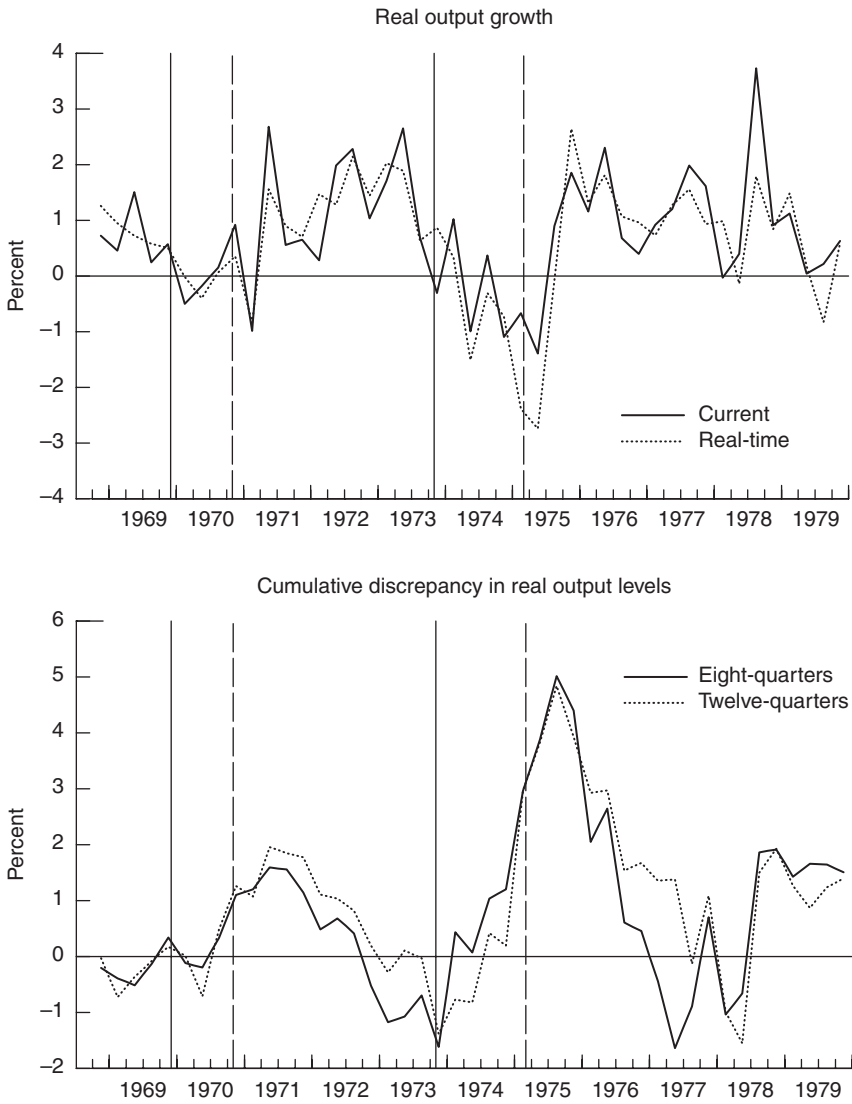


Figure 12.4 Real output mismeasurement.

Notes

Real output growth is the quarterly change in real output for quarter  $t - 1$ , in percent. The cumulative discrepancies show the difference in estimates of real output growth between current and real-time data over the horizons shown ending in quarter  $t - 1$ , in percent. See also notes to Figures 12.1 and 12.2.

growth over the same period as seen with current data,  $(q_{1974:4|T} - q_{1971:4|T})$ . Using the current data suggests that relative to the 1971:4 baseline, output in 1974:4 was 3 percentage points higher than using the real-time data. This disparity provides a measure of the mismeasurement of the level of output, but only a rough measure, because it depends on how reliable the comparison of the baseline quarter (here 1971:4) would be. The lower panel of Figure 12.4 repeats these calculations for every quarter in the sample. The resulting cumulative discrepancy in the level of real output is shown for two horizons, 2 and 3 years, to show how the results change with alternative baselines. That is, in each quarter,  $t$ , the plot shows:

$$(q_{t-1|T} - q_{t-1-k|T}) - (q_{t-1|t} - q_{t-1-k|t})$$

for  $k = 8$  (2-year horizon) and  $k = 12$  (3-year horizon). These cumulative errors suggest that the measurement of real output was too pessimistic following both the 1970 and 1974 recessions and could account for a significant portion of the mismeasurement of the output gap. The worst errors, in 1975, coincide with the worst errors in the output-gap measures shown in Figure 12.3 and can account for as much as 5 percentage points of the output-gap mismeasurement that year.

This illustrates that mismeasurement of the level of actual output was a significant contributing factor to the mismeasurement of economic activity in the 1970s. However, a substantial and highly persistent discrepancy between the real-time and current estimates of the output-gap still remains. This must be attributed to estimates of potential output that proved, in retrospect, to have been too optimistic. Indeed, a major problem with the real-time output-gap estimates in the early 1970s, is that they were based on estimates of potential output which were shaped by the extraordinary performance of the economy during the 1950s and 1960s. In this sample, potential output was projected to grow at an annual rate of 4 percent until the end of 1969, an estimate that was raised to 4.3 percent in 1970. Based on current data and the experience of the past 30 years, this may appear very optimistic. The average growth of real output from 1970 to 1998 was 2.8 percent per year. However, growth from 1950 to 1969 averaged 4.2 percent per year and at the time it was believed that potential output growth had accelerated somewhat in the late 1960s. The deterioration in economic growth we now identify with the “productivity slowdown,” which had already started in the late 1960s, was not recognized until considerably later. Potential output growth estimates were revised downward in the 1970s, to 4 percent in 1974, 3.75 percent in 1976, 3.5 percent in 1977, and 3 percent in 1979. But for the whole decade, these revisions lagged behind the reduction in potential output growth implicit in current estimates as constructed with the benefit of hindsight.

Another factor contributing to the mismeasurement of the output gap during the early 1970s, was an implicit assumption at the beginning of the decade that the natural rate of unemployment was 4 percent. But following the experience of unexpectedly high unemployment *and* inflation, especially during 1974 and 1975, this assumption was also brought into question and revised upwards, to 4.9 in

1977, and 5.1 in 1979. By contrast, the current CBO estimate for that time is about 6 percent or higher.<sup>9</sup>

Okun's law (Okun 1962) provides a rule of thumb for the extent of mismeasurement of the output gap associated with such incorrect estimates of the natural rate. According to this law, as was applied at the time, the output gap was believed to be roughly equal to three times the unemployment gap. (More recently, this same relationship is being applied with a lower coefficient, e.g. 2–2.5.) Thus, if the natural rate assumption in the early 1970s was 2 percentage points too optimistic, Okun's law would suggest that potential output estimates could be about 6 percentage points too optimistic as well.<sup>10</sup>

### **The evolution of beliefs, policy, and inflation**

In retrospect, it is clear that mistaken beliefs regarding potential output growth and the natural rate of unemployment at the start of the 1970s, coupled with a slow pace of adjustment of these beliefs in the face of a continuing deterioration in the nation's productive capacity prospects, resulted in estimates of the level of potential output and the output gap that were consistently too optimistic during the 1970s. A pertinent question is whether policy-makers did or should have considered the official estimates of the output gap overly optimistic in real time. Based on information available at the time, in the early 1970s, it was not evident that the official estimates should have been controversial.<sup>11</sup> As Peter Clark observed in 1979:<sup>12</sup>

Research on potential GNP from 1964 to 1974 produced a number of different views on the best estimation technique, but very little disagreement about the estimates themselves. All the results were similar to the CEA estimates or even somewhat higher.

(p. 141)

Although the nexus of inflation, output, and unemployment from 1970 to 1972 was considered somewhat puzzling, it was the surprising acceleration of inflation in 1973—while output was still well below potential and unemployment substantially higher than 4 percent—that prompted a re-examination of the earlier estimates.<sup>13</sup> In January 1974, the Council of Economic Advisers acknowledged increased uncertainty regarding estimates of potential output and revised downward earlier estimates of both the level and growth rate of potential output. The energy crisis and associated recession which spanned 1974 and continued into early 1975, made it extremely difficult to separate any further changes in the underlying trend of potential output from cyclical developments during these 2 years. The estimate of potential output growth was then revised downward in early 1976, and a major effort to revamp the historical estimates of potential output was initiated that year, which resulted in the major revision evident in the data in January 1977. The 1977 revision reduced the estimate of potential output for 1976 by 4 percentage points and brought the spectacular gap for 1975:Q2 (which was first reported to be about 15 percent) down to 10 percent.<sup>14</sup> In retrospect,

even these revised figures from the late 1970s appear overly optimistic when compared to current estimates. However, at the time this was not at all clear and one could even reasonably argue that the Council revisions were too pessimistic.<sup>15</sup> Estimates used at the time by professional forecasting groups such as Data Resources Incorporated and Wharton Econometrics were not dramatically different either.<sup>16</sup>

Whether any of these revisions should have been carried out earlier or should have been anticipated by policy-makers, remains a difficult question. It is indeed possible that policy-makers anticipated some of these revisions before their official publication. For a revision as large as the one published in 1977, in particular, some of the changes may have been anticipated prior to the official release of the new estimates. Returning to Figure 12.2, it is interesting to note that based on the published real-time data, the setting of the federal funds rate prior to this revision, during 1976, was consistently about 200 basis points higher than the Taylor rule. This policy is equivalent to a setting of the Taylor rule with an output-gap estimate that is 4 percentage points lower than the official estimates published in 1976—exactly the revision for 1976 reflected in the 1977 estimates of potential output. Thus, during 1976, actual policy was consistent with the Taylor rule adjusting for the large subsequent revision in potential output that was published in January 1977.

To confirm whether misperceptions regarding the output gap actually influenced the monetary policy process, it is useful to examine direct evidence from the deliberations of the Federal Open Market Committee (FOMC). An enlightening example appears in the *FOMC Memorandum of Discussion* for the contentious August 18, 1970, meeting. This was in the context of the series of easings that had started in February to counteract the recession underway. The August meeting was important in that by then real activity had stopped deteriorating and the staff was forecasting a modest expansion. (See Figure 12.5.)<sup>17</sup> The record shows that close to the end of the meeting the committee was evenly split, with six members (including the Chairman) voting in favor of a directive calling for additional easing, and six members voting in favor of an alternative that would have essentially maintained an unchanged policy stance. Members opposing further easing pointed to the need to concentrate on reducing inflation, which had fallen in the second quarter, but was still over 4 percent. However, other members were concerned that the level of economic activity was not improving fast enough and at the end of the meeting, an easing was adopted. Referring to the staff forecasts of GNP, a governor is reported to have explained the need for this easing by noting that: “If those projections were realized, however, the gap between actual and potential real GNP would be between 5.5 and 6 percent by the second quarter of 1971. In his judgment, that was not satisfactory as a goal of policy” (p. 45). Indeed, these projections proved quite accurate—based on the official estimates of potential output available at the time. But in retrospect, these projected gaps appear spectacularly off the mark.<sup>18</sup>

The record for the meeting also indicates that committee members were in agreement that policy should continue to aim towards reducing inflation. Given the perceived slack in economic activity, however, easing policy was not considered

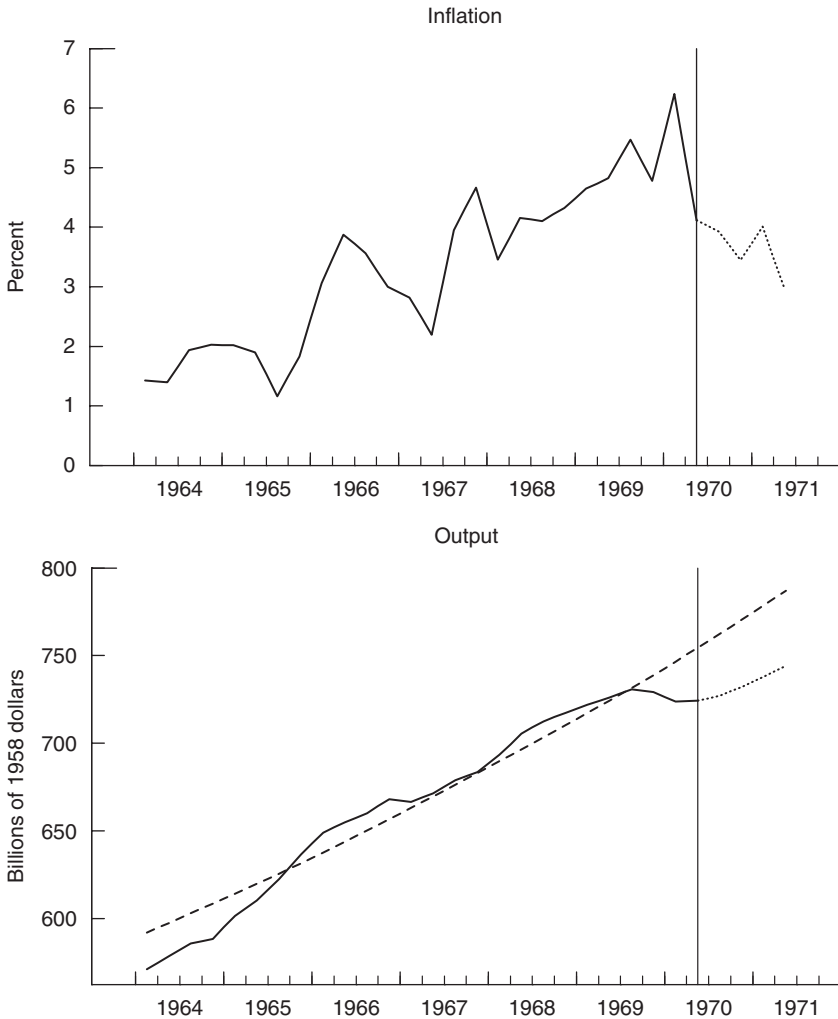


Figure 12.5 The economic outlook at the August 1970 FOMC Meeting.

Notes

Inflation is the log change in the output deflator from the previous quarter, in percent annual rate. Output is actual GNP (solid line) and the official estimate of potential GNP (dashed line) for the quarter shown, measured in an annual rate with constant 1958 dollars. The vertical line in 1970:Q2 indicates the last quarter of historical data. The dotted lines represent Greenbook forecasts.

inconsistent with this objective by the majority. As stated in the policy directive (adopted with three dissenting votes), "...it is the policy of the Federal Open Market Committee to foster financial conditions conducive to orderly reduction in the rate of inflation, while encouraging the resumption of sustainable economic growth" (p. 66).



