BEATRICE SCHEUBEL

Bismarck's Institutions

Beiträge zur Finanzwissenschaft
31

Mohr Siebeck

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herausgegeben von

Hans-Werner Sinn und Clemens Fuest

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Beatrice Scheubel

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A Historical Perspective on the Social Security Hypothesis

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e-ISBN PDF 978-3-16-152497-4
ISBN 978-3-16-152272-7
ISSN 0340-675X (Beiträge zur Finanzwissenschaft)

Die Deutsche Nationalbibliothek lists this publication in the Deutsche Nationalbibliographie; detailed bibliographic data are available on the Internet at *http://dnb.dnb.de.*

The book was printed on non-aging paper and bound by Gulde-Druck in Tübingen.

Printed in Germany.

To my parents

Preface

Why would an economist write a scientific book on fertility? Because it matters. It matters for all those topics we face every day in modern societies: it matters for the ageing problem that will significantly weigh on growth in most developed economies during the coming years; it matters for the size of future pension increases and it matters for whether people will have to work longer. While it is necessary to identify not only the problem of declining fertility, but also its causes, there is surprisingly little evidence on one of its major causes of declining fertility: the existence of public institutions. To activate and to contribute to this debate, I decided to write this book.

However, identifying an effect of social security on fertility is not easy, since social security systems have been in place in many countries for decades. Therefore, I pursued the project with historical data. The first comprehensive social security system in the world was introduced in Germany, which coincidentally also has quite reliable historical statistics. Notwithstanding this, historical statistics do not exist for every single issue the researcher would like to analyse. When I tried to gather this data, many colleagues were sceptical whether I would find the data for a proper empirical analysis. It became clear that I could finish this project only when Kathrin Weny made me aware of the work by Monika Sniegs and Lars Kaschke who had collected data from the public pension insurance administration in Imperial Germany. Matched with demographic information from the Annual Yearbooks of Statistics they are a valuable source for understanding the introduction of social insurance in Imperial Germany.

Working with historical data also led me to come across some interesting historical particularities:

Bavaria was special: Bavaria's special role in the federation of German states was mirrored in how much Bavarian Regional Insurance Agencies had to adhere to instructions from the Federal Insurance Agency.

The pension system was a dowry fund: Even though women were covered by pension insurance if they worked in a profession that qualified for pension insurance, they remained effectively uninsured since they would claim back their contributions as soon as they got married.

Discrimination of Slav minorities in east Prussia even happened within the pension system: Lars Kaschke and Monika Sniegs already mentioned the discrimination of Slav minorities as an explanation for unusual data patterns in their work on the quality of the statistics collected by pension insurance administration in Imperial Germany. I show that this effect is robust to controlling for a series of confounding factors, and have devoted one appendix in this book to provide econometric evidence.

Bismarck's pension system was not 'Bismarckian': the original 1889 law on pension insurance has many funded elements. Thus, Bismarck's pension system as it was introduced initially was not 'Bismarckian' in the sense in which it is nowadays referred to by economists. Largely unnoticed by today's scientific community (and even less so by the contemporary one), the early years of the pension system witnessed a regime change.

While dealing with these and many other questions (and answers) that I provide in this book, many people have supported me in pursuing this project:

First and foremost I am grateful to my family for their continuous support.

Second, I am grateful to my 'academic teachers' from whom I have learned how to work scientifically. Hans-Werner Sinn's fervour with which he publicly addresses economic issues and public policy problems has inspired me to write about such a political topic. My supervisor's ever critical approach made me think twice about my arguments and identification strategies. And of course, without him I would not have discovered my enthusiasm for public economics during my undergraduate studies. Without Joachim Winter, I would not have started to work empirically. Daniel Schunk taught me how to write and review papers properly.

Third, I am grateful to Amelie Wuppermann for her comments on texts and methods and to both Amelie and Nikolaus Solonar for reading this manuscript, despite its length, more than once. I thank Laila Neuthor for her support and advice.

Fourth, I am also grateful to the colleagues at the Center for Economic Studies who provided support and comments in various internal seminars and to Mailina Lienke, Kathrin Weny, Jakob Eberl and Daniele Montanari who provided valuable research assistance at the Center for Economic Studies.

Last but not least, I would like to thank my editor Stephanie Warnke-De Nobili for her support and suggestions which have helped me to turn the book into its current 'edited' version.

Working on this book reminded me time and again that we can only learn the real lessons for the future from the past. I hope that this work will raise the awareness for the impact that public policies can have on people's behaviour, even if such effects may take a long time to become visible.

Frankfurt am Main, May 2013

Beatrice Scheubel

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Fertility and the Family Now and Then

People will always have children.

Kinder kriegen die Leute immer.

Konrad Adenauer, German Chancellor, 1957

Anna and Martin Bär with their children Marie, Babette and Georg in front of their home in rural Frankonia (around 1902). Georg, the eldest, was born in 1892, one year after the public pension insurance came into force. *Source:* family archive.

1.1 The Fertility Decline and Population Ageing

"*People will always have children.*" Konrad Adenauer, first chancellor of the Federal Republic of Germany, was confident that people would always have a substantial number of children. Of course, if people would always have a substantial number of children, a pay as you go pension system would be perfectly adequate and sustainable in the long run. However, the baby boomer generation[1] born in the years shortly following Adenauer's remark, unfortunately decided otherwise.

Not only in Germany did the baby boomers appear to be perfectly happy with one child or without any children at all, a phenomenon termed lowest-low fertility in the literature (e.g. Billari et al. 2002; Morgan 2003; Billari and Kohler 2004). However, their personal utility does not coincide with the social optimum. It does not require complicated maths to realise that the individual decision to have few or no children converts into a lower birth rate in the aggregate. In the end, this leads to a lower population growth rate – a development only exacerbated by increasing life expectancy. A lower population growth rate would not be a problem for society if chancellor Adenauer's government had not decided to make the public pension system a pay as you go system. In a pay as you go pension system, the payment of pensions and the population growth rate are inextricably linked, hence also the pensions of the baby boomer generation and their decision to have fewer children.

The baby boomers had new and modern ideas about their lives, but currently these ideas are fully backlashing. The sustainability of the public pay as you go pension system is at stake. While having few or no children make it easier to have an additional car or a more expensive holiday, pensions are at risk. The decreasing labour force cannot finance the pensions of the ageing baby boomers in any realistic scenario. When the baby boomers retire – around 2025–2035 – the burden is the largest: the German National Statistical Office estimates the old age dependency ratio[2] to rise to above 50% by 2030 (Statistisches Bundesamt 2009). Simply put, in 2030 two working individuals will have to support one pensioner. Even today the old age dependency ratio is already at 30.8% (Eurostat 2011b). What is alarming is that neither individuals nor the state took sufficient precautions.

[1] The baby boomer generation is the cohort born after World War II, when birth rates rose as a consequence of the war and increasing economic growth. In Germany, the baby boomer generation is the cohort born between approximately 1955 and 1965.

[2] The old age dependency ratio is the ratio of people aged 65 or older relative to the population aged 15–64.

The baby boomers grew up in a period of exceptional economic prosperity. While their standard of living is higher than the standard of living of any of the preceding generations, they rather consumed than saved, relying on the governmental arrangements. As a consequence, private saving can now hardly make up for the pension gap that results from their decision to reduce the family size (e.g. Disney 2004; Börsch-Supan et al. 2005).

German politicians have been notorious in ignoring the hard facts about population ageing. In 1986, Germany's then Labour Minister Norbert Blüm famously campaigned for reelection claiming that "one thing is for sure: the pensions" (*"Eins ist sicher: die Rente."*). Though in the 1980s, when the baby boomers were in the prime childbearing age, it should have begun to dawn on politicians that the baby boomers refused to play along as they were supposed to.

The German government has slowly started to be concerned about the sustainability of the pay as you go pension system only since the 1990s. This trend is also evident in other European governments in countries with rapidly ageing populations. Unfortunately, introducing 'sustainability factors' and similar measures that index pensions to average life expectancy are not enough. The 2007-2009 financial crisis immensely aggravated the sustainability problems of Europe's pay as you go pension systems. Many European countries have increased their debt level to rescue the banking sector to such an extent that extensive taxation is necessary to shoulder this burden. The room for manoeuvre to raise pension contribution rates or tax rates to finance the implicit debt in pay as you go pension schemes[3] has become minuscule.

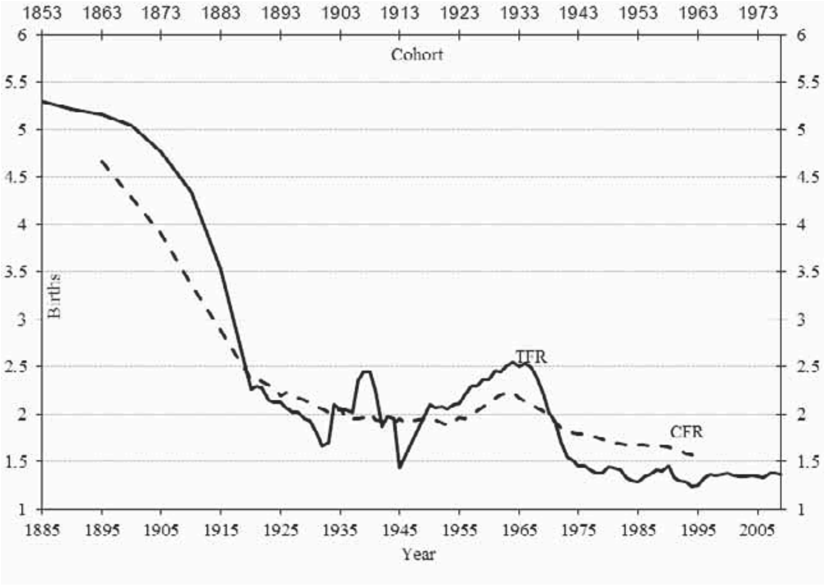
Observing the lowest-low fertility levels today, it may seem careless that Adenauer introduced a statutory pension scheme that entirely depends on private decision-making. But in 1957, it appeared that people would always have many children. Or did it not? In fact, the tendency towards smaller families and the phenomenon of declining birth rates are not new at all. Except for the disruptions caused by the two World Wars, birth rates have been declining for years (in fact, for more than a century), largely ignored by governments.

The ideal of having only a one-child or two-child family emerged already at the end of the *nineteenth* century. Already in 1914, von Gruber observed a tendency towards a "two-child system"[4], or even towards an ideal family with one or no child in 1914. Even though couples may have started to have children already by their mid-twenties around 1900, this does not mean that the final number of children was necessarily higher than 2.

[3] The implicit debt in a pay as you go pension system is the present value of all existing pension entitlements. In most systems the state has a legal obligation to service these claims.

[4] von Gruber 1914, p. 14.

Figure 1.1: Total fertility rate and completed fertility rate in Germany



Completed fertility rate (CFR) and total fertility rate (TFR) for Germany. Sources (TFR): Figures before 1921 refer to Imperial Germany. Figures for 1945–1989 refer to West Germany. Figures 1990–2009 refer to unified Germany. Figures for 1885–1920 from Festy (1979), p. 222. Figures for 1921–1945 from Marschalck (1984), p. 159. Figures for 1964–2009 from the German National Statistical Office (2010b). Sources (CFR): Cohorts 1865–1890, 1895, 1900, 1905, 1910, 1915, 1920, 1925 from Schwarz (1991, 1997). Cohorts 1891–1894, 1896–1899, 1901–1904, 1906–1909, 1911–1914, 1916–1917 from Marschalck (1984), p. 159. Cohorts 1923, 1926, 1929 from Marschalck (1982), p. 81. Cohorts 1930–1965: German National Statistical Office (2010a), figures for 1961–1965 estimated.

Figure 1.1 shows the total fertility rate (TFR)[5] and the completed fertility rate (CFR)[6] for all years since 1885 and cohorts born since 1863 respectively. The completed fertility rate is the most adequate measure of fertility, since in recent years women have started to postpone family formation to ages decidedly beyond 30. The average age of German women when they give birth to their first child was 31.4 years in 2009 (Statistisches Bundesamt 2011e). However, this does not necessarily imply a proportionately lower family size

[5] The TFR is defined as $TFR_t = \sum_{age=15}^{age=49} \frac{(BIRTHS_t^{age})}{WOMEN_t^{age} \cdot 1000}$. That is to say, the TFR in year t is equal to the sum of all cohort-specific birth rates in year t. Fertility measures are discussed in chapter 2.

[6] The CFR is defined as $CFR_y \sum_{t=y+14}^{t=y+48} \frac{(BIRTHS_t^{age})}{WOMEN_t^{age} \cdot 1000}$. That is to say, the CFR of cohort y is equal to the age-specific birth rate of all women of cohort y in all their fertile years. Fertility measures are discussed in chapter 2.

in comparison to those women, who start family formation in their twenties, as intervals between births can be shorter. Accordingly, drawing conclusions from all births per woman in the childbearing age in one year (i.e. the TFR) for the final number of children per woman (i.e. the CFR) may underestimate the number of births if women just postpone fertility. This phenomenon is visible in figure 1.1 since approximately 1975 or for cohorts born since approximately 1940 or later.

The opposite is true if women tend to have children early in their fertile years. Again, this does not necessarily mean that they display the same fertility for all fertile years. In this case, the TFR overestimates the CFR. This is the case for the late nineteenth century and the early twentieth century years or cohorts born between 1865 and 1885. There must have been some form of adjustment process both at the beginning of the twentieth century and since the 1970s. However, it becomes apparent that the transition to the two-child family already took place between 1885 and 1920. Fertility had fallen from approximately 5.5 children per woman to less than 2.5 children per woman by 1920. This resembles almost a 55% reduction in about 35 years. In addition, except for the 1950s/60s baby boom it has been below 2 ever since. For births to fall by another 50% to slightly above 1 child per woman it has taken another 70 years. It is quite apparent that people do *not* always have children.

The tendency towards smaller families can be observed in all European economies (figure 1.2). In fact, we are talking about the *second* fertility decline as opposed to the *first* fertility decline (e.g. Lesthaeghe 2010), which took place a century earlier. The first fertility decline is neither specific to Germany nor to Europe. It refers to the decline in fertility a society experiences with increasing economic development. Instead, it is a phenomenon that can be observed for several of today's developing economies (e.g. Lestaeghe and Neels 2002). The second fertility decline, in contrast to the first, takes place in developed economies and is a relatively new phenomenon. It is commonly associated with the widespread availability of the contraceptive pill, increasing female labour force participation and an associated cultural change in attitudes.