Indeed, from the perspective of the Taylor rule, the policy adopted during that meeting was consistent with the long run inflation target of 2 percent that is implicit in the rule—conditioning on the official output gap estimates available at the time.

Incorrect assessment of the economy's potential influenced the staff's advice to the Committee as well. During 1975, when these misperceptions appeared to be at their worst, the staff suggested that a policy of further easing could be pursued with little concern about inflation, despite the high degree of monetary accommodation that was already in place. At the May 1975 meeting, for example, the staff argued that "...there is such a large amount of slack in the economy now that real growth would have to exceed our projection by a wide margin, and for an extended period, before excess aggregate demand once again emerged as a significant problem." (*FOMC Memorandum of Discussion*, May 1975: 26). And further, "[s]imulations using the econometric model suggested that a considerably faster rate of expansion could be stimulated without having a significant effect on the rate of increase in prices—that a considerably more rapid rate of increase in real GNP would still be consistent with a further winding down of inflationary pressures" (p. 27). In the event, the FOMC did not pursue a policy of greater accommodation, and yet inflation outcomes for the rest of 1975 and for 1976 were worse than anticipated by the staff. The incorrect assessments of the economy's potential at the time, of course, influenced the forecasting process, and inflation forecasts also proved too optimistic.

To be sure, this evidence does not imply that FOMC policy during the 1970s literally "followed" the Taylor rule. What it does indicate is that policy was influenced by the same considerations as are embedded in the Taylor rule, namely deviations of inflation from the Federal Reserve's low inflation objective, and deviations of economic activity from perceptions of the economy's sustainable economic growth path. Furthermore, it illustrates that because of the emphasis the rule places on the concept of the "gap," the rule itself becomes susceptible to the exact same problems apparent in the activist discretionary stabilization strategy pursued during the 1970s.

The fact that actual policy during the 1970s does not greatly differ from the Taylor rule as could be implemented in real time also suggests that examining the implications of following the rule in the presence of misperceptions regarding potential output—or the related concept of the natural rate of unemployment—could potentially be useful for understanding the acceleration of inflation during the early 1970s. A rule of thumb on how much of the inflation pickup could be attributed to mismeasurement of the output gap with the Taylor rule can be derived by determining the steady state of inflation compatible with a constant level of mismeasurement in the rule. From equation (1), in steady state  $(\pi - \pi^*) + y = 0$ , so any perceived persistent output gap would exactly balance a persistent deviation of inflation from its target. For example, an inflation rate of 8 percent, instead of the 2 percent target in the rule, could be consistent with a persistent 6 percentage point error in the output gap or, using Okun's law as described earlier, a 2 percentage point misperception of the natural rate of unemployment. To the extent the Taylor rule is believed to

provide a reasonable guide to monetary policy, an inflationary outcome such as this should not be entirely unexpected as errors of this nature simply reflect the ignorance associated with real-time assessments of the economy's potential.

Key policy figures later admitted that a mistake of this nature—if not exact magnitude—had indeed been committed. Shortly after leaving the Federal Reserve, Arthur Burns (1979) pointed to the delay in recognizing the increase in the natural rate and the productivity slowdown in the late 1960s and 1970s as two major factors for the inflationary outcomes of the period. Herbert Stein, who served as member and later chairman of the Council of Economic Advisers during the Nixon administration, identified the belief that the natural rate was 4 percent and its implications for inflation “the most serious error of the Nixon CEA” (p. 19). As he explained: “fascinated by the idea of ‘the natural rate of unemployment,’ which we thought to be 4 percent, we thought it necessary only to let the unemployment rate rise slightly above that to hold down inflation” (pp. 19–20).<sup>19</sup>

## Conclusion

Activist stabilization policies require prompt and accurate assessments of the level of economic activity in relation to a concept of the economy's potential. As a practical matter, considerable uncertainty frequently obscures the current state of the economy and renders measures such as the “output gap” and the “unemployment gap” highly unreliable in real time. Although policies that rely on these measures may appear promising in the absence of these difficulties, such policies can easily prove counterproductive in practice. This chapter uses the inflationary experience of the 1970s as a laboratory to show that recently proposed monetary policy rules that react to such “gaps” are as susceptible to these difficulties as earlier discretionary policies guided by similar activist objectives.

To be sure, this does not diminish the appeal or the importance of rule-based or rule-like policy. But it does point to the desirability of examining more robust alternatives to policies emphasizing “gaps” for policy design. Also, the unfavorable outcomes of the pursuit of gap-based policies cannot be necessarily seen as evidence favoring the monetary growth targeting approach proposed by monetarists at the other end of the debate. The difficulties experienced in the early 1980s with the various variants of *M1* as well as the questions about *M2* in the early 1990s suggest that, although they can be very useful at times, monetary growth targeting strategies are far from an ideal solution, and that they also would require modifications and discretion in practice.

The middle ground, perhaps, could be in the direction of strategies that concentrate neither on gaps, nor on money growth targeting, but on a common objective related to both, the stability of growth in the economy, and nominal income. Tobin emphasized this middle ground during the 1980s, when difficulties at both ends of the activist–monetarist debate were better understood.

I will state my view very bluntly. The long-run targets of the Federal Reserve should be expressed as a path of nominal GNP...

These targets should take precedence over any short-run instrument targets for monetary aggregates or interest rates. It should be made clear that both the Fed's instruments and those intermediate targets will be varied so as to keep nominal GNP on track—not of course month to month or quarter to quarter but on average year to year.

(Tobin 1981, 1987: 373)

For two years ahead, the intermediate target should be nominal GNP growth... This would indicate how the policymakers would allow price and productivity shocks to affect output and employment, while allowing complete freedom to offset velocity-of-money surprises with money supplies. Indeed, the Fed might advertise this target as a velocity-adjusted monetary aggregate...

(Tobin 1983: 516)

Other economists during the 1980s, including some who had earlier been more optimistic about the usefulness of “output gaps” and “unemployment gaps” as guides, also suggested moving to this middle ground. For example, Arthur Okun agreed that “[policymakers] do not serve the nation well if they concentrate on output and employment targets—whether the objective is set forth as achieving full employment, the natural unemployment rate, or potential GNP” (1981: 354). Rather, he concluded, an efficient macroeconomic strategy could be designed based on “adoption of the objective of growth in nominal GNP” (p. 357). From the other end of the debate, in a careful examination of the usefulness and limitations of money growth targeting strategies, McCallum (1985) also concluded that “an intermediate target strategy could more fruitfully be based on the path of nominal GNP than of the money stock” (p. 591). Concentrating on nominal income for guiding policy appeared to evolve into a strategy with many proponents seeking to balance the desire for reasonable economic performance against the temptation of excessive activism. Commenting on McCallum (1985), Tobin characteristically remarked: “Let us rejoice that views are converging” (1985: 607).

With our limited knowledge of the workings of the economy, we can never be certain that we have successfully identified the best approach for stabilization policies. We can only hope that by seeking guidance from the past, especially understanding the underlying problems, that likely led to earlier mistakes, we can avoid repeating the most glaring of such mistakes going forward. The recently proposed policy rules that emphasize a gap-based approach to monetary policy seem to capture the essence of the stabilization approach that was in place during the 1960s and 1970s. With correct readings of the state of the economy, such policies may be successful. However, the 1970s provide a striking example when such strategies were much less successful. To the extent the macroeconomic outcomes of the 1970s are not considered particularly favorable, the usefulness of such monetary policy rules as guides for monetary policy decisions ought to be carefully examined.

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## Notes

- 1 Clarida *et al.* (1999), McCallum (1999), and Taylor (1999c) provide surveys of the recent monetary policy rules literature. Fischer (1990) reviews earlier contributions.
- 2 Tobin (1966, 1972) provides informative reviews of the early debates and the economic outcomes of the period. Heller *et al.* (1961) provide an early outline, and the classic 1962 Economic Report of the President reviews the original plans, ideas, and their rationale.
- 3 De Long (1997), Hetzel (1998), and Meyer (1999) provide extensive analysis and bibliographies. Eckstein (1978) and Blinder (1979) provide enlightening contemporaneous analyses.
- 4 The following exchange of views, from Wessel (2000), is informative regarding the terminological difficulty:

James Tobin, a Nobel laureate in the nonrules camp, questions if Mr. Taylor preaches what he claims to preach: “Starting from the side of the debate opposite to mine, he seems to arrive at the same place. Follow the spirit, the intent, of a rule, he says, and do not be bound by a particular quantitative formula.” Mr. Taylor responds: “What I would like to do is get rules to 80% of the decision. That would be enormous progress.”

Tobin (1999c) provides a detailed exposition of the usefulness of the Taylor-rule framework and its relationship to his own views on policy strategy.

- 5 By “current” or “final” data I mean data available when the snapshot of data used for this analysis was taken. Of course, “final” data corresponding to later snapshots will differ. Here, I rely on data as available on October 1999, when I originally put together the dataset for this study.
- 6 These are the same series as employed by the Federal Reserve Bank of St Louis for the Taylor rule published in the *Monetary Trends*. Taylor (1999b) relied on a Hodrick-Prescott trend definition for potential output. This is essentially similar to the CBO series over the historical period relevant for this analysis.
- 7 Usage of the official series for potential output was quite common during the 1970s. Plots and discussion of the series can even be found in several textbooks published at the time, including Samuelson (1976), Branson and Litvack (1976), Dornbusch and Fischer (1978), and Meyer (1980).
- 8 A quantitative assessment of how large the difference in such outcomes might have been had the rule been followed could be performed with model-based counterfactual simulations. (See e.g. Orphanides 2003b.) However, such comparisons would be dependent on the specification of the model.
- 9 With the 1982 recession, the uncertainty of these estimates became even higher, and point estimates also rose, as reflected in Tobin (1983): “Unfortunately no one knows what the NAIRU is. Current estimates for the United States vary from 8 percent to 5 percent” (p. 512).
- 10 Although potential output was not constructed using Okun’s law, it was influenced by the baseline assumption that the economy was at potential in mid-1955 with unemployment near 4 percent and stable prices. Consequently, using deviations of

unemployment from 4 percent and Okun's law was considered a useful rough guide for the output gap.

- 11 Robert Solow (1982) provides an enlightening analysis of what went wrong with the Council's original estimates of potential output. His account attributes most of the error to the unexpected unfavorable shift in trend productivity that started in the 1960s. Evidence documenting the unreliability of end-of-sample business cycle estimates, for example, Christiano and Fitzgerald (1999) and Orphanides and van Norden (2002) suggests that mistakes of this nature are largely unavoidable.
- 12 Clark's views are particularly useful as his work during 1976 resulted in the major improvement in the official estimates of potential output which was published in 1977.
- 13 As shown in Figure 12.3, this inflation acceleration appeared much sharper in real time due to the pattern of mismeasurement in inflation in these years. In retrospect, of course, this is not at all puzzling, considering the severe overheating of the economy in 1973 depicted in the current data in the bottom panel of the figure.
- 14 By 1979, the gap for 1975 Q2 was further revised downwards, closer to 8 percent, and kept shrinking with subsequent revisions.
- 15 See for example, Perry (1977) and the discussion following his article for a range of views and estimates spanning the Council's revisions.
- 16 For example, in the introduction to his book on "The Great Recession," which was completed in 1976, DRI's Otto Eckstein observed that "[b]y the trough of the recession in the spring of 1975, real GNP had fallen 14.5% below the full employment path" (p. 1)
- 17 Data for the second quarter which had become available in the intermeeting period indicated real GNP had grown by 0.5 percent as compared to the 5.4 percent drop in the first quarter. Figure 12.5 presents historical data and forecasts of inflation and output (as well as the official estimate of potential) as available at the meeting.
- 18 The reference to *projected* output gaps also indicates awareness of the need to be "forward-looking" in setting policy. Indeed, the policy discussions suggest that throughout this period, decisions were greatly influenced by the projected outlook for inflation and economic activity. Orphanides (2002, 2004) confirms that estimated policy rules based on Federal Reserve Board staff forecasts can be used to characterize these policy decisions.
- 19 To their credit and unlike many other economists at the time, Burns and Stein had already subscribed to Friedman's (1968) natural rate view by the end of the 1960s. As a result, they avoided the additional problems associated with the perception of a long run tradeoff between inflation and unemployment. Sargent (1999) demonstrates the inflationary consequences of policy driven by such perceptions.

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# 13 The Fed's monetary policy rule

Past, present, and future

*Antonio Moreno*

## Introduction

There are now a number of papers which derive optimal monetary policy rules in the context of structural macroeconomic models.<sup>1</sup> One common feature of these works is that the resulting reduced form coefficients in the policy rule are composed of two sets of structural parameters, some pertaining to the monetary authority's loss function and others describing the behavior of the private sector. While these papers derive normative prescriptions about the monetary authority behavior, very few estimates of the deep parameters in the monetary authority's loss function are available in the literature. The present chapter provides such estimates.

It has also been recently argued that there was a shift in the way monetary policy was conducted with the arrival of Paul Volcker to the Federal Reserve (Clarida *et al.* (1999) and Boivin and Giannoni (2003) among others). The strategy followed by these researchers is based on estimating policy rules across sample periods and comparing the values of the long run coefficients on expected inflation. However, these empirical papers typically do not identify the Fed's preferences embedded in the optimal policy rule coefficients.<sup>2</sup> In this chapter, we show that there was indeed an economically significant change in the Fed's preferences in the early 1980s towards more inflation stabilization.

The second goal of this chapter is to derive the optimal changes in the policy reaction function as the private sector becomes more forward-looking. This is a relevant question as papers by Boivin and Giannoni (2003) and Moreno (2003) have reported a significant increase of the private sector forward-looking behavior in the supply equation. To this end, we consider a standard three equation Rational Expectations macro model which exhibits endogenous persistence in the inflation rate, the output gap, and the Federal funds rate. In the context of a strict inflation targeting framework, we show that the monetary authority should react more strongly to inflation as the price setting becomes more forward-looking up to a point. The reason is that when agents are very forward-looking, it is no longer effective to react more aggressively to inflation deviations from target when the price setting becomes more forward-looking. A similar finding is obtained in the case of the forward-looking parameter in the demand equation.



The chapter proceeds as follows. First, we lay out the complete structural model which we consider. In the following section we define the monetary policy plan and obtain estimates of the Fed's preferences in its loss function for different sample periods. In the third section, we derive the optimal changes in the Fed's long run response coefficient on inflation as a function of the supply and demand forward-looking parameters. The final section concludes.

## A model for the US economy

We first describe a simple macro model for the US economy which has been used in recent monetary policy studies such as Rotemberg and Woodford (1998). The model comprises supply, demand, and monetary policy equations:

$$\pi_t = \delta E_t \pi_{t+1} + (1 - \delta) \pi_{t-1} + \lambda y_t + \epsilon_{AS}, \quad (1)$$

$$y_t = \mu E_t y_{t-1} + (1 - \mu) y_{t-1} - \phi(i_t - E_t \pi_{t+1} - \bar{r}) + \epsilon_{IS}, \quad (2)$$

$$i_t = \bar{r} + \bar{\pi} + \rho i_{t-1} + (1 - \rho)[\beta(E_t \pi_{t+1} - \bar{\pi}) + \gamma y_t] + \epsilon_{MP}, \quad (3)$$

$\pi_t$  and  $y_t$  are the inflation rate and detrended output between time  $t - 1$  and  $t$  respectively, and  $i_t$  is the Federal funds rate at time  $t$ . The long run natural real interest rate is  $\bar{r}$  and  $\bar{\pi}$  is the long run level of inflation. One advantage of this macro model is that while being both parsimonious and structural, its implied dynamics are broadly consistent with those documented by empirical VAR studies.

The Aggregate Supply (AS) equation in (1) is a generalization of the Calvo (1983) pricing equation. The IS or demand equation in (2) can be derived through representative agent lifetime utility maximization as in Fuhrer (2000). Its endogenous persistence is due to the presence of habit formation in the utility function. Finally, the monetary policy equation in (3) is the one proposed by Clarida *et al.* (2000). In this policy rule, the monetary authority smoothes the interest rate path, and reacts to expected inflation and to the output gap.

Table 13.1 shows the full information maximum likelihood (FIML) estimates obtained by the procedure described in Moreno (2003). We use Consumer Price Index (CPI) inflation, output detrended quadratically, and the Federal funds rate. Given the evidence of parameter instability documented in the literature, two sample periods were identified on the basis of the sup-Wald statistic derived by Bai, Lumsdaine, and Stock (1998). The sup-Wald test detects the fourth quarter of 1980 as the most likely break date in the parameters of an unconstrained vector autoregression. Accordingly, we start the second subsample on the fourth quarter of 1980.<sup>3</sup>

Three major facts emerge from the parameter estimates. First, the three standard deviations of the structural shocks were lower in the second period, especially the one corresponding to the IS shock. This implies that macroeconomic conditions were more benign in 1980s and 1990s. Second, the Fed reacted more strongly to expected inflation in the second period, although not significantly so.

Table 13.1 Structural parameter estimates

|               | First period       | Second period      |
|---------------|--------------------|--------------------|
| $\delta$      | 0.5482<br>(0.0182) | 0.6188<br>(0.0294) |
| $\lambda$     | 0.0072<br>(0.0052) | 0.0009<br>(0.0032) |
| $\mu$         | 0.5180<br>(0.0213) | 0.4959<br>(0.0219) |
| $\phi$        | 0.0146<br>(0.0126) | 0.0032<br>(0.0035) |
| $\rho$        | 0.7740<br>(0.0509) | 0.8784<br>(0.0305) |
| $\beta$       | 0.9825<br>(0.1400) | 1.9652<br>(0.5890) |
| $\gamma$      | 0.6992<br>(0.2448) | 0.5686<br>(0.3676) |
| $\sigma_{AS}$ | 1.2034<br>(0.0984) | 1.0015<br>(0.0865) |
| $\sigma_{IS}$ | 0.7149<br>(0.0566) | 0.3794<br>(0.0301) |
| $\sigma_{MP}$ | 0.7551<br>(0.0559) | 0.7322<br>(0.0564) |

## Notes

This table shows the FIML parameter estimates of the structural new Keynesian macro model obtained by the procedure outlined in Moreno (2003). CPI inflation, quadratically detrended output, and the Federal funds rate are the variables used in estimation. The first subsample spans the period 1957:2Q–1980:3Q and the second subsample covers the period 1980:4Q–2001:2Q. The model's equations in demeaned form are:

$$\begin{aligned}\pi_t &= \delta E_t \pi_{t+1} + (1 - \delta) \pi_{t-1} + \lambda y_t + \epsilon_{AS,t} \\ y_t &= \mu E_t y_{t+1} + (1 - \mu) y_{t-1} - \phi (r_t - E_t \pi_{t+1}) + \epsilon_{IS,t} \\ r_t &= \rho r_{t-1} + (1 - \rho) (\beta E_t \pi_{t+1} + \gamma y_t) + \epsilon_{MP,t}\end{aligned}$$

Third, private agents put more weight on expected inflation in the AS equation during the second period.

In the next section we will use these parameter estimates to obtain the probability distribution of the monetary authority's preferences in its loss function across sample periods.

### Estimates of the preferences in the loss function of the Federal Reserve

Clarida *et al.* (1999) first documented an increase in the Fed's long run response to expected inflation after 1979. It is commonplace in the literature to see changes in this response arising from a shift in the preferences of the monetary authority.

However, optimal monetary policy papers such as Woodford (2003) show that the long run response coefficients are also a function of structural private sector parameters. In this context, it could be that the Fed reacted more strongly to inflation after 1980 because it detected a modification in some structural parameters of the economy. In this section we show that the Fed's more aggressive response to expected inflation was indeed the result of a change in its preferences.

We first formulate the optimization problem of the Fed which gives rise to our interest rate reaction function:

$$\min_{i_t} \left\{ \frac{1}{2} [\psi \lambda_\pi (E_t \pi_{t+1} - \bar{\pi})^2 + y_t^2 + \lambda_i i_t^2 + \lambda_\Delta (i_t - i_{t-1})^2] \right\} \quad (4)$$

subject to equations (1) and (2).  $\psi$  is the subjective time discount factor.  $\lambda_\pi$ ,  $\lambda_i$ , and  $\lambda_\Delta$  are the objective function weights on expected inflation, interest rate variation and, interest rate changes, respectively. This objective function implies that the Fed manages the nominal interest rate so as to stabilize deviations of expected inflation from its target as well as the current output gap. Additionally, the Fed tries to avoid excessive interest rate variation as well as deviations of the current interest rate from its past value. Since this objective function does not contain expected future terms beyond the next period inflation forecast, this optimization problem falls under the category of discretion. In other words, the Fed reoptimizes the objective function in (4) every period in order to set the optimal value for the Federal funds rate.<sup>4</sup>

The implied interest rate rule becomes, in mean deviation form:

$$i_t = \frac{\lambda_\Delta}{\lambda_i + \lambda_\Delta} i_{t-1} - \frac{\psi \lambda_\pi}{\lambda_i + \lambda_\Delta} \frac{\partial E_t \pi_{t+1}}{\partial i_t} E_t \pi_{t+1} - \frac{1}{\lambda_i + \lambda_\Delta} \frac{\partial y_t}{\partial i_t} y_t \quad (5)$$

Matching these coefficients with those in the Clarida *et al.* (2000) rule in (3), which we estimated, yields:

$$\beta = - \frac{\psi \lambda_\pi}{\lambda_i} \frac{\partial E_t \pi_{t+1}}{\partial i_t} \quad (6)$$

$$\gamma = - \frac{1}{\lambda_i} \frac{\partial y_t}{\partial i_t} \quad (7)$$

$$\rho = \frac{\lambda_\Delta}{\lambda_i + \lambda_\Delta} \quad (8)$$

Equation (6) shows that as the Fed puts more weight on expected inflation deviations from target, it responds more aggressively to expected inflation in the policy rule. The partial derivatives in the policy rule coefficients reflect the constraints imposed by the AS and IS equations in the optimization program of the monetary authority. Equations (6) and (7) show that it is optimal to react more strongly to expected inflation and the output gap when these two variables become more

sensitive to changes in the interest rate, respectively. Notice that the partial derivatives  $\partial E_t \pi_{t+1} / \partial i_t$  and  $\partial y_t / \partial i_t$  will be negative for reasonable parameter values as obtained in our estimations. Equation (8) shows that the optimal coefficient on the interest rate lag,  $\rho$ , grows in tandem with the tendency of the Fed towards smoothing the interest rate. Finally, when the Fed puts less weight on interest rate variability, the three policy coefficients become larger.

One difficulty in computing the partial derivatives in our setting is the endogeneity of the interest rate,  $i_t$ , in our model. However, given our policy rule, we can distinguish an exogenous part as a source of interest rate fluctuations, the monetary policy shock  $\epsilon_{MP_t}$ . In the first part of Appendix, we derive these partial derivatives by proxying changes in  $i_t$  with changes in its exogenous part. Hence, we can identify  $\lambda_\pi$ ,  $\lambda_i$  and  $\lambda_\Delta$  uniquely by setting  $\psi$  to 0.99, a standard value in the literature. In order to compute the differences in the Fed's loss function weights across sample periods, we use the parameter estimates shown in Table 13.1.

The estimates in Table 13.2 show that there was an increase in  $\lambda_\pi$ , implying a larger concern of the Fed about deviations of expected inflation from its target. Accordingly, the larger estimate of the long run response to expected inflation can indeed be economically attributed to changes in the preferences of the monetary authority, and not to changes in the structural parameters in the AS and IS equations.<sup>5</sup> Table 13.2 also lists the implied monetary policy weights on the expected inflation, interest rate, and interest rate difference terms for both periods. The point estimates show that the Fed was less concerned about interest rate variability in the second period, since the term  $\lambda_i$  became smaller in 1980s and 1990s.

*Table 13.2* Estimates of the Federal Reserve's preferences

|                  | <i>First period</i>                           | <i>Second period</i>                            |
|------------------|---|---|
| $\lambda_\pi$    | 1.2937<br>(0.7415 28.4476)<br>[0.9066 3.5010] | 6.1078<br>(1.0966 122.2351)<br>[3.1023 72.8869] |
| $\lambda_i$      | 0.1039<br>(0.0363 0.4079)<br>[0.0675 0.3131]  | 0.0599<br>(0.0192 0.3810)<br>[0.0214 0.1246]    |
| $\lambda_\Delta$ | 0.3545<br>(0.1112 2.1532)<br>[0.1796 1.5693]  | 0.4334<br>(0.1211 3.5913)<br>[0.2980 2.2491]    |

#### Notes

This table lists the preference parameters in the objective function of the Federal Reserve in (4) across sample periods.  $\lambda_\pi$  is the weight on expected inflation,  $\lambda_i$  is the weight on the interest rate and  $\lambda_\Delta$  is the weight on the interest rate first difference. Two sets of 90 percent confidence intervals obtained through a Montecarlo simulation appear in parenthesis and square brackets below the point estimates. The first set excludes both explosive model's solutions and negative values for the Fed's preferences in the Montecarlo study. The second set additionally fixes the parameters  $\lambda$  and  $\phi$  in the simulations.

$\lambda_{\Delta}$  is larger in the second period, reflecting an increasing concern of the monetary authority towards smoothing the interest rate path.

In order to draw statistical inference, we compute the probability distributions of the policy parameters. To this end, we perform a Montecarlo simulation by taking draws from the distributions of the structural parameters and computing the policy preferences. We repeat this exercise 1000 times, yielding a probability distribution for the policy weights. Explosive solutions to the structural model and negative values for the policy preferences were discarded in the process. The first set of 90 percent confidence intervals appears in parentheses below the point estimates in Table 13.2. It shows that there is plenty of statistical uncertainty regarding the values of the preference parameters, especially in the second period. In our exercise, this uncertainty stems from the combined uncertainty of the structural parameters, which is especially pronounced in the monetary transmission mechanism parameters,  $\lambda$  and  $\phi$ . We then compute confidence intervals fixing these two parameters. They appear in square brackets. While the intervals are still quite large, they are clearly tighter than in the first case. For instance, the weight on expected inflation is significantly larger in the second period. This finding implies that much of the uncertainty in the policy preferences is due to the large standard errors of  $\lambda$  and  $\phi$ .

To summarize the results in this section, we showed that there was an important shift in the preferences of the Fed since 1980 in favor of inflation stabilization. This date approximately coincides with the arrival of Paul Volcker to the Federal Reserve Board. We also showed that this result is not statistically significant. This uncertainty was shown to stem mainly from the imprecise estimates of the parameters describing the monetary policy transmission mechanism.

### **Optimal policy under endogenous persistence**

Our macroeconomic model exhibits endogenous persistence in the supply and demand equations. This endogenous persistence is captured by the private sector parameters  $(1-\delta)$  and  $(1-\mu)$  in the structural model. As  $\delta$  and  $\mu$  become larger, inflation and output display less persistency. As shown in the previous section, the optimal response of the Fed to expected inflation depends on all the parameters of the structural model. In this section, we assess the impact of changes in these private sector parameters on the optimal Fed's response to expected inflation. This is a relevant issue, since the estimates in Boivin and Giannoni (2003) and Moreno (2003) show a significant increase in  $\delta$ , the forward-looking parameter in the AS equation, during 1980s and 1990s.

In order to determine unique optimal relations between  $\beta$  and  $\delta$ , and between  $\beta$  and  $\mu$ , we will assume in our analysis that the monetary authority practices strict inflation targeting, that is,  $\gamma=0$ . In the second part of Appendix, we show how to derive the optimal relation between the long run response to inflation and the forward-looking parameters through numerical approximations. These approximations can be computed via the implicit function theorem, since the partial derivatives in (6) depend on  $\beta$  and both  $\delta$  and  $\mu$ . As shown in Appendix, the sign

relation between the Fed’s response to inflation and these forward-looking parameters can be expressed as:

$$\frac{\partial \tilde{\beta}}{\partial \theta_i} = - \frac{k \cdot [\partial f(\theta) / \partial \theta_i]}{1 + k \cdot [\partial f(\theta) / \partial \beta]} \quad f(\theta) = \frac{\partial E_t \pi_{t+1}}{\partial i_t}, \quad k > 0 \quad \delta, \mu \in \theta_i \quad (9)$$

where  $\tilde{\beta}$  an implicit function of  $\beta$ .

Figure 13.1 graphs  $f(\theta)$  as a function of  $\beta$  for different values of  $\lambda$ , including the estimated one, 0.0072. The remaining AS and IS parameters are fixed at their first period estimates, whereas the policy parameters are fixed at their second period values. Results do not change if we fix all the remaining parameters at either their first or second period values. Figure 13.1 shows that, for realistic parameter values ( $\beta > 0.2$ ),  $f(\theta)$  is an increasing function of  $\beta$ . This implies that the denominator in (9) will always be positive for a reasonable parameter space. Hence, the sign of the implicit function’s partial derivative,  $\partial \tilde{\beta} / \partial \theta_i$ , depends inversely on the sign of the partial derivative  $\partial f(\theta) / \partial \theta_i$ .