Economic conditions were very different for the baby boomers compared to their grandparents. Nevertheless, both generations decided to have a smaller family than their parents and grandparents. If the decision on family size were as individual and private as we would assume, why do we observe similar behavioural patterns? Perhaps, the seemingly private decision was not really private, since the state became involved fairly early on. The existence of public insurance schemes reduces the necessity to provide privately for old age – for example, by having children who can care for their parents when the parents are old. Typically, the payment of a pension in a public pension scheme is not tied to the individual number of children. Why should the baby boomers have children if they could also have an additional car while the state guaranteed their pension? Why should their grandparents use their tight budget on more children if the government provided for old age?

In fact, both the first and the second fertility decline can be related to the same phenomenon: the welfare state increasingly assumed the duties of a family. The pension system itself has caused the sustainability problems that are now associated with it (e.g. Sinn 2004a, 2005). In particular, the state has been present in the marital bed since the late 1880s when comprehensive social insurance was introduced in Germany. Therefore, it is worth going back in time and to devote some attention to the factors at play during the first demographic transition. By finding out what drove the decision of the grandparents of the baby boomers on the size of their families and how the state got involved in this process, we may understand the factors that are still at play today better.

1.2 Going Back in Time: The First Demographic Transition in Germany

To contemporary observers, the situation was crystal clear. By the end of the nineteenth century, Germany experienced a drastic cultural change with modern families becoming smaller. This was caused by German women refusing to assume their role as mother and housewife. Instead, they became increasingly active in the labour force. The 1912 cartoon in figure 1.3 illustrates that contemporary observes considered the emancipation of women as a major cause of the fertility decline. Figure 1.3 shows the cover of the 29 July 1912 issue of *Simplicissimus*. *Simplicissimus* is a political satire magazine that was very popular across Germany at the beginning of the 20th century and that reviewed current politics in Imperial Germany and the Weimar Republic critically. It was founded in 1896 by Albert Langen. The fact that the editors of *Simplicissimus* dedicated a whole issue to declining birth rates in Germany, illustrates how apparent it had become already at the beginning of the twentieth century. It was a problem of national importance, especially in view of the upcoming war. Put differently, the onset of the first demographic transition had finally been realised.

The dynamics had, however, been on-going since much earlier. Population growth had already been slowing down by the mid-nineteenth century. The top panel of figure 1.4 shows both births and deaths per 1000 in selected European countries. The solid lines map the number of births and the dashed

lines map the number of deaths. Note that the figures show averaged data for 10-year-spans to make numbers comparable across countries. The number of live births per 1000 only decreased visibly between 1880 and 1890 in most countries.
The number of deaths per mill had already decreased since 1860, for example also in France, and England and Wales. In the Netherlands the number of deaths had been decreasing for the whole period. In general, births fall with a lag of approximately one 10-year-span after the fall in deaths. The lag is particularly large in Denmark and particularly small for Imperial Germany. In Imperial Germany, the two lines run parallel. This means that births and deaths had started to decline in the same 10-year-span.

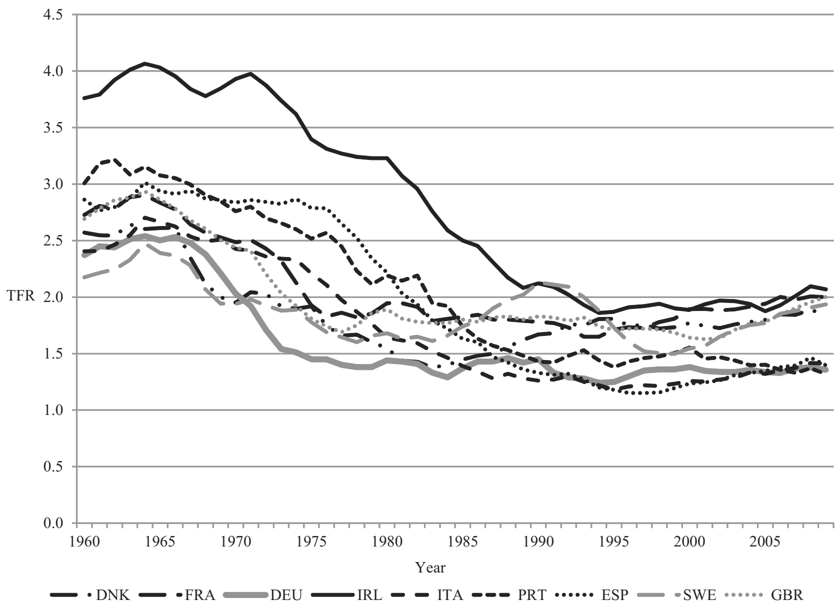
For Imperial Germany, fertility and mortality *rates* had also peaked at the same point in time, which means that the lag was shorter than for other countries. Mortality rates and fertility rates are shown in the bottom panel of figure 1.4. For the sake of clarity we only show the rates for Imperial Germany and one southern and one northern neighbour. Here too, mortality rates decreased earlier in Denmark. In Austria mortality rates seem to have peaked later than fertility rates, but the drop afterwards is more pronounced.

One conclusion from these numbers appears clear-cut: mortality rates were decreasing, therefore the population adjusted with a lag to the reduced necessity of having more children. Yet, for the population to adjust the number of children, *infant* mortality has to decrease. However, in Imperial Germany, infant mortality has fallen significantly only since 1905 (Knodel 1974).

As decreased mortality was a result of increasing prosperity and an increased standard of living caused by industrialisation, we can more broadly interpret the falling birth rate as a result of the population adapting to the changed economic and social conditions (Marschalck 1984). Nevertheless, as mentioned above, the adaptation lag was larger in some countries than in others. For example, mortality in Denmark started to decline much earlier than in Imperial Germany, but Germany was rather late in joining other European countries with regard to the decline in fertility. Why would the intensity and the timing of the fertility response to decreased mortality differ across Europe? It is clear that other factors must have influenced the timing and the extent of the fertility decline.

Malthus (1807) and Ricardo (1817) were among the earliest economists who dealt with population dynamics. However, at the beginning of the twentieth century, the population was not yet declining. Quite on the contrary, the population was growing rapidly. Both Malthus and Ricardo observed that population growth was inversely related to food prices and that population growth was positively related to wages at an aggregate level. This relationship became known as the Malthusian doctrine. It was the common

Figure 1.2: Total Fertility Rate in selected European countries



Source: World Bank (2011a)

concept to describe population dynamics. By the end of the nineteenth century, however, population growth became negatively related to growing prosperity. Nevertheless, even renowned German economists like Adolph Wagner found it difficult to part with the Malthusian doctrine. In his 1892 economics textbook, Wagner remarked that his view of economics could be summarised as "Robert Malthus is still right in all essential aspects" (*"Robert Malthus behält in allem Wesentlichen recht"*).[7] Wagner fervently argued that the fertility decline was temporary and just a problem of statistical accounting. However, at the beginning of the twentieth century, the fertility decline could not be denied any longer. Only then, Wagner admitted that the Malthusian doctrine could not explain the phenomenon.

The individual and conscious decision to limit the number of births became the focus of later studies on the subject (e.g. Brentano 1909, Wolf 1928). In fact, Malthus' theory had been driving most of population-related research until the early twentieth century. Only when the fertility decline could not be ignored any longer, did different explanations emerge.

[7] Wagner (1892), p. vi.

Figure 1.3: Cartoon from Simplicissimus

Source: Simplicissimus (1912)

At the beginning of the twentieth century, academics, policy makers, and the public were alarmed by decreasing fertility. The decline of the population in neighbouring France, which took place earlier than in Germany, was observed in horror (e.g. Oldenberg 1911; Kresse 1912; Marcuse 1913; Seeberg 1913). The fertility decline became a question of national security (Neumann 1978). Until World War I, it was a universally acknowledged fact that the size of the population was the key to growth and prosperity (Matz 2002).

Even though the first demographic transition was very obvious by 1910, the causes were not. The role of women in society changed gradually, but steadily, and along with this came changed attitudes towards the ideal family size. It is not clear to what extent this cultural change was triggered by economic development, whether both had a common cause, and what role the new welfare state institutions played.

1.2.1 Cultural Change

Female Labour Force Participation

Generally it cannot be emphasised enough that mother nature herself determined the profession of women to be mother and housewife, and that natural laws must not be ignored under any circumstances in order to avert serious damage, which would likely particularly affect the next generation i particular.

Im Allgemeinen kann man nicht stark genug betonen, daß die Natur selbst der Frau ihren Beruf als Mutter und als Hausfrau vorgeschrieben hat, und daß Naturgesetze unter keinen Umständen ohne schwere Schädigungen, welche sich im vorliegenden Falle besonders an dem nachwachsenden Geschlecht zeigen würden, ignoriert werden können.

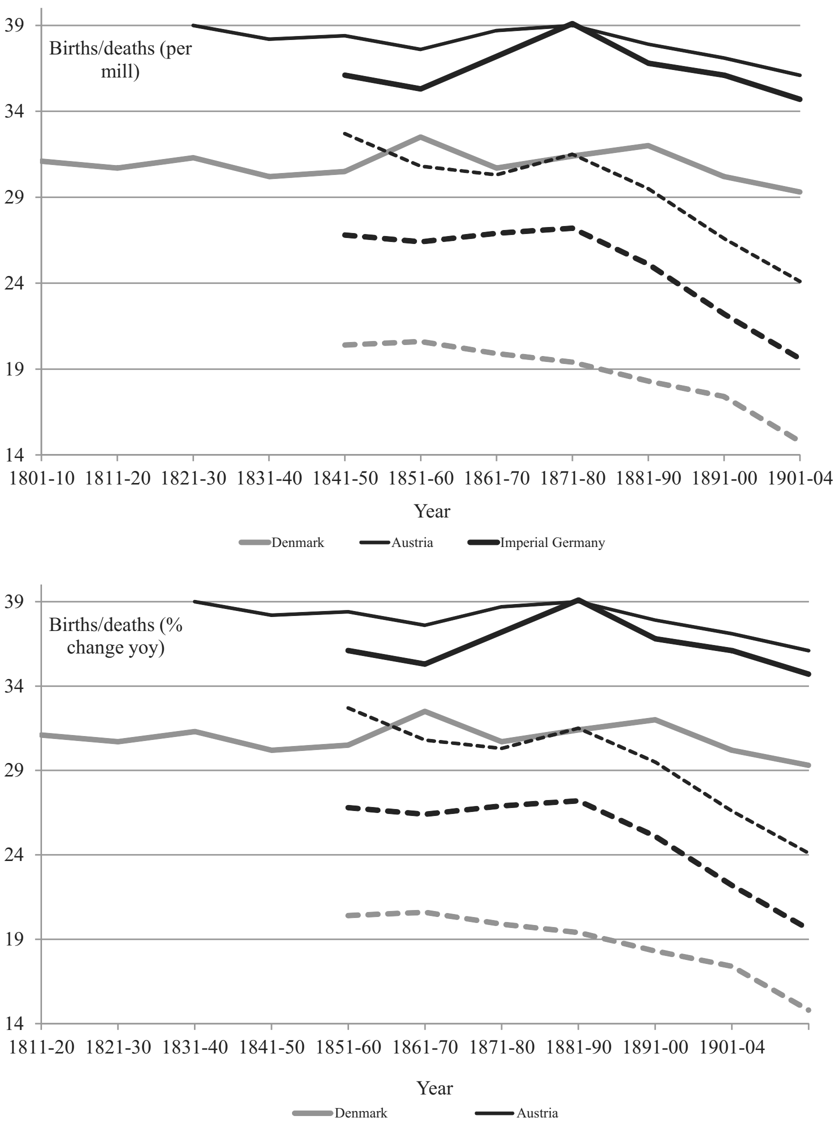
Max Planck, German Physicist and Nobel Laureate, 1897
Source: Kirchhoff (1897), p. 257.

In the light of the population decline, limiting the family size was seen as morally highly questionable. For example, Kresse (1912) considered contraception “condemnable”[8], as it implied female conceitedness to avoid the hardships that come with giving birth and raising a child. It was easy to blame ‘immoral’ women, who would not assume the traditional role as housewife and mother, for the alarming decline in fertility. Kresse (1912), Marcuse (1913), and Seeberg (1913), inter alia, registered changing cultural habits and linked this to the fertility decline.[9] Kresse (1912) did neither perceive it as

[8] Kresse (1912), p. 10.

[9] In this context, it seems consequential that Kirchhoff (1897) published a handbook on “the academic woman”, the reviews in which should establish whether the female sex was fit to study and to perhaps pursue an academic career. After all, at the time of the study, women were not entitled to vote and only admitted to study at universities on – albeit increasing – occasions. The Kirchhoff (1987) handbook reflects the debate whether this development could be approved of. It also shows that the number approving of studying women was increasing,

Figure 1.4: Population dynamics in Europe



Source: Mombert (1907).

"natural"[10] for women to work. Seeberg (1913) considered individualism and female egoism as reasons for the fertility decline. Differences between Catholic and Protestant regions and regions with ethnic minorities were emphasised in this context to underpin the morally 'right' and 'wrong' ideas (e.g. Seeberg 1913).

The arguments have apparently not changed much. When the German Government discussed measures to increase the availability of childcare facilities in order to make it easier for women to reconcile having children with working in 2009, many politicians and commentators opposed this measure, precisely because women were supposed to stay at home and care for their children. It appears that it has been as difficult at the beginning of the twentieth century to reconcile having children with working for women in Germany as it had been at the beginning of the new millennium. In 1900, women started to study and also participated in the labour force. In 2000, women continue pursuing other goals than just marriage and having a family. If they have to choose, they more often choose a career instead of children. Could this really be the main cause for decreasing fertility rates?