Figure 13.2 shows that  $f(\theta)$  is initially a decreasing function of  $\delta$ . However, when  $\delta$  becomes larger (approximately 0.6),  $f(\theta)$  becomes an increasing function of  $\delta$ . This implies that for values of  $\delta$  smaller than 0.6 the Fed should react more strongly to expected inflation as agents become more forward-looking in the supply equation. However, when  $\delta$  is sufficiently large, the Fed should respond less aggressively.

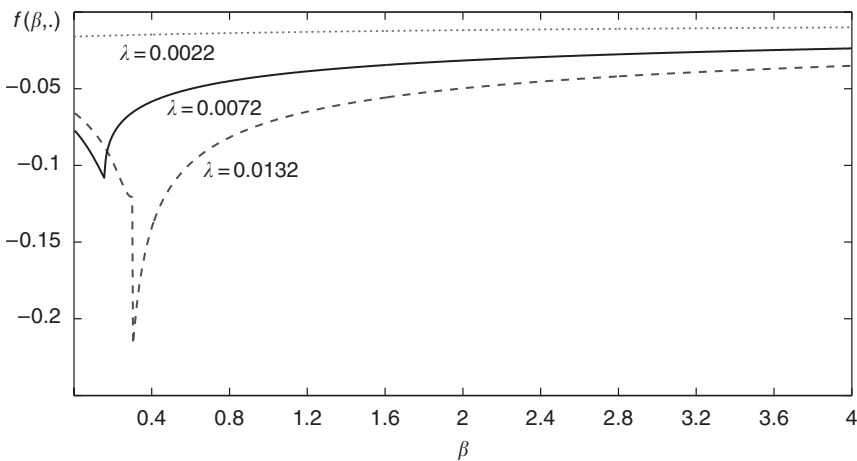


Figure 13.1 Denominator slope.

Notes

This figure graphs the function  $f(\theta)$  in (9) depending on  $\beta$  and holding the remaining parameters fixed. The slope of this function determines the sign of the denominator of the implicit function derivative in equation (9).

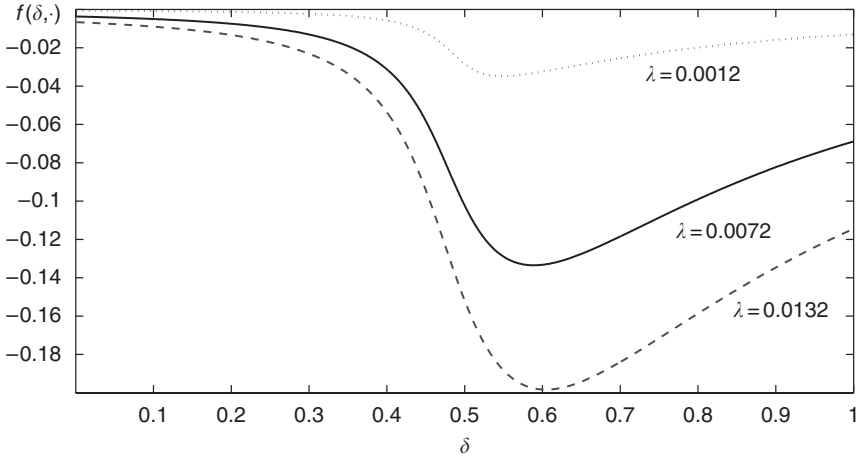


Figure 13.2 Numerator slope  $f(\delta)$ .

Notes

This figure graphs the function  $f(\theta)$  in (9) depending on  $\delta$  and holding the remaining parameters fixed. The slope of this function determines the sign of the denominator of the implicit function derivative in equation (9).

To understand the intuition behind this result, recall that the loss function in (5) implies that the Fed will react more strongly to expected inflation when changes in the interest rate are more effective in reducing expected inflation. Our structural macro model contains two monetary transmission mechanisms from the interest rate to inflation. Interest rate changes affect the output gap through the real rate in the IS equation. In turn, output gap movements influence inflation through the Phillips curve relation in the AS equation. The second channel consists of expectational effects. As the monetary authority reacts more aggressively to inflation, the private sector adjusts its inflation expectations which directly affect the inflation rate. We now show how the effectiveness of monetary policy varies with the endogenous persistence of inflation and the output gap.

At small values of  $\delta$ , contractionary monetary policy is quite effective in reducing expected inflation, as future inflation still depends heavily on current inflation. Hence, as agents become more forward-looking when  $\delta$  is still not very large, current inflation will experience a larger reduction following an interest rate increase (since the term  $\delta E_t \pi_{t+1}$  in the supply equation will be larger in absolute value). This reinforces the decline in expected inflation, making contractionary monetary policy more effective. However, at high values of  $\delta$ , expected inflation does not greatly depend on current inflation. Accordingly, increases in  $\delta$  will make expected inflation even less dependent on future inflation (and will also make the term  $\delta E_t \pi_{t+1}$  smaller in absolute value), so that monetary policy will be less effective in reducing expected inflation. This implies the existence of a cutoff value  $\delta^*$  such that for  $\delta > \delta^*$ , it is no longer optimal to react more aggressively to expected inflation as  $\delta$  grows.

Figure 13.2 performs a calibration exercise around different values of the Phillips curve parameter  $\lambda$ . It shows that when monetary policy is less effective in reducing inflation volatility (for smaller values of  $\lambda$ ), the cutoff value is smaller, whereas for larger values of  $\lambda$ , the cutoff value is higher. Finally, Figure 13.3 presents the impulse responses of inflation to a monetary policy shock. It shows that for low values of  $\delta$  in the AS equation, as agents become more forward-looking, monetary policy is more effective in reducing inflation for about 15 periods. However, when  $\delta$  is very large, the opposite is true during the 50 periods following the shock. These two pieces of evidence corroborate the ideas in the previous paragraph.<sup>6</sup>

Figure 13.4 graphs  $f(\theta)$  as a function of  $\mu$ , the forward-looking parameter in the IS equation. It is decreasing up to values of  $\mu$  close to 0.4, when it starts to increase. As a result, for values of  $\mu$  close to 0.5, as estimated in our sample, increases in the forward-looking behavior of agents in the IS equation should be followed by a smaller reaction of the Fed to expected inflation. The reason is that for large values of  $\mu$ , a smaller output gap persistence will make monetary policy less effective, since the way it influences inflation is by contracting the output gap. However, when  $\mu$  is below 0.4, increases in the forward-looking parameter in the IS equation will reinforce the effect of contractionary monetary policy on the current output gap (through a larger value of the  $\mu E_t y_{t+1}$  term in the IS equation). The mechanism is analogous to that of  $\delta$  and is illustrated in Figure 13.5. When  $\mu$  is small, as it grows, monetary policy becomes more effective in reducing inflation, whereas the opposite is true when  $\mu$  is large.

Our results resemble those obtained by Lansing and Trehan (2003) in a related optimal monetary policy exercise. There are, however, some differences. In their case, as  $\mu$  grows, it is optimal to react less aggressively to inflation as long as  $\mu$  is greater than 0.1, whereas in our chapter, the cutoff value  $\mu^*$  is 0.4. While Lansing

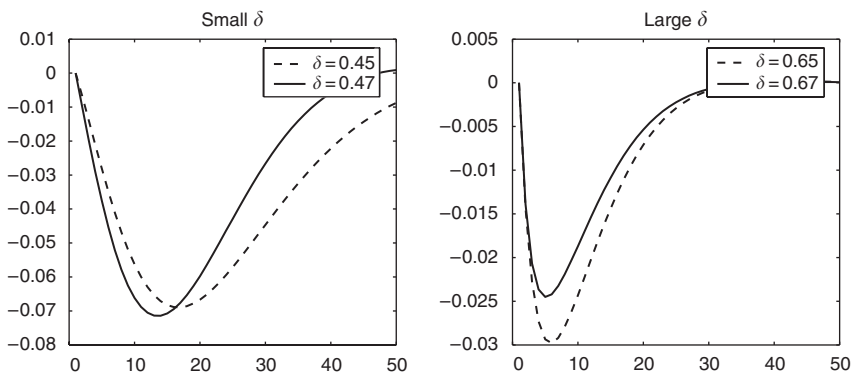


Figure 13.3 Inflation response to a monetary policy shock for different values of  $\delta$ .

#### Notes

This figure presents the response functions of inflation to a monetary policy shock. It presents responses under alternative values of  $\delta$ . The remaining model's parameters are held at their second period estimates.



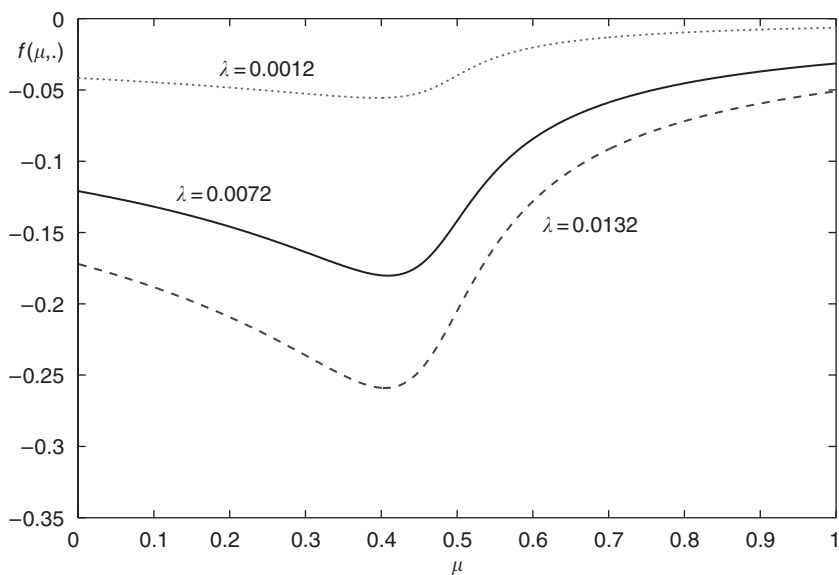


Figure 13.4 Numerator slope  $(\mu)$ .

Notes

This figure graphs the function  $f(\theta)$  in (9) depending on  $\mu$  and holding the remaining parameters fixed. The slope of these functions determine the sign of the numerator of the implicit function derivative in equation (9).

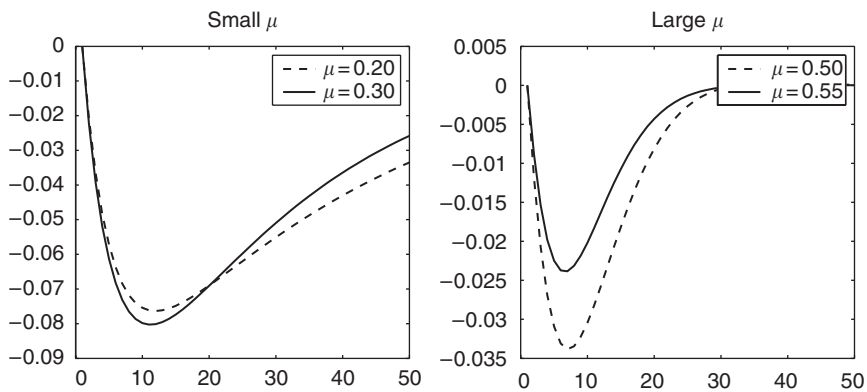


Figure 13.5 Inflation response to a monetary policy shock for different values of  $\mu$ .

Notes

This figure presents the response functions of inflation to a monetary policy shock. It presents responses under alternative values of  $\mu$ . The remaining model's parameters are held at their second period estimates.

and Trehan (2003) include output gap stabilization in their Central Bank loss function, they also consider a different structural model. Whereas in this chapter the expectations influence all the variables contemporaneously, in their case it is the lagged expectations which affect the current period variables. This implies that in our exercise the expectations and the current values affect each other simultaneously, so that as  $\mu$  grows, monetary policy is more effective up to higher values of  $\mu$  (since the current output gap will react more strongly to interest rate changes). Our results also differ in the case of optimal monetary policy for different values of  $\delta$ . In Lansing and Trehan (2003), it is not until  $\delta$  is around 0.95 that increases in  $\delta$  should restrain the monetary policy reaction, whereas in our case the cutoff value is around 0.60. This occurs because monetary policy starts being ineffective earlier in our case.

To understand the different optimal Fed's behavior under increases of  $\mu$  and  $\delta$  in our exercise ( $\mu^*$  is larger with respect to Lansing and Trehan (2003) whereas  $\delta^*$  is smaller), notice that a given increase in a parameter results in a larger percentage increase at small parameter values. This effect dominates at small values of  $\mu$ , where initial increases of  $\mu$  have a sizable effect on the output gap, with the output gap being still quite persistent. However, in the case of  $\delta$ , when this parameter is quite large, further increases of  $\delta$  would have two effects. On the one hand, the percentage increase in  $\delta$  is small and on the other hand, it exacerbates the already small degree of persistence in inflation, making expected inflation depend even less on current inflation. These two effects are amplified in our exercise, where expectations affect the macro variables contemporaneously.

The results in this section illustrate the importance of the expectational effects in monetary policy management. As the private sector becomes more forward-looking, expectations of the future variables behave differently, so that the effects of monetary policy actions also differ. One important implication of our study is that the monetary authority should not modify its reaction to inflation monotonically as changes in the private sector behavior occur.

## Conclusions

This chapter shows that there was an economically, but not statistically, significant change in the preferences of the Federal Reserve after 1980 towards inflation stabilization. We also show, in the context of a strict inflation targeting regime, the optimal changes in the Fed's reaction to expected inflation when the forward-looking behavior of the private sector changes.

The importance of the private sector's degree of forward-looking behavior has been high-lighted in this chapter. There have been several attempts in the literature to derive aggregate supply equations featuring both forward- and backward-looking components. Fuhrer and Moore (1995), for instance, develop a real wage contracting model with endogenous persistence. In this case, the persistence is induced by the existence of wage-setters who adjust their current real wages with respect to past real wages. One caveat of these works is that the

endogenous persistence of inflation is not ultimately grounded in optimizing behavior. A better understanding of the sources of inflation persistence would be desirable as the Fed's optimal policy changes with it.

## Appendix

### Computing the partial derivatives

Equations (6) and (7) show that the optimal  $\beta$  and  $\gamma$  coefficients in our reaction function depend on partial derivatives of the target variables with respect to interest rate changes. In order to compute these partial derivatives, we recognize both an endogenous and an exogenous part in our model's interest rate:

$$i_t = \hat{i}_t + \tilde{i}_t \tag{10}$$

where, in mean deviation,  $\hat{i}_t = \rho i_{t-1} + (1 - \rho)(\beta E_t \pi_{t+1} + \gamma y_t)$  and  $\tilde{i}_t = \epsilon_{MP_t}$ . Therefore,  $\tilde{i}_t$  constitutes the exogenous part. In this setting, we can proxy the partial derivative terms involving changes in  $\tilde{i}_t$  with changes in  $\tilde{i}_t$  by applying vector differentiation rules to our model solution. The implied model's solution is:  $\bar{X}_{t+1} = \Omega \bar{X}_t + \Gamma \epsilon_{t+1}$ , where  $\bar{X}_t = [\pi_t \ x_t \ i_t]'$  in demeaned form. Since the next period expectations can be expressed as  $E_t \bar{X}_{t+1} = \Omega \bar{X}_t$ , we can obtain:

$$E_t \bar{X}_{t+1} = \Omega (\Omega \bar{X}_{t-1} + \Gamma \epsilon_t) \tag{11}$$

Therefore  $\partial E_t \bar{X}_{t+1} / \partial \epsilon_t = \Omega \Gamma$ , so that  $\partial E_t \pi_{t+1} / \partial \tilde{i}_t$  is simply the (1,3) element of the product matrix  $\Omega \Gamma$ , that is:

$$\frac{\partial E_t \pi_{t+1}}{\partial \tilde{i}_t} = \Omega_{11} \Gamma_{13} + \Omega_{12} \Gamma_{23} + \Omega_{13} \Gamma_{33} \tag{12}$$

In order to obtain the partial derivative  $\partial y_t / \partial \tilde{i}_t$  in equation (7), we follow the procedure described earlier and use the IS equation to obtain:

$$\begin{aligned} \frac{\partial y_t}{\partial \tilde{i}_t} &= \Gamma_{13} (\mu \Omega_{21} + \phi \Omega_{11}) + \Gamma_{23} (\mu \Omega_{22} + \phi \Omega_{12}) \\ &+ \Gamma_{33} (\mu \Omega_{23} + \phi (1 - \Omega_{13})) \end{aligned} \tag{13}$$

### Optimal Fed behavior

In this second part of the Appendix, we derive the optimal changes in the Fed's reaction to expected inflation when the behavior of the private sector in the

AS and IS equations varies. We reproduce equation (6) for ease of exposition:

$$\beta = -\frac{\psi\lambda_\pi}{\lambda_i} \frac{\partial E_t \pi_{t+1}}{\partial i_t} \quad (14)$$

In the previous section of the Appendix, we computed an approximation to the term.  $\partial E_t \pi_{t+1} / \partial i_t$ . As can be seen in equation (12), this term depends on the reduced form elements of the model's Rational Expectations solution which, in turn, also depend on  $\beta$ . Therefore, we can apply the Implicit Function theorem to equation (14) so as to determine how the Fed would change its reaction to expected inflation when the private sector becomes more forward-looking in the supply and demand equations.

Let us first introduce some additional notation:

$$f(\theta) = \frac{\partial E_t \pi_{t+1}}{\partial i_t} \quad \delta, \lambda, \mu, \phi, \beta, \gamma, \rho \in \theta \quad (15)$$

Then, we can rewrite (14) as:

$$\tilde{\beta} = \beta + k \cdot f(\theta) = 0 \quad k = \frac{\psi\lambda_\pi}{\lambda_i} > 0 \quad (16)$$

Using the Implicit Function theorem:

$$\frac{\partial \tilde{\beta}}{\partial \theta_i} = -\frac{k \cdot [\partial f(\theta) / \partial \theta_i]}{1 + k \cdot [\partial f(\theta) / \partial \beta]} \quad \forall \theta_i \in \theta \quad (17)$$

In order to obtain the sign of the partial derivatives, we can compute numerically vectors of the  $\Omega_{ij}$  and  $\Gamma_{ij}$  terms in (12) as a function of  $\delta$ ,  $\mu$ , and  $\beta$  holding the remaining parameters constant. In this way, we can construct  $f(\theta)$  in (12) as a function of each parameter, so that we can graphically identify the sign of the terms  $\partial f / \partial \theta_i$ ,  $\partial f / \partial \beta$ , and, in turn, the sign of the derivative  $\partial \tilde{\beta} / \partial \theta_i$  for  $\delta$ ,  $\mu \in \theta_i$ . Figures 13.1, 13.2, and 13.4 graph the functions involved in the implicit function derivatives in (17).

## Notes

- 1 Clarida *et al.* (1999), Woodford (2003) or Lansing and Trehan (2003) are some examples.
- 2 Söderlind (1999), and Cecchetti and Ehrman (2000) obtain estimates of deep parameters. However, their work is not focused on the shift of the preferences of the US Fed in the early 1980s. Their methodology is also quite different to ours.
- 3 Both estimations yield a stationary Rational Expectations solution. The first period estimates imply multiple equilibria. In this instance, we choose the equilibrium associated with the Recursive Method in Cho and Moreno (2003) which selects the bubble-free equilibrium.
- 4 Svensson (2003) criticizes forecast-based instrument rules of this kind on the grounds of time inconsistency. Our goal in this chapter is to provide a deeper interpretation of the coefficients in an interest rate rule which seems to capture the short-term interest

rate dynamics quite closely. Accordingly, the loss function which we consider does not include any term of period other than the current one. This precludes the appearance of the term  $E_t i_{t+1}$  as an argument in the reaction function.

- 5 In a related exercise within a more stylized framework, Cecchetti and Ehrman (2000) show that the Central Banks of several countries which adopted inflation targeting put more weight on inflation deviations after the adoption date.
- 6 We stress that our results are limited to the case of strict inflation targeting.

## Acknowledgments

I thank Seonghoon Cho, Michael Ehrmann, Kevin Lansing and Paolo Surico for helpful comments and suggestions. Financial support from the Fundación Ramón Areces is gratefully acknowledged.

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# 14 What is the impact of tax and welfare reforms on fiscal stabilizers?

A simple model and an application to EMU

*Marco Buti and Paul Van den Noord*

## **Introduction**

Taxation inevitably impinges on most aspects of economic activity, and thus careful consideration must be given to its design—in addition to its level and hence the level of related expenditure. So long as taxation affects incentives, it may alter economic behavior of consumers, producers or workers in ways that reduce the amount or utilization of physical, human and knowledge capital, and thus growth. Therefore, to the extent the tax system matters for economic efficiency, its costs are likely to rise with the level of taxation. The widespread perception that in many European countries, the tax burden is too high and the tax system unduly distortive has led to calls for tax reforms. Empirical research suggests that a cut in the tax share in GDP by 1 percentage point raises output per working-age person in the long run by 0.6–0.7 percent (OECD 2000).

While policy-makers' efforts to streamline the welfare state and enact tax reforms that aim to bring down the tax burden may thus pay off in terms of better efficiency, this may come at a cost in terms of weaker fiscal automatic stabilization. This trade-off between stabilization and efficiency would be particularly unpalatable in Economic and Monetary Union (EMU) countries, since they already have lost national monetary policy and the exchange rate as adjustment mechanisms to country-specific shocks. Indeed, EMU members would ideally aim for both stronger fiscal stabilization and higher economic efficiency, and a trade-off between the two would be quite unwelcome.

Fortunately, this difficult trade-off may not always be relevant. In other papers (Buti *et al.* 2003a,b) we have shown that there may be a level of the tax burden beyond which reducing it may not only yield better efficiency, but, depending on the nature of economic shocks, also render fiscal automatic stabilizers more effective. If supply shocks tend to prevail, a reduction in the tax burden might carry a “double dividend” of efficiency gains and better fiscal stabilization properties. This conclusion draws on evidence that lower taxation improves the terms of the short run inflation-unemployment trade-off (i.e. makes the Phillips curve flatter), by reducing the wedge between the marginal cost of labor and the

marginal take-home pay. This is encouraging for countries with high tax burdens that are considering a reduction in the size of the public sector.

The present chapter takes this analysis further, by introducing a distinction between the “optimal” tax burden at which, under supply shocks, the automatic stabilizers are most powerful and beyond which favorable stabilization properties decline, and a “critical” tax burden beyond which stabilization properties become perverse. Beyond the latter point, taxes and benefits have destabilizing effects on output in the event of supply shocks and destabilizing effects on inflation in the event of supply and demand shocks, thereby increasing the likelihood of a policy conflict with the Central Bank. Numerical simulations show that several Euro-area countries—especially the very open ones—may well have a tax burden above this critical level, while most countries will have a tax burden that exceeds the “optimal” level.

The chapter is organized as follows. First, a model of wage setting incorporating the effect of taxes is developed. The basic mechanisms are then incorporated in the second section in simple macroeconomic model to analyze the stabilizing effects of taxation. In the third section, the two concepts of “threshold” tax rates are derived. The fourth section provides some numerical simulations of such tax rates. The final section concludes.

### **A model of wage setting with wage resistance**

The basic tenet of this chapter is that automatic stabilizers operate not only on the demand-side through their impact on disposable income, but also on the supply-side through their impact on *ex ante* profitability. Distortionary taxes and benefits affect the level of equilibrium unemployment and potential output.<sup>1</sup> What is important in our analysis, however, is the impact of distorting taxes and benefits on the reaction of aggregate supply to unexpected inflation, that is the slope—not the position—of the aggregate supply curve.

We assume that workers pass through the cyclical variations in their tax burden at least partly onto employers. This implies that there is “real wage resistance” in an imperfect labor market.<sup>2</sup> This is illustrated in Figure 14.1, which depicts the downward sloping labor demand schedule and an upward sloping wage formation curve. It shows that the wage formation curve is steeper for higher tax and benefit rates. This is based on the following mechanism. As demand for labor increases, employers will bid up real wages. The higher the tax rate, the higher will be the increase in the tax bill for a given *ex ante* pay rise. Given that the labor market is tightening, workers may be able to recover some of that extra tax from their employer via a real wage increase on top of the initial “scarcity premium.” Thus, the higher the tax rate, the more compensation workers will seek to obtain from their employer for a given *ex ante* increase in employment and real wages.<sup>3</sup> To the extent benefits can be considered as negative taxes (i.e. means tested), this will prompt workers to seek extra compensation to top up the scarcity premium as well. The higher the (initial) benefit, the larger this compensation will be, and the steeper will be the wage formation function.

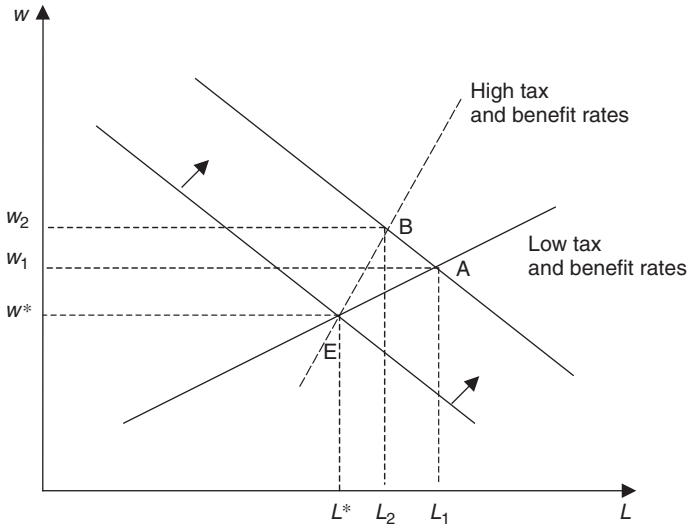


Figure 14.1 The impact of taxation on wage formation: labor demand shock.

The first panel of Figure 14.1 depicts an increase in the demand for labor, represented by an outward shift of the labor demand schedule. With low taxes and benefits, this is shown to raise employment from  $L^*$  to  $L_1$  and the real producer wage from  $w^*$  to  $w_1$ . In order to obtain the same result in terms of after-tax wages if taxes and benefits are higher, however, the real employer wage needs to increase by more, from  $w^*$  to  $w_2$ , and employment would increase by less, from  $L^*$  to  $L_2$ . This implies that the deviation of employment from the initial equilibrium is smaller. In line with the results of Auerbach and Feenberg (2000), the tax and benefit system thus operates as an automatic stabilizer also on the labor market.

However, the opposite holds in the case of a shock to labor supply. This is illustrated in Figure 14.2, which shows that, following a negative supply shock—for example, a wage push following a rise in unionization—taxes and benefits drive employment further away from the initial equilibrium. The higher the tax burden and the generosity of the benefit system (i.e. the higher the marginal effective tax rate), the stronger the destabilizing effect.

To convert these notions into a formal relationship, we postulate the following wage formation function:

$$w = f(L) + \gamma(T - G) \tag{1}$$

where  $w$  is the real producer wage,  $L$  is employment and  $T$  is the real revenue of distorting tax per worker and  $G$  is the real (means tested) benefit per worker. We assume the first derivative of the function  $f$  with respect to  $L$  to be positive, in line with the graphical representation in Figure 14.1.  $\gamma$  is the coefficient of wage



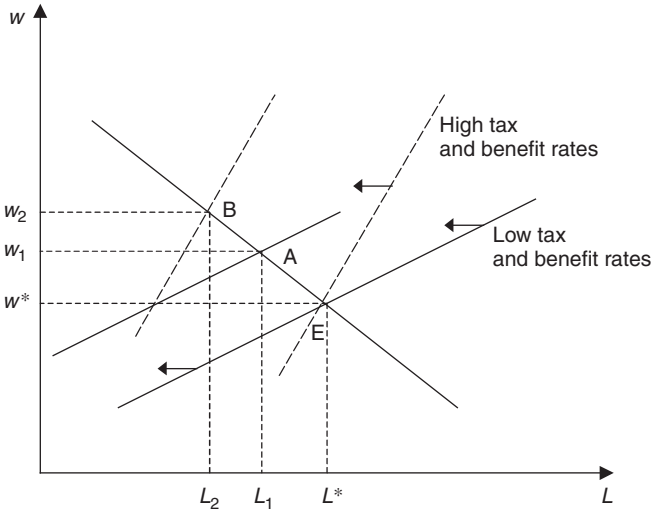


Figure 14.2 The impact of taxation on wage formation: labor supply.

resistance: it varies between 0 (all tax increases or benefit losses are borne by labor) and 1 (tax increases or benefit losses are passed through entirely to employers). Rewriting in rates of change (denoted by a dot over a variable) yields:

$$\dot{w} \left[ 1 - \gamma \left( \frac{\Delta T}{\Delta w} - \frac{\Delta G}{\Delta w} \right) \right] = \left[ 1 - \gamma \left( \frac{T}{w} - \frac{G}{w} \right) \right] \rho \dot{L} \tag{2}$$

in which  $\rho = (df/dL)(L/f(L))$  is the elasticity of the real wage with respect to (cyclical variations in) employment.