Table 2.8 presents the share of working women as recorded in the occupational censuses in 1882, 1895, 1907, and 1925. The share of employed women rose to almost 18% in 1925, i.e. it doubled between 1882 and 1925, but the level of working married women remained rather low: 2.7% in 1882 and 9.1% in 1925. However, we must view these figures with caution. Increasing female labour force participation towards the end of the nineteenth century was a consequence of necessities. First, about 10% of women stayed single all their life. They had to make a living. Second, as Fait (1997) notes, among working class families the husband's income was hardly enough to support the whole family. Thus even though women were expected to work only until they got married or had their first child, in reality married women continued to work to support the family. The type of work was different, and it was often pursued from home, but Fait (1997) claims that the number of working women was much higher than official statistics would suggest. Geyer (1924) is a contemporary source, who confirms that working class women had to work to support the family.

Nowadays a higher rate of female labour force participation is generally associated with very low birth rates. Figure 1.5 shows this relationship for three points in time, 1980, 1990, and 2009 for selected OECD countries. In Germany, female labour force participation has increased from slightly above

even though Kirchhoff acknowledges that "it need not necessarily be studying at a university" (Kirchhoff 1897, p. X), and even if so, the "shrew's natural instinct to form a family will be strong enough" (Kirchhoff 1897, p. XIV).

[10] Kresse (1912), p. 16.

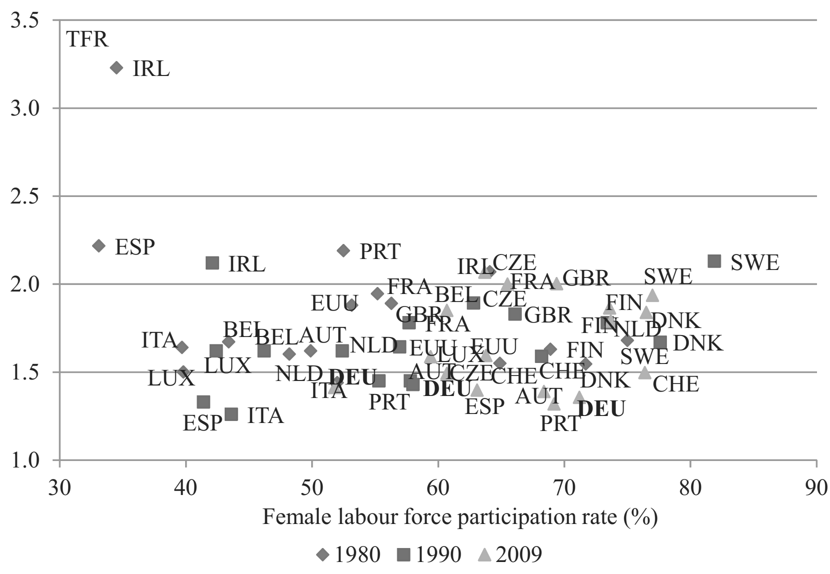
Table 1.1: Nonagricultural female employment

Year	*All women 14 or over (% employed)*	*Married women (% employed)*
1882	9.4	2.7
1895	11.7	4.3
1907	14.3	6.6
1925	18.0	9.1

Source: Knodel (1974), p. 226.

50% in 1980 to slighly above 70% in 2009. The male labour force participation rate has always been around 80% (World Bank 2011c). The TFR in Germany fell from nearly 1.5 to slightly above 1.3. The Scandinavian countries, however, display both a TFR above 2 and an exceptionally high female labour force participation rate. These countries are well-known for facilitating the labour market participation of mothers.

Figure 1.5: Fertility and female labour force participation in OCED countries



Source: World Bank (2011a).

The negative relationship between an increasing female labour force participation rate is strongest in more traditional, predominantly Catholic countries:

Portugal, Spain, and Italy. In terms of the birth rate, Germany can be considered as a part of this group. Obviously, conservative attitudes towards working women still play a major role in determining fertility.

Marriage and the Family

It is astonishing that there should be a decline in birth rates, given the eagerness to get married in Imperial Germany, where a third of the population is said to get married perennially.

Man ist erstaunt, wie bei einer derartigen Heiratswütigkeit im Deutschen Reich, wo ein Drittel der Bevölkerung alljährlich eine neue Ehe schließen soll, ein Geburtenrückgang entstehen soll.

E. Roesle, German Statistician, 1914
Source: Roesle (1914), p. 8 on the reliability of statistics on marriages in Marcuse (1913).

Increasing female labour force participation has often been related to decreasing marriage rates. At the end of the nineteenth century, the illegitimacy rate was about 10%; most births occurred within marriage. If the marriage rate declined – as claimed by Marcuse (1913) – this would immediately convert into a lower birth rate. Decreasing marriage rates are also mentioned as one of the causes of the second demographic transition (e.g. Kalwij 2000; Bratti and Tatsiramos 2008; Bloom et al. 2009; Michaud and Tatsiramos 2009). A later age at marriage often coincides with postponing fertility, since it gives a woman a shorter time span during which she can biologically have children (tempo effect). This leads to couples having only one, or at most two children (e.g. Bongaarts and Feeney 1998; Bongaarts 1999).

It is important to distinguish between two effects: did the marriage age increase or did the marriage rate decrease? In Imperial Germany, the age of consent was 16 for women and 20 for men, but the average age at marriage was 29.65 years for Prussian men and 26.5 years for Prussian women during 1891–95 (see also table 1.2). This is remarkably late.

One reason that is often mentioned as a reason for the higher age at which people got married during the nineteenth century is that nuptiality laws were relatively strict, which often required the potential husband to have property or at least a regular income.[11]

The resulting marriage pattern was coined European Marriage Pattern (EMP) (e.g. Hajnal 1965; Knodel and Maynes 1976; Cotts Watkins 1981). It is called European Marriage Pattern, as the higher age at which people got married for the first time was common in nineteenth century Europe, except for Eastern Europe (Knodel and Maynes 1976).

[11] Against the background of exploding population growth in the early nineteenth century, many states had introduced strict nuptiality laws between 1820 and 1840 in order to curb population growth (Knodel 1967; Marschalck 1984).

Table 1.2: Age at first marriage

	Preußen		*Bayern*	
	Men	*Women*	*Men*	*Women*
1891–95	29.65	26.5	27.6	25.3
1896–97			27.4	24.9
1901–04	28.90	25.7		

Source: Mombert (1907).

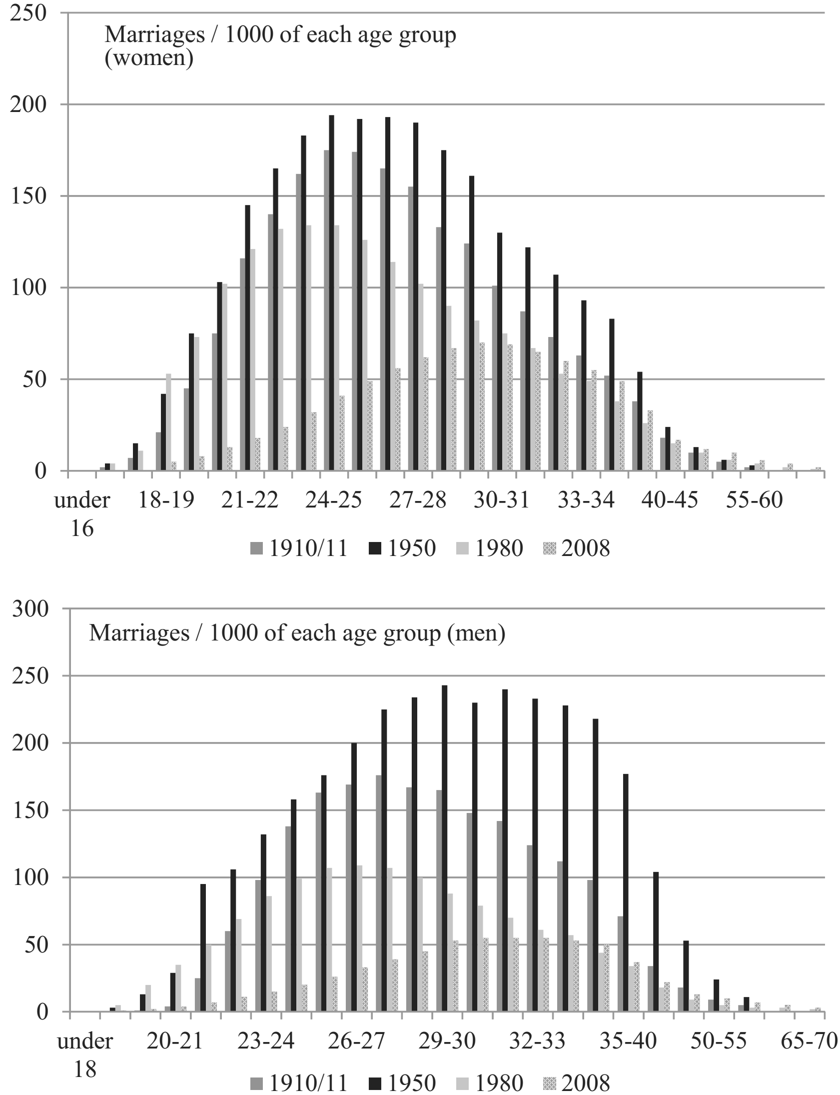
From 1860 onwards, the strict nuptiality laws were abolished gradually in the German states, except for Bavaria where they remained relatively strict until the end of the nineteenth century (Gestrich 1999). Interestingly, the amendments that had been made earlier in the century were abolished in most states when Imperial Germany was founded in 1871, but nuptiality laws were only harmonised in 1919 (Knodel 1967). This harmonisation is often considered one of the main causes for the decline in the age at which got people married, which is also apparent in table 1.2. In Prussia, the age at which people got married declined by almost a year between 1891 and 1904. In Bavaria, it declined by almost a year for women between 1891 and 1897.

The European Marriage Pattern cannot be considered a reason for the fertility decline, because it should have changed as uptiality laws were abolished.[12] However, the average age at at which people first married continued to rise until the 1970s (Hradil 2006). Figure 1.6 shows the share of each age group marrying in Germany for four different points in time. The blue bars refer to 1910/1911, the red bars refer to 1950, the green bars refer to 1980, and the purple bars refer to 2008. The first interesting observation from figure 1.6 is that the mode of the 1950 distribution is higher than the mode of the 1910/11 distribution, thus the average age at which people got married for the first time increased for both men and women between 1910/11 and 1950. However, the mode for the 1980 distribution is below *both* the mode of the 1950 and the 1910/1911 distribution.

The average age at which people married for the first time is higher in 1950 because of World War II. Owing to the difficult economic situation following the war, men and women of marriageable age had to wait a while until they were economically in a position to form a family (Eglster and Menning 2003).

[12] Even if there had been an effect of postponed marriages before the strict nuptiality laws were abolished, it had been relatively small (Knodel 1967).

Figure 1.6: Age at first marriage in Germany



Source: Statistisches Bundesamt (2011c). New marriages refers to all marriages of people previously registered as single. Figures for 1910/11 refer to Imperial Germany, figures for 1950 and 1980 refer to West Germany, and figures for 2008 refer to unified Germany.

Contraception

There is nothing more significant for the readiness to procreate than the ruling morals on sexuality. They also determine how most of the other aspects influencing natality (including advanced preventive techniques) come into effect.

Es gibt nichts Bedeutsameres für die Geburtlichkeit als die jeweilige Sexualmoral. Von ihr hängt auch ab, wie die meisten übrigen auf die Natalität einwirkenden Faktoren (mit Einschluß des Fortschritts der Präventivtechnik) sich jeweils äußern.

Julius Wolf, German Economist, 1928
Source: Wolf (1928), p. 20.

Available contraceptive techniques were a prerequisite for both the first and the second fertility decline to take place, even though they are often considered a major cause for both the first and the second demographic transition (e.g. Guinnane 2011). For example, the low level of birth rates in Western societies is frequently related to the advent of the contraceptive pill. The sudden drop in birth rates during the 1970s is linked to the widespread availability of it (Goldin and Katz 2002). Interestingly, this argument is not new. When the first fertility decline became apparent in approximately 1910, commentators soon resorted to explain the phenomenon with new techniques to control births. However, some forms of contraception were available much earlier than only by the 1880s and 1890s, such as condoms (Neumann 1978). More sophisticated methods were developed only in the 1920s (Woycke 1988).

Neumann (1878) provides a detailed summary of early twentieth century studies on the use of contraception and highlights that some forms of contraception were widespread among all classes of the population. Neumann also concludes that the desire to limit fertility existed in Germany long before the Wilhelmine empire and that about two thirds of the working classes used some form of birth control. This was the case especially among educated workers (Ritter and Tenfelde 1992). Table 1.3 reproduces birth control rates among a sample of 467 married women as in Neuman (1978). Dribe and Scalone (2009) provide evidence on deliberate birth control before the first demographic transition using an event-history analysis. They show that marital fertility immediately reacts to movements in grain prices. This further supports the view that a deliberate reduction in (marital) fertility was possible already in the eighteenth and early nineteenth century. And when contraceptive methods did not prevent a pregnancy, it was most common to end the pregnancy by abortion.

The increased use of contraceptive techniques or increased abortion rates thus rather point to more conscious family planning for other reasons. Moreover, none of the sources date the widespread availability of contraception. It should therefore not be a question of how the population reacted to the availability of contraception, but *why* they increasingly resorted to use it.

Table 1.3: Use of birth control (1914)

Total sample size		*Using no birth control*		*Using birth control*	
114	Farmers' wives	59	(52%)	55	(48%)
148	Workers' wives	42	(28%)	106	(72%)
137	Artisans' wives	42	(31%)	95	(69%)
68	Officials' wives	13	(19%)	55	(81%)

Reproduced as in Neumann (1978).

In fact, contemporary observers and scientists already came up with economic explanations, which are not much different from the more sophisticated economic theories of fertility.

1.2.2 The Theory of Prosperity and Classical Demographic Transition Theory

Men stop producing offspring when further augmenting the number of children bears less satisfaction than other delights in life, which would otherwise be unaffordable; or when having more children bears less satisfaction than the satisfaction from having avoided the pain and suffering of their wives; or they do not have more children to avoid the procreation of children with deficient health; or they stop to have more children in order to provide their children with better prerequisites for the struggle of life.