Next, we define the average and marginal rates of the distortive tax and benefits as, respectively,  $t = T/w$  and  $t' = \Delta T/\Delta w$ ,  $g = G/w$ ,  $g' = \Delta G/\Delta w$ . These are all positive, except for the marginal benefit rate  $g'$  which is negative due to means testing.

By inserting  $t$ ,  $t'$ ,  $g$ , and  $g'$  in (2) and defining the tax elasticity with respect to wage earnings  $\xi$ , as the ratio between the marginal and average tax rate, and  $\xi_g$  as the ratio between the marginal and average benefit rate, after some manipulations, we obtain:

$$\dot{w} = \frac{[1 - \gamma(t - g)]}{[1 - \gamma(\xi t' - \xi_g g)]} \rho \dot{L} \tag{3}$$

Equation (3) can be easily transformed into an output supply function of the Lucas-Phillips type. In order to do so, we assume the nominal rate of change of the producer wage to be equal to the expected rate of inflation ( $\pi^e$ ) plus the rate of change of the real producer wage, and that wages are fully passed into prices

(i.e.  $\pi = \dot{w} + \pi^e$ ). We assume the *ex ante* tax and benefit rates  $t$  and  $g$ , to be the same (i.e. in equilibrium, taxes are just sufficient to finance benefit expenditure, hence  $t = g$ ). This is consistent also with the fiscal rule in EMU that the budget should be balanced over the cycle.<sup>4</sup> Finally, we assume that output supply is proportional to labor input. Under those assumptions, the output supply function becomes:

$$y = (1 - \gamma\xi t) \omega(\pi - \pi^e) \quad (4)$$

where  $\omega$  and  $\xi = \xi_t - \xi_g$  are constant, positive parameters.

Hence, if there is some degree of wage resistance (i.e.  $\gamma$  is positive), the reaction of output to an inflation surprise is smaller, the larger the value of  $t$ . In other words, in countries with bigger governments and higher taxes, a value of inflation larger (smaller) than expected will lead to a smaller (larger) reaction of output, which corresponds to a steeper supply function in the output-inflation space. The intuition for this result is clear. Take the case of a positive inflation surprise: as employers demand more labor to increase production, they will have to pay higher wages to cover not only for the higher prices, but also on account of the fact that the real production wage moves up; this tends to limit the rise in production.<sup>5</sup>

A progressive tax system (i.e.  $\xi_t > 1$ ) accentuates this effect, although it is not a necessary condition for it to occur.<sup>6</sup> At first sight, this contradicts the standard finding in union-wage models that progressive taxation moderates wage claims because it reduces the loss associated with a fall in wage income per worker without affecting the gain in wage income associated with increased employment. However, these models are based exclusively on the behavior of unions, look only at taxation as opposed to the tax and benefit system, and ignore the impact of taxation and benefits on search efforts, consumption-leisure trade-offs and efficiency wages. Taking these mechanisms into account may be shown to change the sign of the impact of a progressive tax and benefit system on wage claims from negative to positive (Naess-Schmidt 2003).

### Taxation and stabilization in a simple macroeconomic model

We now consider a version of the standard AD-AS model of a country belonging to a monetary union, which is closed vis-à-vis the rest of the world.<sup>7</sup> The IS aggregate demand and Lucas-Phillips supply curves for the home country are written as:

$$y^d = \phi_1 d - \phi_2(i - \pi^e) - \phi_3 \pi - \phi_4 y + \varepsilon^d \quad (5)$$

$$y^s = (1 - \gamma\xi t) \omega(\pi - \pi^e) + \varepsilon^s \quad (6)$$

where  $y$  is output,  $d$  is the budget deficit,  $\pi$  is inflation (“ $e$ ” reads “expected”),  $i$  is the nominal interest rate and  $t$  is the tax rate.  $y$ ,  $d$ , and  $t$  are expressed in terms of potential (baseline) output.  $\varepsilon^d$  and  $\varepsilon^s$  represent, respectively, uncorrelated temporary demand and supply shocks of zero mean. All the variables are percentage

points' deviations with respect to the baseline.  $\phi_1, \phi_2, \phi_3$ , and  $\phi_4$  and nonnegative parameters.

Equation (5) assumes that fluctuations in aggregate demand depend on (changes in) the budget deficit, the real interest rate, competitiveness, absorption, and a shock. Equation (6) is equivalent to equation (4) with an exogenous shock term added.

Aggregate demand and supply equations are complemented with the policy rules followed by the fiscal and monetary authorities. The Central Bank aims at stabilizing inflation and output of the currency area as a whole. We posit a simple Taylor rule of the form:

$$i = \lambda(\alpha\pi + \beta y) \quad (7)$$

where,  $\lambda$  captures the weight of the domestic country in the currency area, and  $\alpha$  and  $\beta$  are the preferences of the monetary authority over inflation and output, respectively. For a conservative central banker, we have  $\alpha > \beta$ . We assume that the monetary authority sets interest rates so as to maintain inflation on a fixed target in the "medium run," which, in this simple setting, means in absence of shocks. Since shocks—regardless of whether they are symmetric or country-specific—are serially uncorrelated with zero average, this implies  $\pi^e = 0$ .

For the fiscal authority, we assume that, in line with the Stability and Growth Pact, the government pursues a neutral discretionary policy, which implies that it sets a target for the structural budget balance and lets automatic stabilizers play symmetrically over the cycle<sup>8</sup>. The deviation of the actual budget balance from the baseline (the latter being structural balance in absence of shocks) is approximated by:

$$d = -(\xi_t - 1)ty + (\xi_g - 1)gy = -\xi ty \quad (8)$$

We capture the size of automatic stabilizers via the interaction of the elasticity  $\xi$  and the parameter  $t$ , with the latter in equilibrium assumed to be equal to the government expenditure ratio  $g$ .

Equating (1) and (2), after substitution of equations (7) and (8) in (5) and (6), the whole system can be solved for  $y$  and  $\pi$ :

$$y = \frac{(1 - \gamma\xi t)\omega\varepsilon^d + (\phi_2\lambda\alpha + \phi_3)\varepsilon^s}{(1 - \gamma\xi t)(1 + \phi_1\xi t + \phi_2\lambda\beta + \phi_4)\omega + \phi_2\lambda\alpha + \phi_3} \quad (9)$$

$$\pi = \frac{\varepsilon^d - (1 + \phi_1\xi t + \phi_2\lambda\beta + \phi_4)\varepsilon^s}{(1 - \gamma\xi t)(1 + \phi_1\xi t + \phi_2\lambda\beta + \phi_4)\omega + \phi_2\lambda\alpha + \phi_3} \quad (10)$$

We turn now to the analysis of shocks. We are interested in analyzing the effects on the degree of stabilization in the event of shocks for different tax burdens  $t$  (or the elasticity  $\xi$ : since the two terms enter in the expression as a product, the effect on the response to shocks is the same).

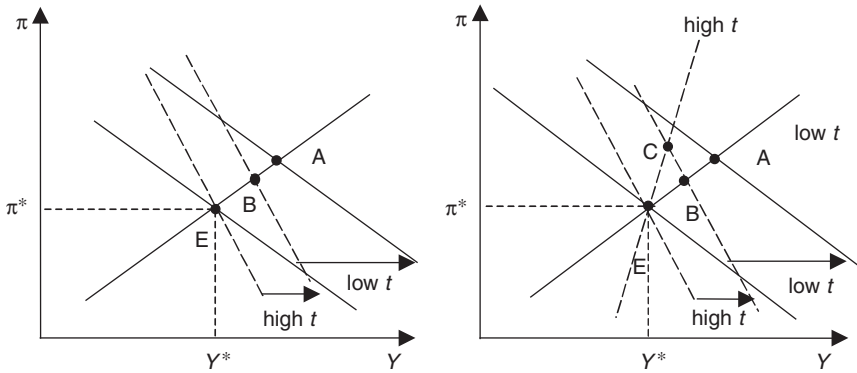


Figure 14.3 The effects of a positive demand shock under alternative tax rates.

The standard model which neglects the effect of taxes and benefits on supply predicts that automatic stabilizers stabilize output and inflation in the event of demand shocks, and stabilize output, but destabilize inflation under supply shocks (Blanchard 2000; Brunila *et al.* 2002; European Commission 2001). In this standard model, automatic stabilizers operate only on the demand-side. Higher stabilizers imply a lower effect of inflation on demand. In the output-inflation space, the aggregate demand schedule is steeper and displays smaller shifts in the event of shocks. The basic difference in our model is that, as stressed earlier, automatic stabilizers operate not only on the demand-side, but also on the supply-side: higher stabilizers—which means a higher level of taxes—make the supply schedule steeper.

The left panel of Figure 14.3 pictures the case of a positive demand shock under a “low” and “high” tax rate (or a low and high budget elasticity) according to the standard model. The slope of the demand curve is higher (in absolute terms) with a high tax rate than with a low one. The reason is that the higher the tax rate, the stronger will be the cushioning effect of automatic stabilizers on demand after an economy has been hit by rise in inflation. A rise in inflation will lead to a fall in demand on various accounts, most prominently a weakening in international competitiveness, a decline in real disposable income, and a tightening of monetary policy. Note that the latter effect, in an EMU context, is strongest in the largest economies, whose weight in the Central Bank’s reaction function is biggest. Automatic stabilizers provide an offset, and hence reduce the impact of inflation on demand and make the demand curve steeper.

The initial equilibrium, E, corresponds to target levels of output ( $Y^*$ ) and inflation ( $\pi^*$ ).<sup>9</sup> A positive demand shock induces a shift of the demand curve to the right.<sup>10</sup> The new equilibrium points, when only the steeper demand curve is considered (left panel), are now at A with a low tax rate, and at B with a high one. The new equilibrium level of output is closer to the optimal level with a high tax rate than with a low one. A similar picture emerges for inflation. Hence, in this case an increase in the tax rate is both output and inflation stabilizing.

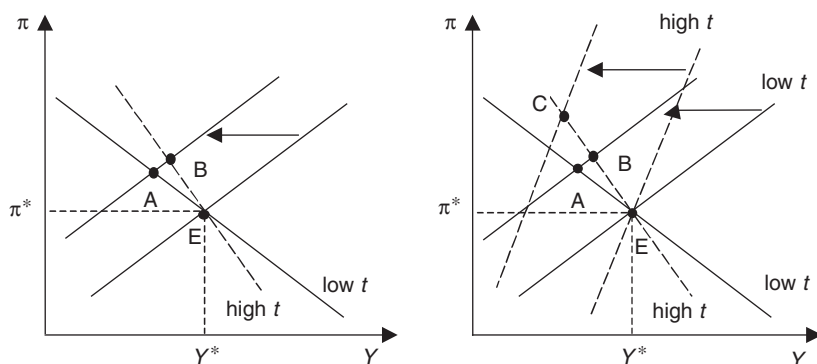


Figure 14.4 The effects of a negative supply shock under alternative tax rates.

Taking into consideration the possibility of the supply curve becoming steeper as well, automatic stabilization may become, however, inflation destabilizing. From the second panel in Figure 14.3, one can notice that this will still lead to a closer output to its optimal level but to a higher inflation. Hence, in this case an increase in the tax rate risks becoming inflation destabilizing beyond a certain point if the slope of the supply curve is more sensitive to the tax burden than the slope of the demand curve.

We turn now to the analysis of a supply shock. As shown in the left panel of Figure 14.4, an adverse supply shock induces a shift of the supply curve to the left. The new equilibrium point is now at A with a low tax burden, and at B with a high tax rate. One can easily notice that the new equilibrium level of output is further away from the initial level with a low tax rate than with a high one. The reverse emerges for inflation. Hence, in this case an increase in the tax rate from a low value to a high one is output stabilizing but inflation destabilizing.

The increase of the tax rate may become, however, output destabilizing if the supply curve also becomes steeper due to high taxation, as shown in the second panel of Figure 14.4. The new equilibrium point is now at C with a high tax burden. It is clear from the graph that the new equilibrium level of output is further away from the initial level with a high tax rate than with a low one. Inflation is always further away from its optimal level with a higher tax rate. Hence, in this case an increase in the tax rate from a low value to a high one is both output destabilizing and inflation destabilizing.

### “Critical” levels of taxation

The previous analysis shows that the changes of taxation to become output-destabilizing rise with the supply curve becoming steeper.<sup>11</sup> On the other hand, the output-destabilizing effect diminishes as the demand curve become steeper. Since the slope of both curves depends on the tax rate, the threshold level for the tax rate beyond which further increase of taxation is destabilizing for output in

the event of a supply shock depends on the relative sensitivity of demand and supply to taxation. This, in turn, depends on the openness of the economy: the more open the economy, the lower will be the fiscal demand multiplier and therefore the steeper will be the supply curve relative to the demand curve for a given tax burden. Therefore, open economies are more likely to face adverse fiscal stabilization properties in the face of a supply shock than relatively closed economies for a given level of taxation (and progressivity).<sup>12</sup>

It is also easy to show that always  $\partial y/\partial t < 0$  for a positive demand shock ( $\varepsilon^d > 0$ ) and  $\partial \pi/\partial t < 0$  for an adverse supply shock ( $\varepsilon^s < 0$ ). As was shown in the graphs in the previous section, this implies that a higher  $t$  (or  $\xi$ ) unambiguously increases the stabilization of output in the event of demand shocks, and destabilizes inflation in the event of a supply shock.

However, in the case of a response of output in the case of supply shocks, or inflation in the case of demand shocks, the initial level of  $t$  matters. In line with the intuition, we show a higher  $t$  to entail stronger output stabilization in the event of demand shocks while it is inflation destabilizing in the event of demand shocks. The crucial result concerns output stabilization in the event of a supply shock and inflation stabilization in the case of a demand shock. In the traditional model in which taxes do not affect supply, higher taxes tend to stabilize both variables. In our model, instead, there exists a threshold level of taxation beyond which a further increase in taxes has perverse stabilization effects.