Der Mensch bricht mit der Kinderzeugung da ab, wo die Vermehrung der Kinderzahl ihm geringere Befriedigung schafft als andere Genüsse des Lebens, die ihm sonst unzugänglich wären, oder als die Befriedigung, die es ihm gewährt, dass seine Frau nicht dem Siechtum verfällt, dass er keine mit Krankheit behafteten Kinder in die Welt setzt, oder seinen Kindern eine bessere Ausrüstung für den Kampf um das Dasein zu verschaffen vermag.

Lujo Brentano, German Economist, 1909
Source: Brentano (1909), p. 606.

Brentano's description of the reasons *not* to have as many children as before is clearly the assessment of an economist. He states that if a higher number of childen "bears less satisfaction than other delights in life", the individual will reduce it. This describes a trade-off of marginal utilities in consumption as later formalised in Becker (1960). Moreover, Brentano states that men stop having children if this yields "less satisfaction than the satisfaction from having avoided the pain and suffering of their wives", which refers to the direct cost of having children. Furthermore, Brentano claims that individuals aim to "avoid the procreation of children with deficient health", which implies that the return to children should not be too low and which corresponds to the quantity-quality trade-off (e.g. Becker and Lewis 1973; Becker and Tomes 1976, 1979; Becker et al. 1990; Hanushek 1992). Providing "children with better prerequisites for the struggle of life" corresponds both to the idea of intergenerational redistribution (e.g. Cigno 1993) and to the idea of children as an investment for the future hardships in life (e.g. Feldstein 1954).

These causes of the fertility decline are related to economic growth – an increasing standard of living, urbanisation, increased female labour supply, alternative options for investment, and decreasing costs of having children due to medical progress. As the standard of living increased, the population tried to control the number of children in order to increase the standard of living even further. For example, rich families had fewer children than poor families.[13] Mombert (1907) provides evidence by comparing rich and poor districts in the city of Bremen. The more prosperous the family in this sample, the smaller the number of children they would have.

Von Gruber (1914) provides a similar comparison of natality in those Berlin districts, which he classifies as either mainly working class or as affluent. He finds that the crude birth rate falls by almost 30% between 1906 and 1911 in the working class districts as opposed to the affluent districts. Variations of this hypothesis have been coined the Theory of Prosperity (*Wohlstandstheorie*). It was put forward by Mombert (1907), Brentano (1909), Wingen (1915), May (1916), and Müller (1922, 1924) to explain the fertility decline, although the term is mainly associated with Brentano.

The economic reasons put forward, inter alia by Brentano (1909) and also in Wagner's later work (e.g. Wagner 1907), are still valid explanations for today's low birth rates, and as we will see, fully in line with Becker (1960). Classical Demographic Transition Theory has emerged from this early work that links the individual behaviour of limiting the family size to economic and social conditions (Malthus 1807; Ricardo 1817; Mombert 1907; Wagner 1907; Brentano 1909; Kresse 1912; Seeberg 1913; Roesle 1914; Thompson 1929; Davis 1945; Notestein 1945).

The Theory of Prosperity presumes that individuals adapt to changing economic conditions. This was often seen as challenging the hypothesis of cultural change, according to which new technologies, such as birth control, or information would spread from urban centres along channels of communication, such as major transportation networks, and would both facilitate the change in behaviour and spread new attitudes. Different views in population research emerged, the so-called innovation/diffusion view – related to cultural change – and the adaptation view – related to economic conditions (Carlsson 1966).[14] Since Carlsson's work, the separation of an innovation/diffusion view and an adaptation view of the fertility decline is still present in the literature (e.g. Goldstein and Klüsener 2010).

[13] Note however that women from all classes practised birth control, even though it was more common in the upper classes, see also table 1.3.

[14] Carlsson used the term adjustment, but in later work the term adaptation has been established as more appropriate for describing the phenomenon.

The discussion on birth control highlights that the innovation/diffusion view and the adaptation view are not substitutes for the explanation of the fertility decline, but complements. The use of contraceptive methods certainly depended on the diffusion of technology and information, but the motive for using contraception depended on changed economic circumstances. The complementarity of the views was already noted by Guinnane et al. (1994).

For example, the observation of more and more hedonistic attitudes even among workers (Neumann 1978) is also in line with the Theory of Prosperity. It became accepted that individuals or couple's should enjoy rising living standards without subjecting themselves to economic hardships because they had many children.

1.2.3 The Role of the State

Neither the innovation view nor the adaptation view take the link between social security and fertility into account. The responsibility of the state in shaping fertility patterns is largely disregarded. Current developments towards lowest-low fertility in Europe are often considered just a matter of taste (e.g. Hakim 2003). More recent research has focused on occasions when institutions clearly intervene in private decision-making. Guinnane and Oglivie (2008) for example analyse how the influence of occupational guilds on the right to marry affected fertility prior to the first demographic transition.

Guinnane (2011) notes that none of the earlier studies addressed the extensive changes which were brought forth by Bismarck's welfare reforms to an extent going beyond adding a variable on social insurance or providing descriptive information at the federal level (e.g. Guinnane 2011; Goldstein and Klüsener 2010; Galloway 2009; Galloway et al. 1998, 1994). Guinnane and Oglivie (2008) however emphasise that institutions can have a large effect on individual behaviour, and on fertility in particular. Thus even if there is growing acknowledgement of the fact that the state exerts a growing influence on decisions made in the matrimonial bed, evidence for both the first and second demographic transition is scarce.

This book attempts to provide evidence of the impact of social security, and pension insurance in particular, on the first demographic transition. We show that the causes for the first and the second demographic transition do not differ that much after all, therefore we can gain important insights through carefully examining the historical experience. Only the first demographic transition provides the unique opportunity to compare the same country with and without a comprehensive social security system.

Chapter 2 provides more in-depth evidence on the factors behind the first demographic transition. Chapter 3 then draws the attention to the focus of this book: the introduction of social insurance in Imperial Germany. This chapter highlights how immense an institutional change took place towards the end of the nineteenth century. More recently, the pensions fertility nexus has received growing attention particularly in the theoretical literature. Chapter 4 provides the theoretical background and a simple model tailored to the institutional setting described in chapter 3. Chapter 5 uses regional data from Imperial Germany during the first demographic transition to put the social security hypothesis to a thorough test.

This book fills a gap in the understanding of the importance of institutions as an explanatory factor for the first fertility decline. It essentially takes the social security hypothesis back to its roots, and raises questions about its consequences. Finding that the state is extensively involved in such an essentially private decision, such as the one of having children, we have to ask whether the state should be allowed to do that. We have to question the design of the pension system. In addition, if governments decide to have pay as you go pension systems in place, which effectively curbs population growth, they have to be clear about the consequences of doing so. Consequently, if a pay as you go system renders itself infeasible in the long run, should the government intervene with pronatalist policies? These are delicate questions, in particular in Germany. Nevertheless they have to be answered in the long run to avoid a collapse of public finances.

Chapter 2

Traditional Explanations for the Fertility Decline in Germany

"The reason the rich have grounds for being arrogant and the poor have to spread their butter thin is because the rich have few, the poor many children."

Prussian working class woman
Source: Moszeik (1909), p. 2.

It is a universally acknowledged fact that a family with many children must be poor. But the question is if a family with many children is poor because of having more children the large number of children, or is having more children the reason why a family is poor? Even if the causal relationship is not clear a priori, this evident correlation motivated Brentano's Theory of Prosperity at the beginning of the nineteenth century and subsequently Becker's Theory of the Family in the 1960s.

Chapter 1 shows that there are numerous explanations for both the first and the second demographic transition. But how much of the fertility decline can they explain? It is important to understand the factors at play during the first demographic transition in order to assess the potential impact of the introduction of the social security system.

As both Brentano and Becker's seminal works are considered to be the cornerstone of modern economic fertility theory, this chapter reviews these microeconomic fertility theories and provides empirical evidence using a novel data set. First, we introduce and discuss the factors that previous research has identified as most influential in shaping fertility at the end of the nineteenth century. Second, we discuss different measures of fertility. Third, we introduce the novel data set which we use for all analyses in this book. Finally, to establish that the data set is adequate for analysing the fertility decline, we derive standard results on the fertility decline with the data that can be directly compared with the results from other studies. In other words, we analyse whether the explanations for the fertility decline we touched upon in the previous chapter are a sufficient explanation for the enormous drop in births.

2.1 The Fertility Decline: Theory and Evidence

2.1.1 Microeconomic Foundations of Fertility Theory

Microeconomic theories of fertility choice either model the individual or a household's fertility decision on the basis of economic decision variables.[1] The adaptation view is more closely linked to these microeconomic principles. The microeconomic approach was initiated by Becker (1960) and further substantiated by Becker and others (Becker 1965, 1988, 1991; Schultz 1969; Barro and Becker 1986, 1888, 1989; Easterlin 1975; Becker and Tomes 1976; Cigno and Ermisch 1989).

The approaches to a (economic) theory of fertility are often referred to as the demand model of fertility, as children are modelled as a consumption good and fertility is modelled as the demand for children. In line with this, the marginal benefit of an additional child has to be equal to the marginal cost of rearing the child in equilibrium.

More recently, microeconomic theories have been linked to economic growth (Barro and Becker 1989; Becker et al. 1990; Becker 1992). This provided the missing link between microeconomic theories and the macroeconomic view on the fertility decline that was adopted by its early observers. In addition, the impact of institutions on fertility has also become the focus of economic research (e.g. McNicholl 1980; Becker and Murphy 1988; Smith 1989; Guinnane and Oglivie 2008). However, the impact of institutions has not been extensively discussed in the context of the demographic transition in nineteenth century Europe. Guinnane (2011) addresses specific details with regard to considering children as a means for old age provisioning, and the existence of institutions, and particularly a social security system as a possibility to substitute away from this. Chapter 4 provides a detailed assessment of the theoretical underpinnings of the relationship between social security, and speciically pension insurance and fertility.

2.1.2 Testing Fertility Theory

Early empirical research on the demographic transition mostly focuses on the question *when* it took place rather than *why*.[2] Coale (1965) observed that

[1] Arroyo and Zhang (1997) provides an overview of dynamic fertility models, both of theories and their empirical implementation. Guinnane (2011) provides a concise summary on more recent empirical research on the historical fertility decline.

[2] Cleland and Wilson (1987) provides an overview of the debate in classic demographic transition theory and link this to, inter alia, early descriptive studies of historical data. Arroyo and Zhang (1998) provides a comprehensive overview of dynamic microeconomic models and the derivation of reduced-form models for estimation. Therefore, they provide an important connection between theoretical advances and the empirical tests of the theories.

fertility in nineteenth century Europe had remained at a certain plateau after which it declined substantially. Based on this observation, Coale introduced the notion of a 10% decline in fertility to marking a period of a decline in fertility, as fertility would never rise following a 10% decline.

Coale was part of the Princeton European Fertility Project (Coale and Watkins 1986 provide a summary), which had been started to learn more about the timing of the fertility decline in Europe and to draw conclusions for developing economies. The European Fertility Project aimed at analysing the fertility decline in major European countries at a comparable administrative level. The Princeton Project's work concluded that innovations, e.g. in the area of birth control, and the diffusion of the new technologies caused the fertility decline rather than changed economic and social conditions, since estimates of economic and social conditions were not significant. In addition, the European Fertility Project researchers dated the fertility decline to more or less the same time in all countries, which would support the cultural diffusion hypothesis. This is widely known as the 'Princeton View'. The implication of this view has far reaching consequences. The confirmation of the cultural diffusion hypothesis and the rejection of the hypothesis that changes in external factors directly triggered a fertility response would also reject the microeconomic theories of fertility.

It does not come as a surprise that the results of the Princeton European Fertility Project have been challenged, both since the quality of the data set is questionable (e.g. Galloway et al. 1994) and due to inadequate estimation methods (e.g. Richards 1977; Brown and Guinnane 2007; Goldstein and Klüsener 2010). Recently, the heterogeneity of the historical experience has been emphasised, which also contradicts the Princeton View. For example, Hirschman (2001) notes that pre-decline fertility levels were much lower in Europe than in other regions of the world. Does this mean that the cultural diffusion hypothesis does not qualify as an explanation for the fertility decline? Are the effects predicted by economic theory confirmed? Only if we understand the fertility decline in terms of the predictions of economic theory can we assess the role that the introduction of pension insurance played.

2.2 Measuring Fertility

Measuring fertility in the historical context is complex. The individual measures that are common in event-history analysis, such as the individual birth history of a woman or a household, cannot be derived from historical data since individual-level data is hardly available. Even detailed fertility measures for an aggregate population are difficult to derive, as measures such as the total fertility rate (TFR)[3] require cohort-specific fertility rates as well as the size of each cohort. This makes the TFR independent of the age structure of the population and thus provides a measure that is comparable across countries. The most accurate measure is the completed fertility rate (CFR),[4] but by definition the CFR can only be computed for all cohorts that have completed their fertile period. Alas, information on the age structure of the population is scarce for the time of the first demographic transition. If it is available, it is only available for census years. However, information on births is mostly available on an annual basis.

As a consequence, the most common measure for fertility that is used with historical data is the crude birth rate (CBR), i.e. the number of births per thousand per annum (Guinnane 2011). To map population dynamics, this number is related to the crude death rate (CDR) to form the crude rate of natural increase (CRNI): $CRNI = CBR - CDR$.

Fertility depends on the marriage pattern of the population. Thererefore, early research by Coale and his collaborators at the Princeton European Fertility Project developed a set of fertility indices that take into account the marriage pattern and, where possible, the age structure of the population.

2.2.1 Fertility Indices and Natural Fertility

Coale (1965, 1969) and his collaborators developed a set of fertility indices to determine the timing of the fertility decline that were not just widely used (e.g. Wetherell 2001) but also widely criticised (e.g. Guinnane et al. 1994). These indices first appeared in the studies emerging from the Princeton Fertility Project (e.g. Coale and Watkins 1986). Knodel (1974) also uses the fertility indices to measure the evolution of fertility in Imperial Germany. In essence, the Coale fertility indices compare natural fertility to observed (age-specific) fertility.

The term *natural fertility* was coined by Henry (1961) and describes fertility in the absence of any deliberate birth control. For this purpose, Henry measures fertility among Hutterites, an Anabaptist sect in the Midwest of the US and Canada. Henry claims this to be natural fertility, since the Hutterites did not practise birth control for religious reasons. Table 2.1 reproduces this fertility schedule in the absence of any deliberate for of birth control.