We consider two concepts of the threshold tax level: the “optimal”  $t$ , call it  $t^*$ , which maximizes output and inflation stabilization in the event of supply and demand shocks, respectively; and the “critical”  $t$ , call it  $t^{**}$ , which corresponds to the level of taxation resulting in zero fiscal stabilization (i.e. the same level of stabilization arising when  $t = 0$ ).

$t^*$  is obtained by taking the derivative of the coefficient of  $\varepsilon_d$  in  $\pi$  or the coefficient of  $\varepsilon_s$  in  $y$  to  $t$  and equating the result to zero:

$$t^* = \frac{\phi_1 - (1 + \phi_2\lambda\beta + \phi_4)\gamma}{2\phi_1\gamma\xi} \quad (11)$$

Hence, for  $t > t^*$ , a rise in  $t$  reduces the degree of output stabilization in the event of supply shocks, and inflation stabilization in the event of demand shocks.

$t^{**}$  is obtained by equating the coefficient of  $\varepsilon_d$  in  $\pi$  or the coefficient of  $\varepsilon_s$  in  $y$  to the same coefficient under  $t = 0$ :

$$t^{**} = \frac{\phi_1 - (1 + \phi_2\lambda\beta + \phi_4)\gamma}{\phi_1\gamma\xi} \quad (12)$$

So  $t^{**} = 2t^*$ .

Some intuitively appealing conclusions can be drawn from this result:

- 1 It appears that there exists a trade-off between the redistributive thrust of the tax and benefit system ( $\xi$ ) and the tax burden ( $t$ ): the less the redistributive

- taxes and benefits are, the higher will be the critical tax rate, and hence the wider is the range of tax rates whereby automatic stabilizers are effective.
- 2 The same applies to the degree of wage resistance ( $\gamma$ ): the higher it is, the lower will be the optimal (and critical) tax rate, because the more the level and redistributive thrust of taxation and spending matter for wage formation, the bigger will be its impact through the supply channel.
  - 3 The threshold level of the tax rate above which automatic stabilizers become destabilizing, depends on the responsiveness of demand to the fiscal impulses stemming from the automatic stabilizers ( $\phi_1$ ). The weaker this responsiveness, (e.g. because of Ricardian behavior) the lower the tax rate that can be “afforded” without risking declining or perverse stabilization properties.
  - 4 The threshold varies inversely with the weight of output stabilization in the Central Bank’s reaction function ( $\beta$ ). A dovish Central Bank will choke off the output effect of automatic stabilizers and thus weaken their effectiveness. Interestingly, this implies that the incentives to reform the tax and welfare system are lower under a hawkish central banker,<sup>13</sup> although incentives to reform the tax system on efficiency grounds would obviously be decisive.
  - 5 A greater openness of the economy ( $\phi_4$ ) reduces the threshold level of taxation. The reason is that the demand effects of automatic stabilizers leak out via foreign trade, implying that the negative supply effects predominate more quickly, that is, even at a lower level of taxation. This is analytically similar to the third point of the list, but may be usefully highlighted separately. This is so because while trade leakage is related to the openness of the economy, policy transmission may be weak even in a closed economy. Open economies in the EMU are thus facing stronger incentives to reform their tax systems than the relatively closed ones.

### How large are $t^*$ and $t^{**}$ ?—some numerical simulations

The typical tax burden in EMU countries is in the range of 40–50 percent of GDP. Is this exceeding the optimal level and would a reduction in the fiscal size thus work out favorably for stabilization? Is it empirically possible or even likely that the tax burden exceeds the critical tax burden?

While a full-fledged analysis is well beyond the scope of this chapter, we can nonetheless provide some tentative indication of the possible values of  $t^*$  and  $t^{**}$ . It goes without saying that our computations are purely illustrative and that one should refrain from drawing policy conclusions from the simple comparison of the estimated  $t^*$  and  $t^{**}$  with the actual tax burden in Euro-area economies. Nevertheless, these estimates are helpful in exemplifying our reasoning.

In Table 14.1, we report the chosen baseline values of the coefficients. With regard to the demand equation, we assumed that  $\phi_1 = 1$  and  $\phi_2 = \phi_3 = \phi_4 = \frac{1}{2}$ , which is broadly in line with the short run elasticities reported in ready-reckoners of the OECD’s INTERLINK model (Dalsgaard *et al.* 2001). The budget elasticity—encompassing both, spending and revenue—is set at  $\xi = \frac{1}{4}$  based on Van den Noord (2000). We assume a hawkish banker, that

is,  $\alpha = \frac{1}{2}$  and  $\beta = 0$ , with the country's weight in the monetary policy reaction function set at  $\lambda = \frac{1}{4}$ . Concerning the supply equation we assumed that  $\omega = 3$ , which corresponds to the mid-range of estimates of the price elasticity of aggregate supply reported in Clarida *et al.* (1998).<sup>14</sup> To gauge the degree of wage resistance, we proceeded somewhat differently. Rather than making a prior assumption for  $\gamma$ , we fixed the incidence of labor taxation on profits at one half, that is,  $\gamma \cdot \xi = \frac{1}{2}$ . This implies that  $\gamma = 0.4$ . This is consistent with the evidence of Alesina and Perotti (1997), which estimate a coefficient of 0.4 for countries in continental Europe in the relation between labor taxes and unit labor costs in manufacturing in a sample of annual data from 14 OECD countries.

Table 14.1 Baseline parameters

|                |                  |
|----------------|------------------|
| $\phi_1 = 1$   | $\xi = 1.25$     |
| $\phi_2 = 0.5$ | $\omega = 3$     |
| $\phi_3 = 0.5$ | $\lambda = 0.25$ |
| $\phi_4 = 0.5$ | $\alpha = 1.5$   |
| $\gamma = 0.4$ | $\beta = 0$      |

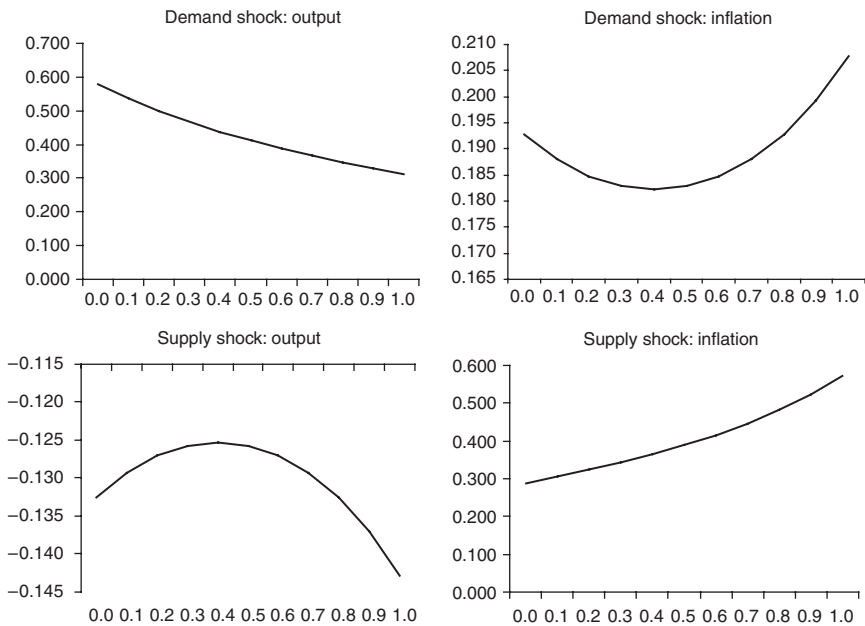


Figure 14.5 Baseline simulation.

Note

The horizontal axes indicate the tax burden ( $t$ ) and the vertical axes, the impact of a shock (normalized at unity) on the output gap or inflation.



Table 14.2 Sensitivity analysis

|                            | $t^*$ | $t^{**}$ |
|----------------------------|-------|----------|
| Base line                  | 0.4   | 0.8      |
| $\xi = 1$                  | 0.5   | 1        |
| $\beta = 1$                | 0.35  | 0.7      |
| $\phi_4 = 0.75$            | 0.3   | 0.6      |
| $\phi_1 = 0.75$            | 0.2   | 0.4      |
| $\gamma = 0.5$             | 0.2   | 0.4      |
| $\beta = 1, \lambda = 0.5$ | 0.3   | 0.6      |

Based on these assumptions, we find that  $t^* = 0.4$ , and  $t^{**} = 0.8$ , which suggests that for countries in the upper end of the range, the tax burden would be suboptimal, but well below the critical level (see Figure 14.5). This implies that a country with an initial tax burden of 50 percent that would cut it by 10 percentage points realizes a slight improvement in the output stabilization properties after an adverse supply shock. The same holds true for the impact on prices after a positive demand shock.

However, these results may be expected to be rather sensitive to the numerical assumptions and hence, if this proves true, the structural features of the economies in EMU. This is confirmed by sensitivity analysis. As shown in Table 14.2 and in the corresponding figures in the Annexure, a reduction in the budget elasticity from  $1\frac{1}{4}$  to 1 raises the value of  $t^*$  to  $\frac{1}{2}$  and  $t^{**}$  to 1. In other words, a tax burden equal to one half of GDP may still be optimal from a stabilization point of view if the tax and benefit system is proportional. By contrast, a greater openness of the economy ( $\phi_4 = \frac{3}{4}$ ), a less effective fiscal policy ( $\phi_1 = \frac{3}{4}$ ) and greater wage resistance ( $\gamma = \frac{1}{2}$ ) all push  $t^*$  into a range of 0.2–0.3 and  $t^{**}$  into a range of 0.4–0.6. Under those conditions, slashing the size of government would pay substantially in terms of the gains in fiscal stabilization properties that would be realized.

From Table 14.2 can be inferred that a similar scope for reductions in the size of government results if the central banker turned dovish to an extent where it gives a positive weight to output and inflation in its policy reaction function ( $\beta$  is set equal to 1). This effect is even more pronounced for larger countries that have a bigger weight in the reaction function (e.g.  $\lambda = \frac{1}{2}$ ). Interestingly, this result runs somewhat counter to the general perception that a hawkish central banker would be more successful in raising incentives for structural reform than a dovish one.

Our results are broadly in line with recent empirical investigations, which have found evidence of a nonlinear relationship between the size of the government and macroeconomic stability.

Martinez-Mongay and Sekkat (2003) test whether the structure of the tax system affects the impact of tax changes on output volatility. In a sample of 25 OECD countries over the period 1960–99, they find that the composition of tax and expenditure, in particular the tax mix, matters for output and price volatility: distorting taxes, namely taxes on labor and capital, tend to have negative effects on macroeconomic stability. Cuaresma *et al.* (2003) find that the smoothing

effect of fiscal stabilizers may revert at high levels. In a panel of 14 EU countries over the period 1970–99, the stabilizing effect changes sign at a level of government expenditure of about 38 percent of GDP. According to their results, for a country displaying a public expenditure ratio around the median value of the distribution (40.6 percent of GDP), an increase in spending by 1 percentage point of GDP will raise the standard deviation of output growth by 0.02 points. The destabilizing effect is higher (0.04 percent) for a country with an expenditure ratio of 44.1 percent. However, this study is not entirely comparable to ours as it focuses solely on government spending and does not distinguish between automatic stabilizers and discretionary policy reactions.

## **Conclusions**

Conventional AD-AS models imply that high and progressive tax systems are efficiency-decreasing but enhance output stabilization in the event of shocks.

Progressive tax systems lead to a lower budget deficit (contraction of fiscal policy) in good times, while the deficit would increase in recessions (fiscal expansion). Moreover, large and progressive tax systems usually go hand in hand with more generous systems of social protection. Although social benefit programs mainly have an equity role, as well as potential efficiency effects when they correct market failures, most of them also act as automatic stabilizers. Unemployment benefits make up the clearest example, but more generally, the relative robustness of expenditure programs to cyclical fluctuations serves to smooth economic activity, and this smoothing effect is likely to increase with the size of government. However, since distorting taxes and benefits have a pervasive impact on potential growth, a trade-off between stabilization and efficiency seems to arise within the standard AD-AS framework. If there is a positive relationship between the size of automatic stabilizers and distortive taxation, any tax reform aiming at lowering distortions and enhancing efficiency will come at the expense of macroeconomic stability.

This issue is at the heart of macroeconomic policy design in EMU. If, as suggested by the standard model, there were a trade-off between stability and flexibility, EMU members—having given up national monetary independence—would not dispose of enough policy instruments to deal with idiosyncratic shocks.

However, this chapter suggests that, in the event of supply shocks, such a trade-off might not exist. Within our model, under the assumption of at least partial wage resistance, cutting tax rates reduces market distortions and enhances the output stabilization in the event of supply shocks, and inflation stabilization in the event of demand shocks. So, if our conclusions are right, unless there is a clear predominance of demand over supply shocks, one should not worry about the possible adverse effects on stabilization of the tax reforms that across the EU are lowering marginal and average tax rates across the whole income scale (European Commission 2000a,b, 2001).

It is understood that the analysis in this chapter is only a first step into the analysis of the relations between efficiency and flexibility, on the one hand, and cyclical stabilization, on the other hand. Obvious improvements concern the theoretical model (which is overly simple and static in nature) and the description of the behavior of policy-makers. Moreover, the numerical simulations are only indicative and should be supplemented by more thorough econometric investigation.

An issue that arises naturally is the apparent contradiction between our conclusion that adverse stabilization effects may arise at lower levels of taxation in smaller economies, and the finding that small, open economies tend to have larger governments (see the seminal contribution by Rodrick (1998), and, recently, Martinez-Mongay (2002)). Two explanations can be offered. First, whatever their initial level, higher taxes are output stabilizing in the event of demand shocks. Hence, if output stabilization is the main goal of fiscal authorities, and demand shocks (are expected to) prevail, larger governments would ensue. However, EMU may bring a change in the composition of shocks by increasing the relative frequency of supply compared to demand shocks.<sup>15</sup> If so, large automatic stabilizers may no longer be optimal. Second, to the extent the tax burden remains below the critical tax burden, a rise in it is stabilizing, although increasingly less so. This, coupled with a higher exposure to shocks, may imply larger governments in small open economies. Econometric analyses based on past data may capture this effect. However, in recent years, the actual tax burden may have reached or even exceeded the critical one. Fresh empirical evidence tends to lend support to our results.

Our analysis indicates that tax reforms aiming at lowering marginal effective tax rates and the tax burden, under supply shocks may enhance the stabilization properties of automatic stabilizers, especially in small Euro-area economies. Hence, they face a lesser dilemma between structural reform and stabilization policy. This may contribute to explain their greater reform efforts and better performance compared with the big “laggards.” However, if EMU brings about greater trade integration, the incentives to step up reform efforts would increase also in the large Euro-area countries.

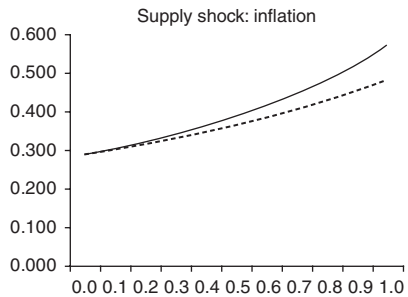
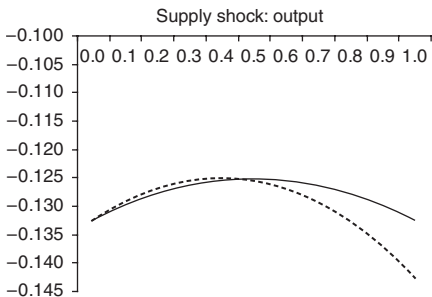
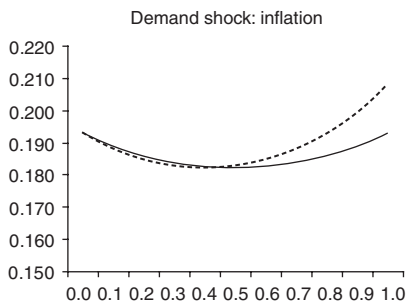
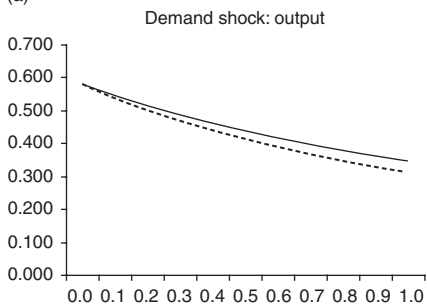
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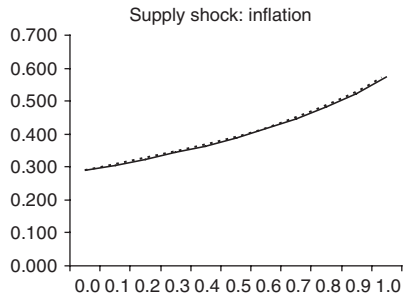
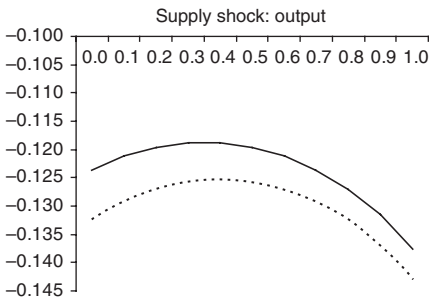
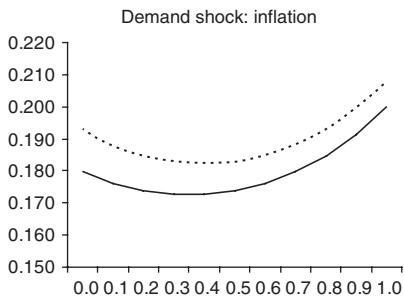
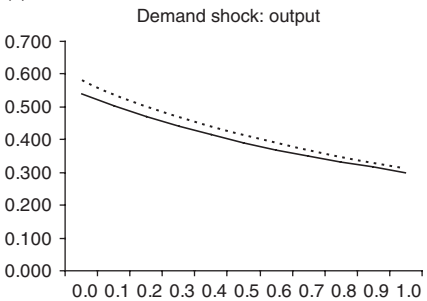
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**Annexure**

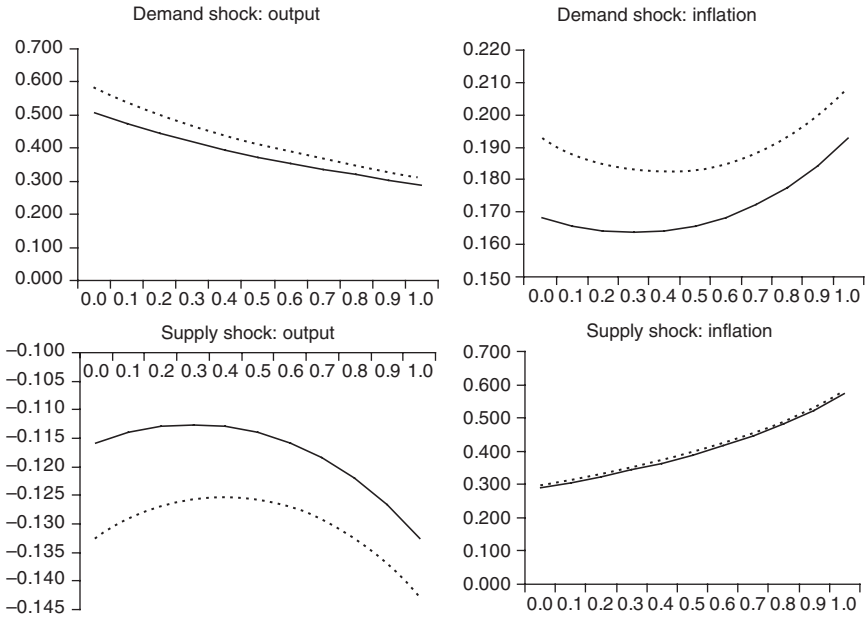
(a)



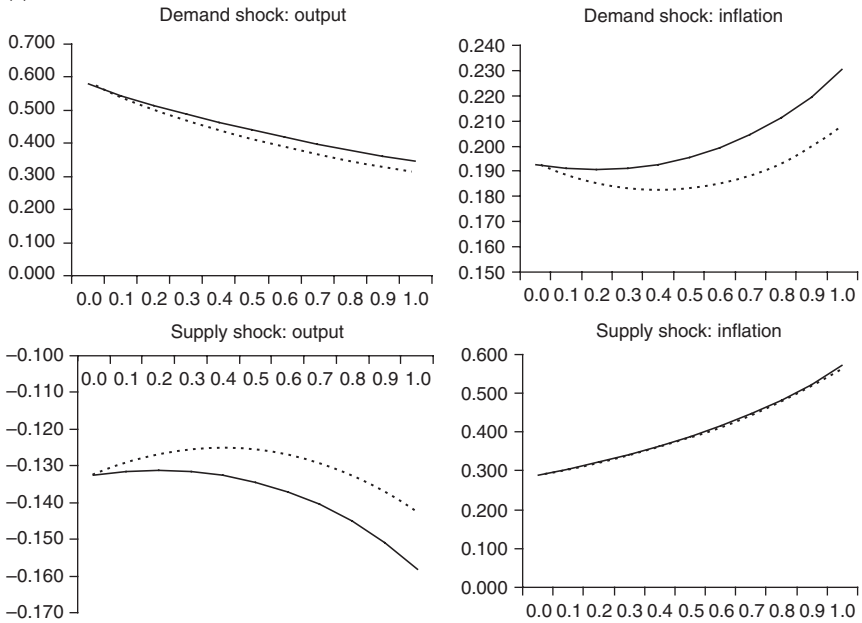
(b)



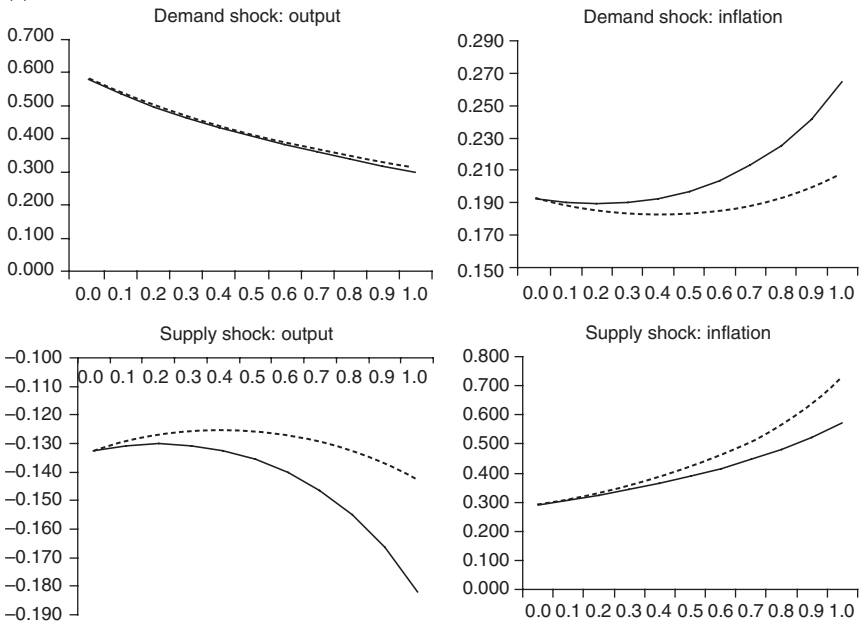
(c)



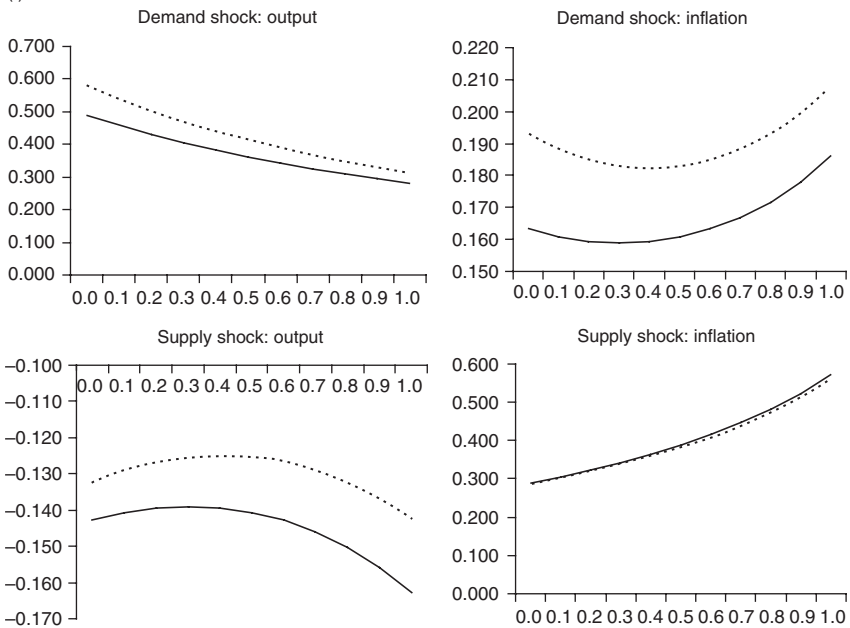
(d)



(e)



(f)



Sensitivity analysis: (a)  $\varepsilon = 1$ ; (b)  $\beta = 1$ ; (c)  $\phi_4 = 0.75$ ; (d)  $\phi_1 = 0.75$ ; (e)  $\gamma = 0.5$ ; (f)  $\beta = 1$ ,  $\lambda = 0.5$ .

Note

The horizontal axes indicate the tax burden ( $t$ ) and the vertical axes the impact of a shock (normalized at unity) on the output gap or inflation. The dotted line is baseline.

## Notes

- 1 See for example, Kneller *et al.* (1999), Van den Noord and Heady (2001), and OECD (2002).
- 2 Evidence of “real wage resistance” in continental Europe is found by Daveri and Tabellini (2000), but not by Layard (1997) who finds that in the long run tax neutrality holds. Notice, however, that what is crucial for our analysis is real wage resistance in the short run. Hence, the results below are not incompatible with long run neutrality of taxes. In OECD (1990), a simple test based on time series regressions of 16 OECD countries shows that while total taxes have no long run effects on labor costs, they have a substantial short run. For an overview of the debate, see Carone and Salomäki (2001) and Daveri (2001).
- 3 Note that this assumes that the government fails to provide such compensation via incomes policy. This assumption is consistent with the starting point of our analysis that governments rely on automatic stabilizers, hence do not modify the tax and spending parameters in response to cyclical fluctuations in economic activity.
- 4 We assume furthermore that the tax and benefit system is neutral with respect to capital and labor, that is, exactly the same average and marginal rates apply to capital income and, for that matter, total value added.
- 5 For this to hold true it must be assumed that governments fail to provide an offsetting tax break to moderate wage demands, that is, do not pursue an incomes policy. But, this is consistent with the basic assumption of our analysis: governments solely and fully rely on automatic stabilizers, hence do not modify the tax and spending parameters in response to cyclical fluctuations in economic activity.
- 6 A sufficient condition is that  $\xi > 0$ , hence  $\xi_t > \xi_g$ , that is, the tax and benefit system as a whole is redistributive.
- 7 The more explicit microfoundations of the supply curve and the focus on a single country within a monetary union are the main changes compared to the model in Buti *et al.* (2003a).
- 8 This is the definition of a “well-behaved” fiscal authority, according to Alesina *et al.* (2001). For more sophisticated reaction functions of fiscal authorities in EMU, see Buti *et al.* (2001), and Buti and Giudice (2002).
- 9 Notice that the initial equilibrium  $E$  is the same with low and high taxes only for reasons of expositional convenience, because we want to focus on the slope of the curves rather than their position.
- 10 Note that the horizontal shift is smaller for higher tax rates as the impact of the demand shock is muted by the automatic stabilizers.
- 11 In the extreme case where the supply curve becomes vertical, the shock would not be smoothed at all, and output would fall by the same extent of the supply shock.
- 12 However, it should be recognized that, due to stronger competition, wage resistance is likely to be smaller in more open economies. In our analysis, we do not consider this interaction.
- 13 From a different perspective, this result is consistent with the view of those who see an expansionary monetary policy going hand in hand with structural reforms. See for example, Bean (1998) and Saint-Paul (2002).
- 14 Note, however, that the value of  $\omega$ , as well as those of  $\phi_3$  and  $\alpha$ , has no impact on the  $t^*$  and  $t^{**}$ . Even though they do affect the degree of fiscal stabilization across levels of  $t$ , they are irrelevant for  $t^*$  which is obtained via the solution of the optimization problem set out earlier.
- 15 Buti *et al.* (1999) argue that EMU’s macroeconomic framework could lead to less policy-induced demand shocks while the increase in market competition brought about by the Euro could entail more supply-related shocks.

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