Table 2.2 reproduces the Coale fertility indices, which are based on Hutterite fertility. Note that our notation is slightly adjusted. The indices are

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[3] The TFR is defined as $TFR_t = \sum_{age=15}^{age=49} \frac{\left(BIRTHS_t^{age}\right)}{WOMEN_t^{age} \cdot 1000}$. That is to say, the TFR in year t is equal to the sum of all cohort-specific birth rates in year t.

[4] The CFR is defined as $CFR_y \sum_{t=y+14}^{t=y+48} \frac{\left(BIRTHS_t^{age}\right)}{WOMEN_t^{age} \cdot 1000}$. That is to say, the CFR of cohort y is equal to the age-specific birth rate of all women of cohort y in all their fertile years.

Table 2.1: Hutterite fertility

Age group	*Number of births*
15–19	.300
20–24	.550
25–29	.502
30–34	.447
35–39	.406
40–44	.222
45–49	.061

Reproduced as in Henry (1961).
The value for the 15–19 group is an average value as used in Knodel (1974).

nevertheless widely used as they are easy to apply to aggregated historical data. They range between 0 and 1 and measure how close a population's fertility is to Hutterite fertility. This implies that the Coale fertility indices effectively measure the diffusion of birth control in a population (Galloway et al 1994).[5]

The overall fertility index relates the total number of births in the population to Hutterite fertility. However, the marital fertility index only relates marital fertility to Hutterite fertility. The difference between the two can thus indicate the extent of non-marital fertility in a population. The overall fertility index and the legitimate fertility index therefore only differ by the real difference between total births and legitimate births and the difference between the number of women and the number of married women.

The fertility indices reflect the age structure in a region, and $I_{m,i}$ even reflects the age-specific marriage rates in a region.[6] This implies that the Coale indices are also based on information regarding the age structure of the population. Knodel (1974) suggests eliminating the age-structure related component in the indices by using an index that only relates marital to non-marital fertility. This, however, also requires age-specific marriage rates, and thus indirectly reflects the age structure.

Demographers developed some additional measures on the basis of this initial approach to define marital fertility. The Coale and Trussell (1974) measures model fertility within a marriage, and allow for age group-specific

[5] The exact timing of the more pronounced use of birth control and the exact level of birth control are not central to our study, however. For our study it is important to know that birth control was available, even to the working class. This information is necessary for the claim that even the working classes could limit the size of the family – to a certain extent – if they wanted to. Neumann (1978) and Dribe and Scalone (2009) provide evidence.

[6] This renders this index incomparable across populations for which the age-specific marriage rates differ.

fertility levels and spacing decisions. Age group-specific fertility levels and deviations from these levels were measured for several age groups, just in the same way in which Henry measured natural fertility.

Table 2.2: Fertility indices

	Fertility Index	Description
Overall fertility	$I_{t,i} = \frac{B_{t,i}}{\sum n_{g,i} F_{g,i}} = I_{m,i} I_{c,i} + I_{u,i}(1 - I_{c,i})$	Relates the total annual number of births $B_{t,i}$ to all women to the demographic composition and the resulting maximum fertility a province can have: $n_{g,i}$ denotes the number of women n in age group g in province i, and $F_{g,i}$ denotes the natural fertility rate for age group g.
Marital fertility	$I_{m,i} = \frac{B_{m,i}}{\sum m_{g,i} F_{g,i}}$	Relates the annual number of marital births $B_{m,i}$ to the number of married women m in age group g in province i, and $F_{g,i}$ denotes the natural fertility rate for age group g.
non-marital fertility	$I_{u,i} = \frac{B_{u,i}}{\sum u_{g,i} F_{g,i}}$	Relates the annual number of non-marital births $B_{u,i}$ to the number of unmarried women u in age group g in province i, and $F_{g,i}$ denotes the natural fertility rate for age group g.
Contribution of marriage to fertility	$I_{c,i} = \frac{\sum m_{g,i} F_i}{\sum n_{g,i} F_{g,i}}$	Relates the maximum fertility schedule of married women $m_{g,i}$ to the maximum fertility schedule of unmarried women $n_{g,i}$.

Reproduced as in Knodel (1974).

For our analysis, which requires comparing fertility at more than two or three points in time, it is not feasible to use the Coale fertility indices as the are not available. The age structure of the population is only available for census years. For this reason, we have to resort to using the CBR and the crude marital birth rate (CMBR). The CMBR is defined in the same way as the CBR, but only counts births within marriages.

It is evident from the discussion that birth rates can differ substantially between age groups. The previous chapter also highlights that even measuring age-specific birth rates as in the TFR can be misleading with regard to the total number of births per woman (the CFR). Whereas the TFR overestimated the CFR during the first demographic transition, it is possible that it currently underestimates the CFR. In the end, the CFR remains the most appropriate measure to use. However, information on the total number of children per woman related to the woman's year of birth is only collected in censuses. Therefore, it is difficult to calculate the CFR especially for the very early cohorts, i.e. for birth years 1860–1880.

The next section shows that we use regional data for our analyses. Owing to the lack of information on age structure at the regional level, we have to resort to using the CMBR. However, we can compare the Coale indices of fertility, which take into account the age structure for 3 out of 37 years in our sample, to show that the CMBR measures approximately the same regional differences as the Coale fertility indices.

2.2.2 Data

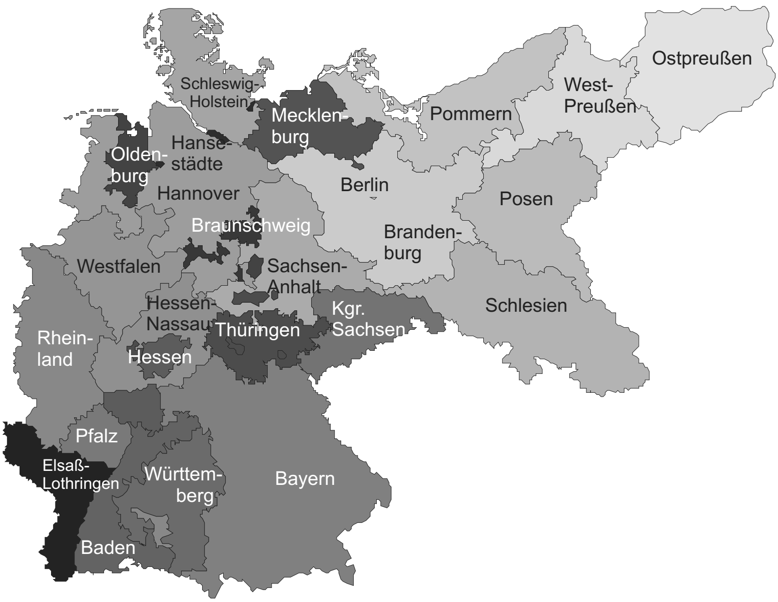
Our analysis is based on a regional data set for Imperial Germany that is derived from two primary data sources. Appendix A details the data sources and how we combined the two data sets. The regional entities in our final data set after harmonising the two data sets are shown in figure 2.1. Figure 2.1 provides the names for the regions used in this study in German. We use the names in German throughout the study, as some regional names have an English equivalent while for some regional names there is no English equivalent. However, when we refer to a broad region, e.g. the Kingdom of Prussia, we use the names in English. Therefore, as a rule, when we use the names in English we refer to a region, while when we use the names in German, we refer to a unit of observation.

2.2.3 Comparison of the CBR and the Coale Indices

As a prerequisite for the analysis that follows, we first show that using the CBR and one of the Coale fertility indices provides similar information. We can only compute the index of overall fertility, $I_{t,i}$, for the years in which the Imperial Statistical Office provides information on the age structure at the provincial level, but not the marital fertility index, as the Imperial Statistical Office did not publish information on age-specific marriage rates at the regional level. We can however approximate the contribution of age-specific marriage rates to fertility on the basis of the percentage of married women compared to the total population. At the provincial level, we do not have information on the proportion of married women in each age group. This means that we can multiply the number of women in each age group with the average fraction of married women in each year.

Figure 2.2 compares the regional distribution of the approximated marital fertility index for 1885 to the CMBR for these years. The maximum figure is above 1 for 1878 and 1885, which proves that using the average marriage rate among the female population is fairly imprecise. The figures correspond to Knodel's figures only for 1890. Knodel assigns 0.735 as the marital fertility index for 1880, 0.726 for 1885, and 0.706 for 1890. Even when considering that our figures on the marital fertility index are somewhat imprecise, our calculation of the marital fertility index indicates a relatively sharp drop in both indices between 1885 and 1890.[7] In particular, the regional structure of total fertility differs from figure 2.2, in both 1878 and 1885. This implies that it is important to control for marriage patterns. While we cannot control for age-specific marriage patterns, we can use regional figures on non-marital birthsto compute the crude *marital* birth rate (CMBR).

Figure 2.1: Regions in Imperial Germany



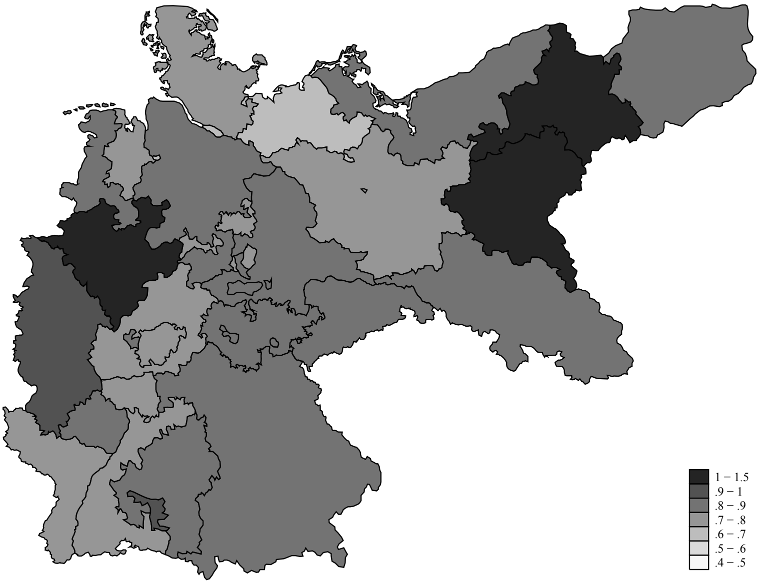
2.3 Mapping the Fertility Decline in Imperial Germany

Fertility in Imperial Germany declined much earlier than in neighbouring European countries. This section first assesses the timing of the fertility decline in the provinces of Imperial Germany and relates our results to existing research. Then we review the strength of the economic theories of fertility to explain the fertility decline in Imperial Germany.

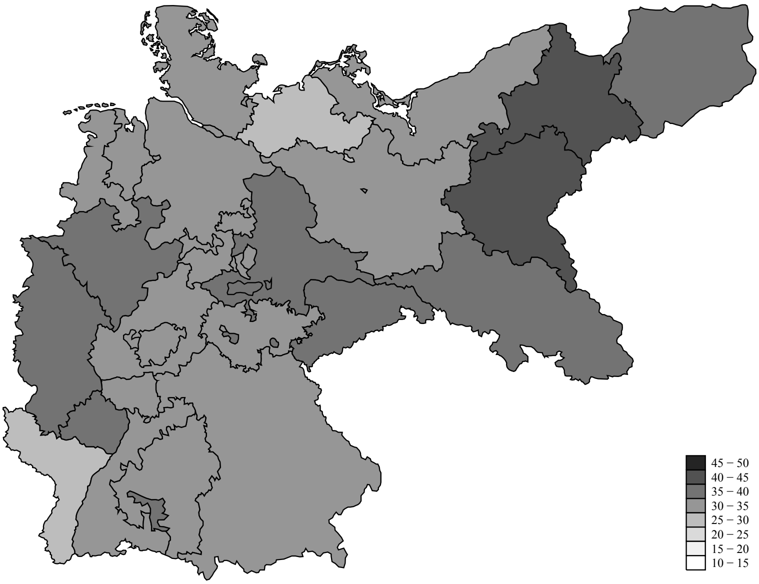
[7] This is the same if we compare the total fertility index to the crude birth rate. The maximum fertility index of 0.36 in 1878 and 1885 is in line with Knodel's (1974) figures for these years. Knodel (1974) reports an average total fertility index of 0.404 for 1880 and 0.395 for 1885. These are, however, average figures. Our average for 1878 is 0.294 and 0.301 for 1885.

Figure 2.2: Approximated marital fertility index and CMBR in 1885

Approximated marital fertility index



Crude marital birth rate



There are corresponding similarities between the total fertility index and the crude birth rate.

2.3.1 Timing

There is no clear method for dating the fertility decline. The measures used by the Princeton Fertility Project – a decline of 10% from maximum fertility – clearly lack a sound theoretical underpinning. Based on this measure, Knodel (1974) dates the fertility decline to the period post 1870 for Prussia, and to somewhere between 1870 and 1900 for Imperial Germany as a whole. Note that this period coincided with the introduction of social insurance between 1883 and 1889. We discuss the introduction of social insurance in detail in chapter 3. Caldwell (1980) dates the decline in marital fertility in Germany to the years between 1875 and 1880, but also uses the Coale marital fertility index. However, the reliability of these indices when it comes to reliably determining the timing of the fertility decline has been questioned.

Galloway et al. (1994) use simulations to measure the precision of each fertility index to determine the beginning of the fertility decline. They use Monte-Carlo exercises to show that $I_{m,i}$ is not very effective in measuring a 10% decline.[8] Therefore, the indices remain a problematic tool for testing the innovation/diffusion hypothesis (Galloway et al. 1994). This renders Knodel's numbers for Germany questionable. In fact, Galloway and coauthors claim that in some areas the fertility transition could be dated to the mid-nineteenth century instead of to the end of the nineteenth century. They also emphasise the difference between the regions in Germany. This supports the adaptation view, as it is highly unlikely that economic circumstances changed in all provinces at the same time.

2.3.2 Causes of the Fertility Decline

This section analyses the causes of the fertility decline most often mentioned in the literature, namely birth control, economic development, education, migration, mortality, nuptiality, urbanisation, industrialisation, political preferences, and religion.[9] Do our data also suggest that these factors played a major role in shaping the fertility decline? Which factor had the most important impact?

The literature has attempted to structure these causes on the basis of several classifications. However, it is difficult to draw clear lines, since a number of effects reinforced each other. For example, Guinnane (2011) considers six broad causes of the fertility decline: mortality decline, innovation in and availability of contraception, direct costs of children, changes in the opportunity cost of children, increased returns to child quality, and children as insur-

[8] In addition, Galloway et al. show that the Coale/Trussell measure neither fares well in detecting the initial stages of the fertility transition.

[9] These categories are closest to the categories used by Knodel (1974).

ance against risk. In order to use a taxonomy that is close to the economic models of fertility, we analyse whether an acknowledged cause of the fertility decline has affected the direct or the indirect cost of having children. While we consider *marriage patterns*, *(internal) migration*, *child mortality* and *the presence of ethnic minorities/culture* to mainly affect the direct cost of having children while we consider *economic development*, *education*, *education*, *increased labour market participation of women*, *urbanisation* and *politics* to mainly affect the indirect cost of having children. We discuss *industrialisation* separately, because it may have reinforced all key determinants of fertility.

Tables 2.3 and 2.6 assess the information used in empirical studies on the European fertility decline. We present separate tables for the studies on Prussia and studies on Imperial Germany and the rest of Europe. It is apparent just by comparing the length of the tables that the data available for Prussia is more detailed than the data available either at the level of federal states for Imperial Germany or for other European countries. Prussian data is also available for earlier years in contrast to other regions of Imperial Germany.[10] It is therefore not surprising that the literature on the European fertility decline mainly uses Prussian data.

The analysis of Prussian data at the *Kreis* level[11] started with the Galloway et al. (1994) study on the implications of using more detailed data and more sophisticated econometric models. As mentioned above, the results derived by the researchers of the Princeton European Fertility Project suggested that the innovation view provided more important explanations for the fertility decline, since estimates of economic variables were insignificant. However, Galloway et al. (1994) show that results differ substantially and also render support to the adaptation view if more sophisticated econometric tools are used.

Galloway and his coauthors supplemented this extensive research through ascertaining more about the primary drivers of the fertility decline (Galloway 1994; Galloway et al. 1994b; Galloway et al. 1997; Galloway et al. 1998; Galloway 2009). Other authors used the same data (e.g. Brown and Guinnane 2003; Brown and Guinnane 2007; Goldstein and Klüsener 2010). Recently, the focus has largely shifted to the indirect determinants of the fertility decline, such as the quantity-quality trade off in children's education and female labour force participation (e.g. Becker et al. 2010, 2011).

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[10] Bavarian data is an exception. Brown and Guinnane (2002) analyse Bavarian data with respect to the fertility decline.

[11] *Kreise* are lower level jurisdictions similar to districts. Prussian data was collected at this level.

The studies mentioned in tables 2.3 and 2.6 discuss a set of determinants behind the European fertility decline. The next two sections review these determinants and their potential to explain the large and sustained fertility decline with the support of our primary data source. The contemporary quotes in this chapter are taken from Neumann (1978), who collected them from early twentieth century sources, most notably Marcuse (1913) and Polano (1916).

2.3.3 Industrialisation

Sure, why not? You can always use children.

35-year-old Lutheran farmer from Mecklenburg
on the question whether he would have more children

Industrialisation was the main driving force behind the changes to the key determinants of fertility. Industrialisation brought forward a shift from the primary to the secondary and tertiary sector. The sectoral shift also created different employment opportunities. Figure 2.3 shows the share of the population in agriculture according to the occupational censuses of 1882 and 1907.[12] Between 1882 and 1907, the share of the population in agriculture decreased sharply in all provinces. The maximum share of the population in agriculture decreased from 65% to 26%. By contrast, the share of the population in mining and trade increased steadily (see figures 2.4 and 2.5).

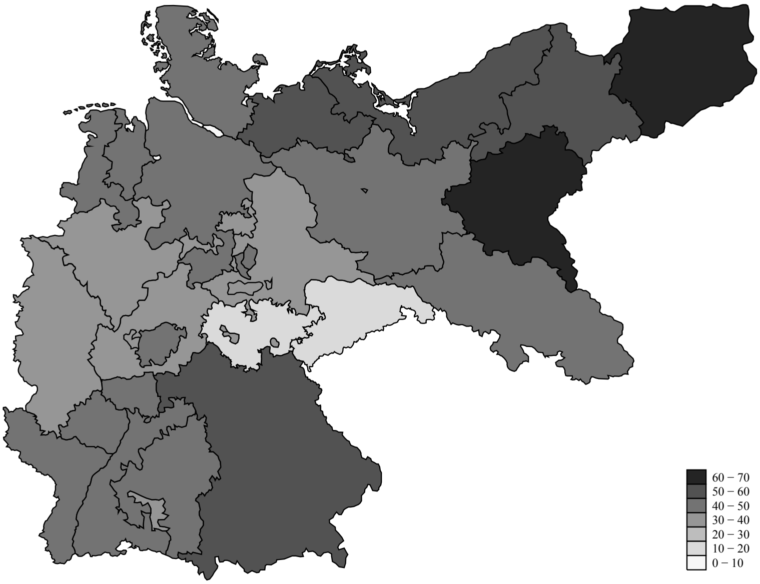
Richards (1977) finds that this sectoral shift had a strong impact on the fertility decline. Goldstein and Klüsener (2010) also test for the effect of the share of the population in agriculture on fertility, and not surprisingly find an inverse relationship. Importantly, corresponding to Goldstein and Klüsener (2010) we find that the fertility decline is the strongest in those areas in which the population working in agriculture is the lowest. Goldstein and Klüsener's data are more detailed. Therefore, being able to draw the same conlusions from our more aggregated data confirms that crucial information can still be inferred from our data, even though they are aggregated.

The upper panel in figure 2.5 shows the percentage of population in agriculture in 1882. The lower panel of figure 2.6 shows the change in the CMBR between 1882 and 1895. It is evident when comparing the upper and lower panel of figure 2.6 that fertility was declining strongest where the percentage of the population in agriculture was lowest. This is most notable for the provinces in central Prussia.

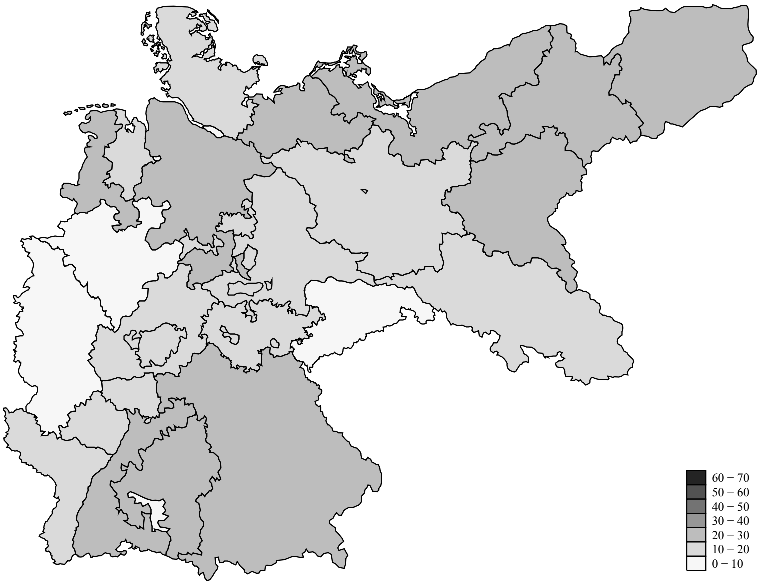
[12] Appendix A gives details on the occupational censuses. Note that Knodel states that the 1871 values are not comparable to the other censuses, but it is likely that Knodel refers to the fact that the 1871 numbers include dependants, while the other censuses report the number of dependants separately. We have adjusted for this.

Figure 2.3: Percentage of the population in agriculture

1882



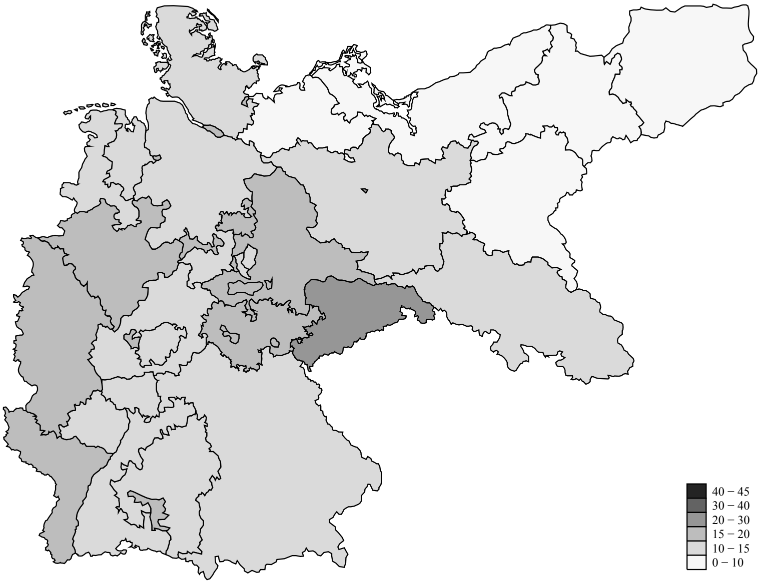
1907



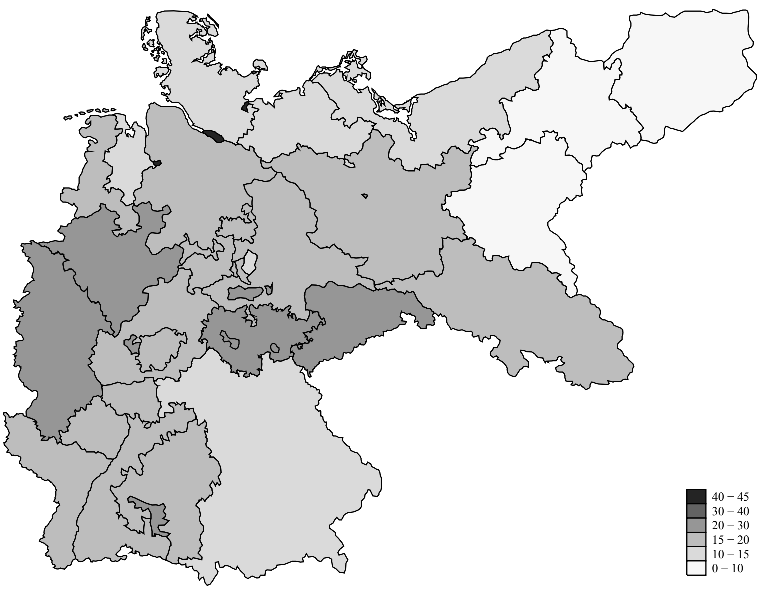
Source: Annual Yearbook of Statistics, Occupational Census.

Figure 2.4: Percentage of the population in mining

1882



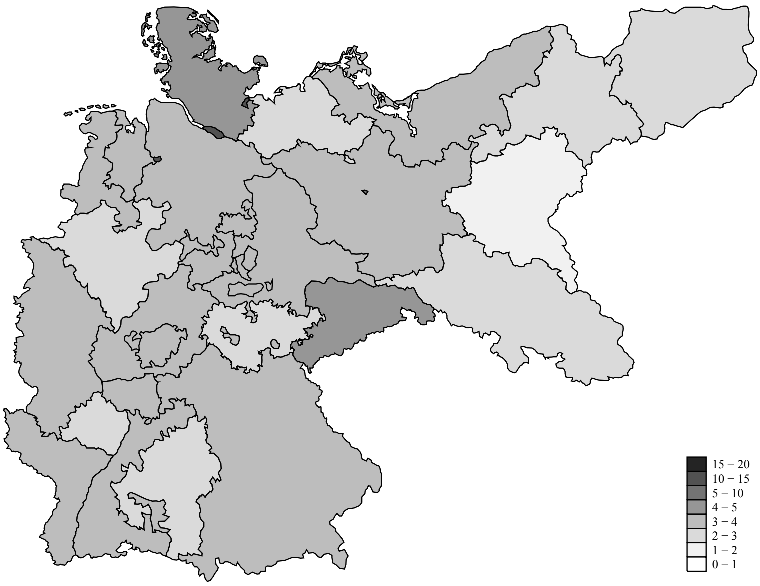
1907



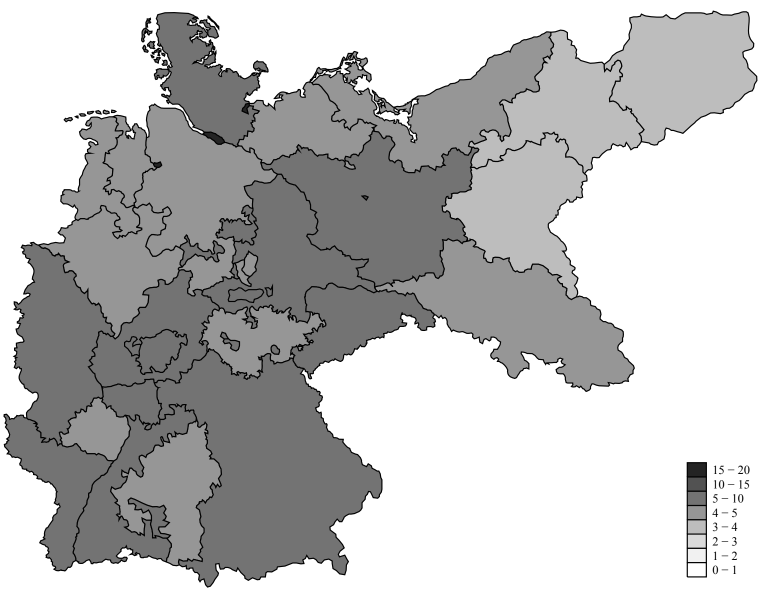
Source: Annual Yearbook of Statistics, Occupational Census.

Figure 2.5: Percentage of the population in trade

1882



1907



Source: Annual Yearbook of Statistics, Occupational Census.

Table 2.3: The fertility decline in Prussia

	Becker et al. (2011)	Becker et al. (2010)	Brown & Guinnane (2002)	Galloway (2009)	Galloway et al. (1998)	Galloway (1994)	Galloway et al. (1994a)	Galloway et al. (1994b)	Goldstein, Klüsener (2010)
				Industrialisation					
Employees in mining			x	x	x		x		x
Empl. in manuf. or industry	x		x	x	x				
Employees in agriculture	x								
Landownership inequality	x	x							
Looms per capita		x							
Female farm laborers		x							
Employed in textile factories			x						
				Direct effect					
Marriage									
Married women	x	x							
Marriages			x			x			
Total married years of females								x	
Age at first marriage		x						x	
Migration									
Sex imbalance ratio				x	x		x	x	x
Temporary male migration									
(Net) Migration			x						

Table 2.3 contd.

	Becker et al. (2011)	Becker et al. (2010)	Brown & Guinnane (2002)	Galloway (2009)	Galloway et al. (1998)	Galloway (1994)	Galloway et al. (1994a)	Galloway et al. (1994b)	Goldstein, Klüsener (2010)
Mortality									
Improved health care									
Employees in health sector				x	x		x	x	x
Infant mortality		x	x		x		x	x	x
Non-infant mortality									
Surviving children at 15 (%)								x	
Religion									
Catholics			x	x	x		x	x	x
Clerical employees				x	x		x	x	x
Protestants	x	x							
Ethnic minorities									
Slav population				x	x		x	x	x
				Indirect effect					
Economic development									
Income/wage				x	x		x	x	x
Savings									
Saving books (per capita)			x						
Education									
Enrolment rate	x	x							
Population density	x	x							
Schools		x							
Teachers				x	x		x		x

Table 2.3 contd.

	Becker et al. (2011)	Becker et al. (2010)	Brown & Guinnane (2002)	Galloway (2009)	Galloway et al. (1998)	Galloway (1994)	Galloway et al. (1994a)	Galloway et al. (1994b)	Goldstein, Klüsener (2010)
Female labour force participation									
Fem. lab. force particip. rate				x	x		x		x
Female wage (opp. cost)			x						
Urbanisation									
Urbanisation				x	x		x		
Employees in communications				x	x		x		x
Urban population									
Politics									
Share of Votes			x	x					x
Social insurance									
Employees in banking				x	x		x		x
Employees in insurance				x	x		x		x

Urbanisation variables include variables such as rising cost of farmland, restrictions to child labour and compulsory schooling.

Table 2.6: The fertility decline in Europe

	Bailey (2010)	Bleakley & Lange (2009)	Brown & Guinnane (2002)	Crafts (1989)	David & Sander-son (1986)	Notestein (1945)	Knodel (1974)	Lesthaeghe & Neels (2002)	Easterlin (1975, 1978)	Guinanne & Oglivie (2008)
				Industrialisation						
Employees in mining			x							
Empl. in manuf. or industry			x				x			
Employed in textile factories			x							
				Direct effect						
Migration										
Sex imbalance ratio							x			
(Net) Migration			x							
Marriage										
Marriages			x							x
Mortality										
Improved health care		x								
Infant mortality			x			x	x			x
Religion										
Catholics			x				x			
Ethnic minorities										
Slav population							x			

Table 2.6 contd.

	Bailey (2010)	Bleakley & Lange (2009)	Brown & Guinnane (2002)	Crafts (1989)	David & Sanderson (1986)	Notestein (1945)	Knodel (1974)	Lesthaeghe & Neels (2002)	Easterlin (1975, 1978)	Guinanne & Oglivie (2008)
					Indirect effect					
Birth control										
Innovation in contraception	x				x					
Economic development										
Saving books (per capita)			x							
Education										
Male literacy / illiterate recruits							x			
Female labour force participation										
Female wage			x	x						
Urbanisation										
Urbanisation									x	
Urban population							x			
Politics										
Share of Votes			x					x		

Urbanisation variables include variables such as rising cost of farmland, restrictions to child labour and compulsory schooling.

Goldstein and Klüsener emphasise that between 1900 and 1906 the fertility decline was mainly centred around Berlin. Figure 2.6 confirms a regional clustering in the province of Brandenburg, around the city of Berlin, already before. This can also render some support for the diffusion hypothesis, since the regional clustering around Berlin appears to be a specific case.

The province Ostpreußen appears to have remained rural and experienced only a moderate decline in fertility. Goldstein and Klüsener interpret the decrease in the share of the population in agriculture rather as a proxy for other factos, such as possibly cultural in nature. While we would not necessarily interpret this as a confirmation of the importance of cultural factors, the discussion has shown that industrialisation and the fertility decline are vastly interlinked phenomena.

2.3.4 Direct Effects on Fertility

The direct cost of children is defined as “the present value of expected outlays plus the imputed value of the parents’ services, minus the present value of the expected money return, plus the imputed value of the child’s services”.[13] Children are considered normal goods (Becker 1960), such that a change to the household’s budget will also affect the household’s expenditure for children.

Marriages

If people marry, they just have children.

46-year-old Catholic factory worker

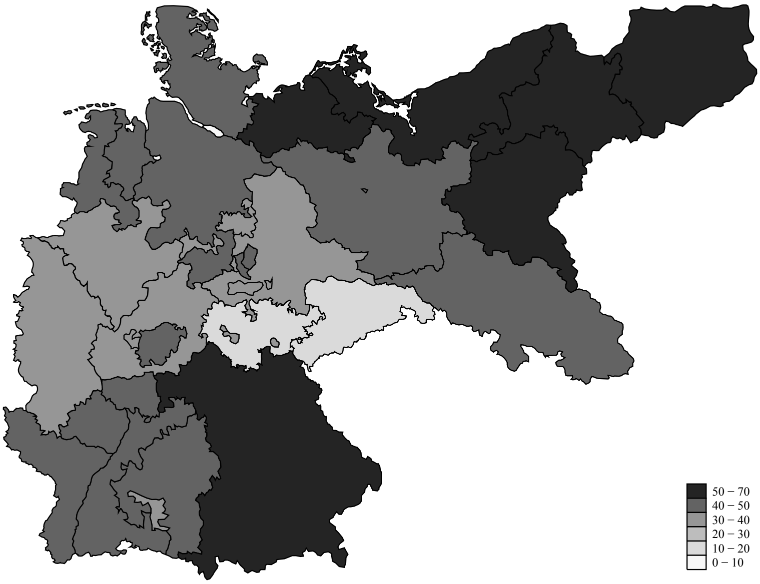
Marriage patterns have long been the focus of research on the fertility decline in Europe (Hajnal 1953; Knodel 1967; Knodel and Maynes 1976; Cotts Watkins 1981; van de Putte et al. 2009). As marriage was a prerequisite for fertility, the contribution of non-marital fertility to overall fertility was modest. Knodel (1974) instead considered diverging marriage patterns in East Prussia as a reason for differences in the fertility decline between the East Prussian provinces and the other provinces. For example, in Bavaria until 1900 getting married was costly because of relatively strict nuptiality laws (Knodel 1967), and so was having children.

During the 1870s, marriage rates increased as a result of liberalised marriage legislation, free movement laws that came into force as Imperial Germany was formed in 1871, and the return of soldiers from the Franco-German war (Knodel 1967). Knodel is of the opinion that the marriage boom that these causes brought about had been finished by 1880.

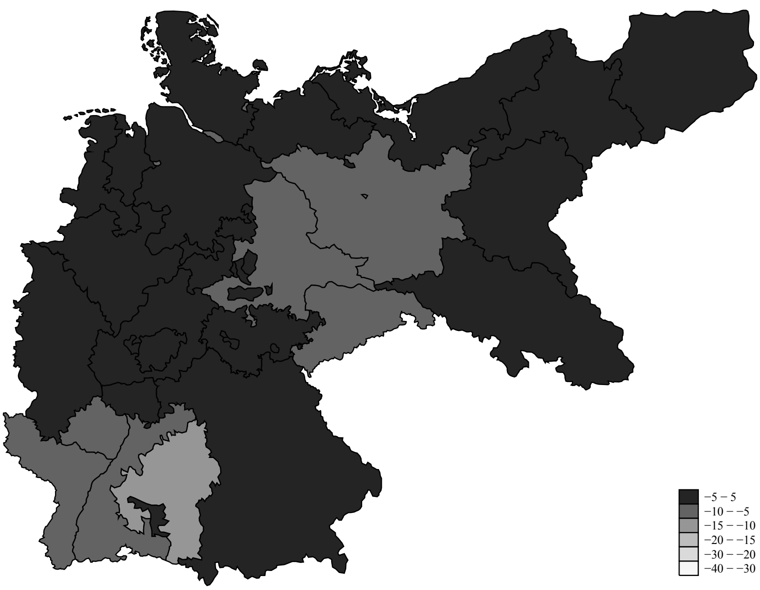
[13] Becker (1960, p. 213.)

Figure 2.6: Change in CMBR and population working in agriculture

Population in agriculture 1882



Change CMBR in 1895 (1882 = 100)



Source: Annual Yearbook of Statistics, Occupational Census.
Data on the share of the population in farming from the Occupational Census 1882.
Note that the implications are similar from what can be inferred from figure 3 in Goldstein and Klüsener (2010).

Even though Knodel (1974) observes a shift to a younger age at marriage, he does not find significant changes in the proportion of married or the proportion of those who never married. As a consequence, he concludes that the fertility decline must have been caused by a decline in marital fertility. Figure 2.7 confirms that the regional clustering of non-marital fertility hardly changed between 1878 and 1890. The range of the contribution of illegitimacy to overall fertility did not change much either between 1878 and 1900.

If illegitimacy did not change substantially, it could nevertheless be possible that there was a substantial change in marriage rates. Figure 2.8 presents more detailed information about regional marriage patterns. The figure shows the marriages per mill for each year. There is clearly less variation between the regions in the West and the regions in the East than in the North and South of Imperial Germany. The regions that exhibit a higher variation also show a lower level of marriages, on average. Some observations stand out. First of all, figure 2.8 shows an almost uniform increase in marriages between 1890 and 1900.

The number of marriages appears to increase between 1890 and 1900 in almost all regions, except Oldenburg, Hannover, and Braunschweig in the North, and Ostpreußen and Posen in the East. In addition, Königreich Sachsen shows an exceptionally high rate of marriages, but the level adjusts to the regional average by approximately 1903. This development took place too late to be considered a result of either the liberalisation of marriage laws (Knodel 1967) or a result of low marriage rates during the Franco German war (Knodel 1974). The existing literature on the topic rather focuses on the impact of urbanisation on nuptiality (e.g. Hajnal 1953; Knodel and Maynes 1976; Cotts Watkins 1981). However, figure 2.8 suggests that there might have been another marriage boom during the 1890s. This makes marriage patterns an unlikely explanation for the first demographic transition, which reached the peak of its velocity in the 1890s.

Migration

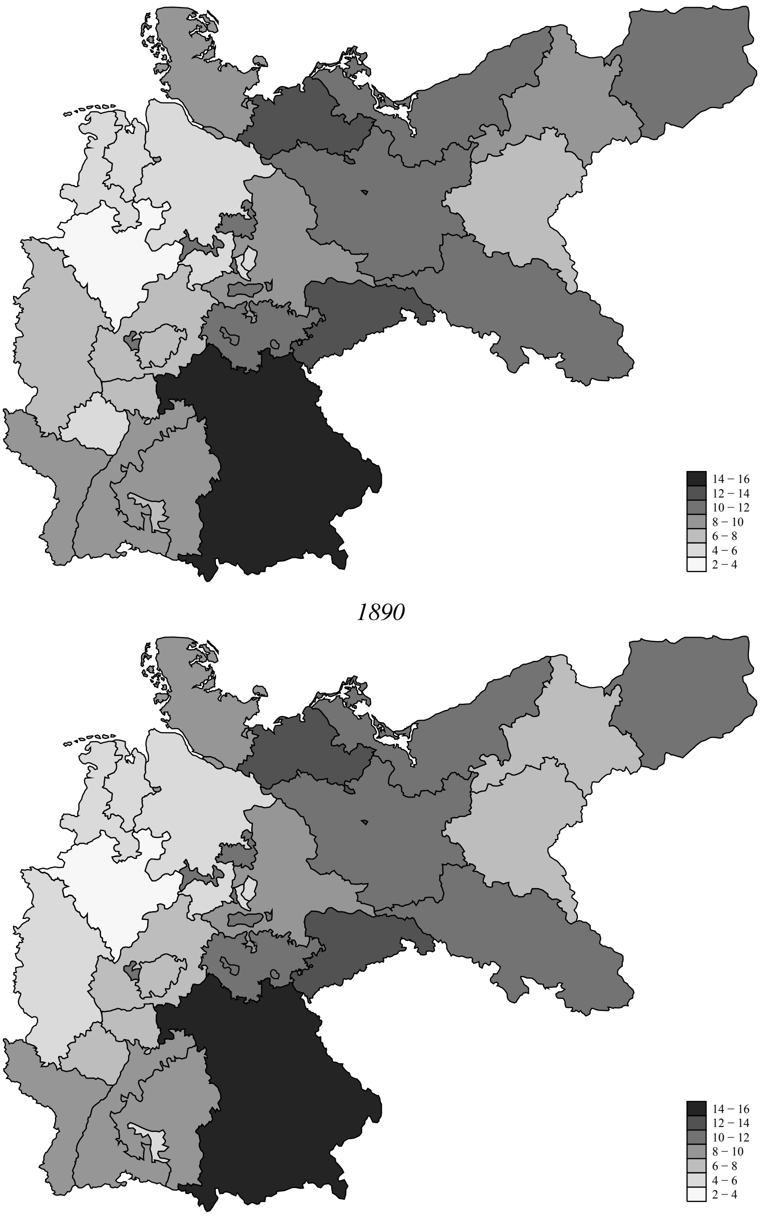
More children cost too much.

27-year-old railroad worker

In nineteenth century Europe, emigration to the new world was an escape from the dire conditions in Europe. It was such an important factor for population dynamics that the Imperial Statistical Office reported emigration figures for almost all years between 1878 and 1911. Khoudour-Castéras (2008) uses these figures for his analysis of the impact of the introduction of social security on emigration from Imperial Germany.

Figure 2.7: Non-marital fertility

1878



Source: Annual Yearbook of Statistics, Occupational Census.

Figure 2.8: Marriages by region

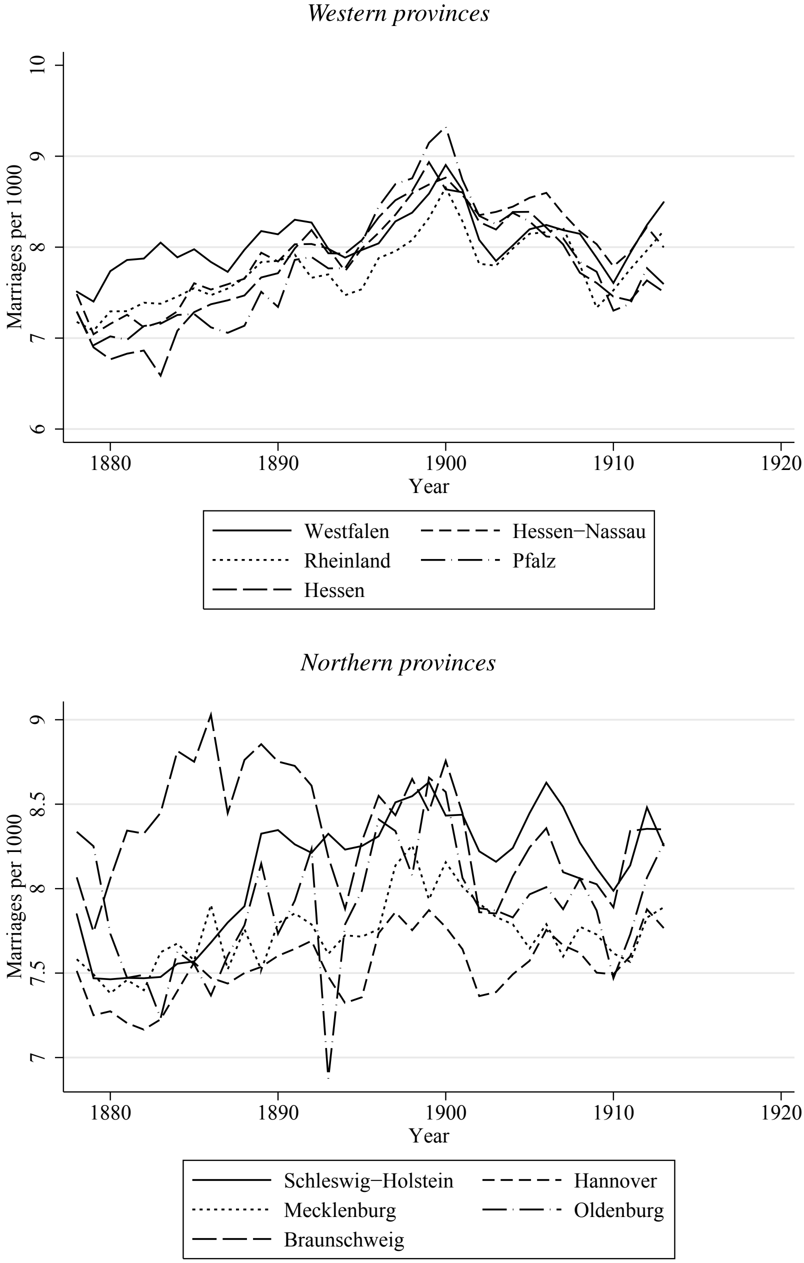
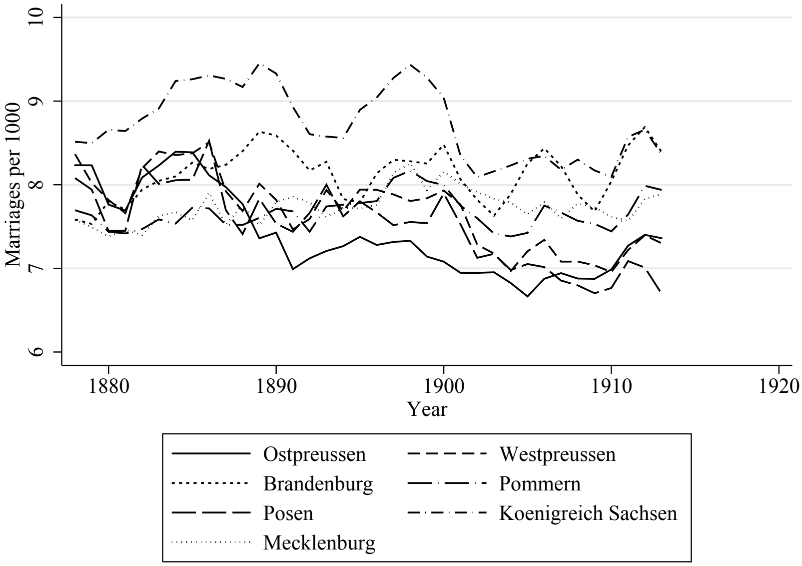
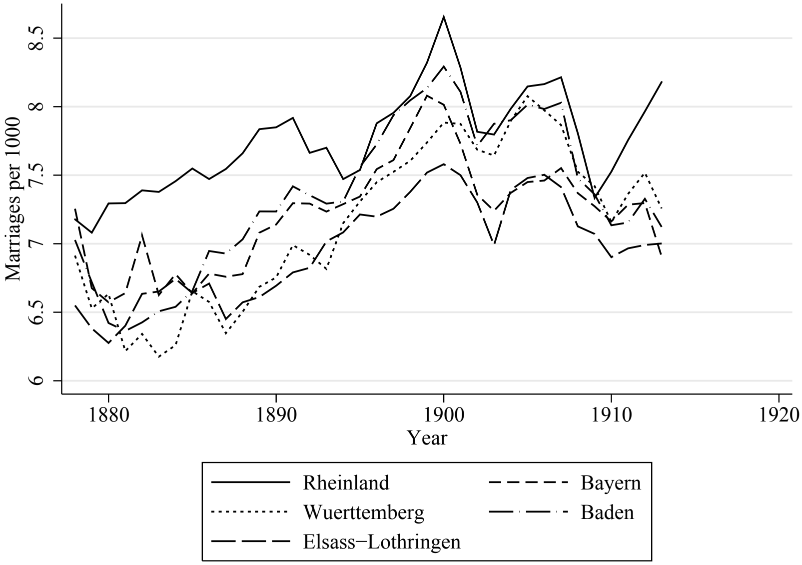


Fig. 2.8 contd.

Eastern provinces



Southern provinces



Source: Annual Yearbook of Statistics.

In addition, Köllmann (1964) describes significant internal migration in Prussia and later in Imperial Germany, even though mobility between the Prussian provinces was always the most significant. Köllmann mentions two phases of internal migration. During the first phase before the 1880s internal migration was a matter of small distances only, but with the beginning of the industrial boom in the West Prussian provinces, people moved from the East Prussian provinces (Ostpreußen, Westpreußen, Pommern, Posen, and Schlesien) to the highly industrialising Ruhr area. This led to a doubling in long distance movements between 1880 and 1907. In addition, the East Prussian provinces also recorded the highest emigration rate to the new world.

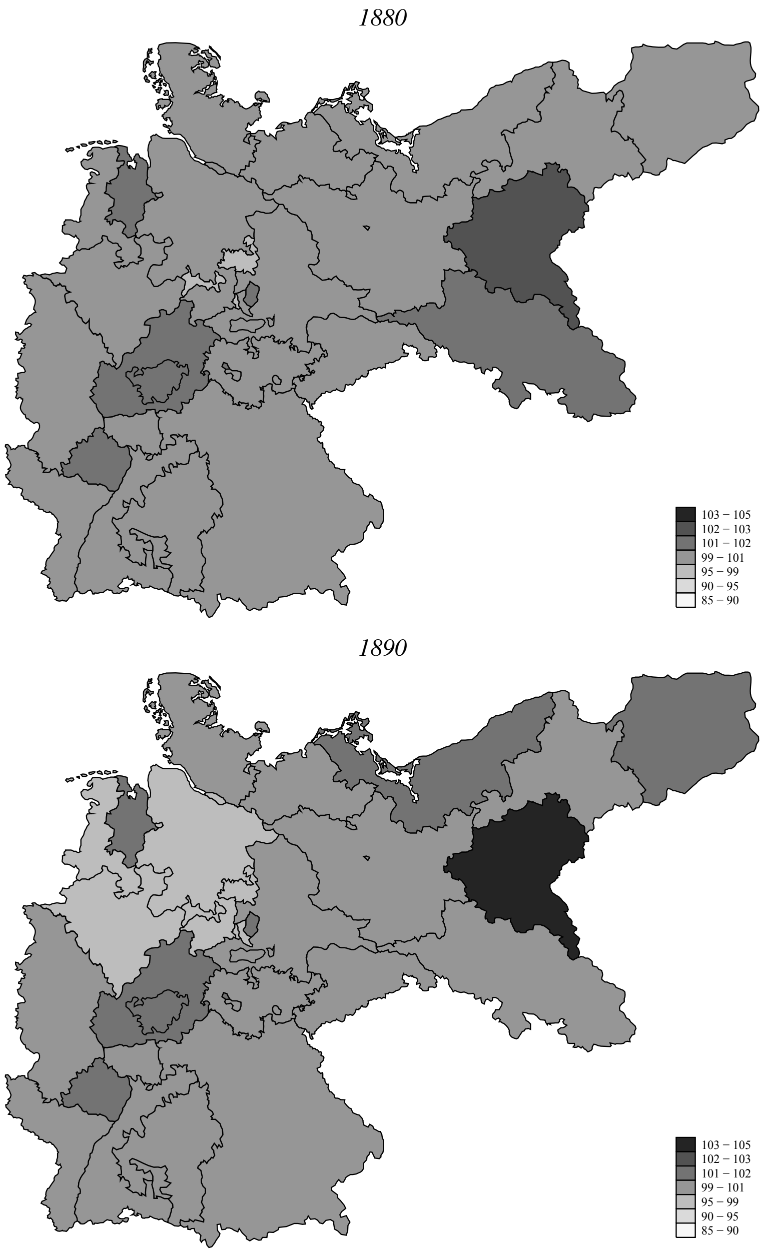
For the analysis of fertility differentials between provinces and over time in Imperial Germany, internal migration is more important than emigration to the new world. Permanent migration may change the *level* of fertility in a province, but not the pace at which the remaining part of the population adjusts fertility. If temporary migration of one partner separates spouses, the depressing effect on fertility is immediate. The cost of children increases by the cost of (repeated) return migration (Borjas 1994).[14]

Figure 2.8 shows the ratio of married women to married men in each province. This ratio is a generally accepted measure of spousal separation and thus a measure of temporary migration. The interesting fact emerging from figure 2.8 is that the sex imbalances ratio changed significantly between 1880 and 1890. This illustrates the second phase of internal migration mentioned by Köllmann (1964). In 1880, the ratio is above 100 – implying a surplus of women – in East Prussia, and below 100 – implying a surplus of men – in Braunschweig in Central Prussia. In 1885, also some West Prussian Provinces displayed a surplus of women. The female surplus in 1890 is concentrated in Ostpreußen and provinces adjacent to the industrialising West, and the male surplus is the highest in the industrialising West.
Figure 2.9 highlights that spousal separation is indeed correlated with internal migration. Spousal separation in 1885 is plotted against the fraction of the population living in the province where they were born. A higher sex imbalances ratio is associated with a lower share of local-born population.

Comparing figure 2.8 to the bottom right panel in figure 2.2 shows that the regions with the highest spousal separation in East Prussia were not the re-

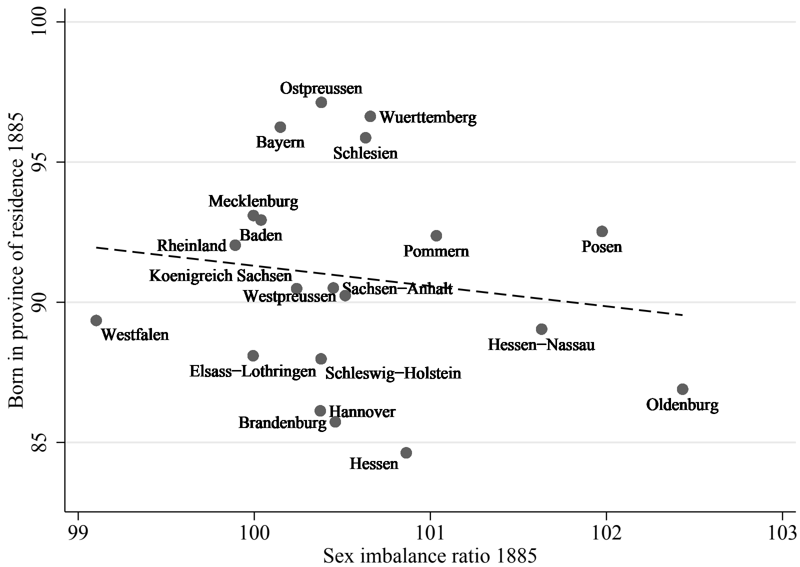
[14] As noted by Köllmann, Knodel (1974), and Kaschke and Sniegs (2001), mostly young men in working age temporary migrated from East to West Prussia. This can affect our primary measure of fertility, the CMBR, depending on whether the population census counted the resident population or the de facto population. The CMBR is a fertility measure adjusted to population size, thus making the way in which the population is counted important. If population figures are based on the de facto population, we may overestimate the CMBR in regions with high temporary out-migration, while we may underestimate the CMBR in regions with high temporary in-migration.

Figure 2.8: Ratio married women per 100 married men



Source: Annual Yearbook of Statistics, Occupational Census.

Figure 2.9: Sex imbalances ratio and internal migration



Source: Annual Yearbook of Statistics, Occupational Census.
Berlin and the Hanseatic Cities are excluded, because they are outliers in terms of the CMBR. They are not, however, outliers in terms of the sex imbalances ratio.

gions with the lowest CMBR. These were neither the regions with the highest change in the CMBR. Nevertheless, we have to acknowledge that both internal migration and high fertility could be related to a third factor, such as limited economic development.

Mortality

We want to get ahead, and our daughter should have things better than my wife and sisters did.

23-year-old master mechanic

Having a large number of children has been considered as insurance against the future death of some of them for a long time. However, it is costly for women taking into account the pregnancy, giving birth and rearing the child; and for the household, as the child has to be fed and raised. Therefore, a decrease in child mortality would be equivalent to an immediate reduction of the direct cost of children.

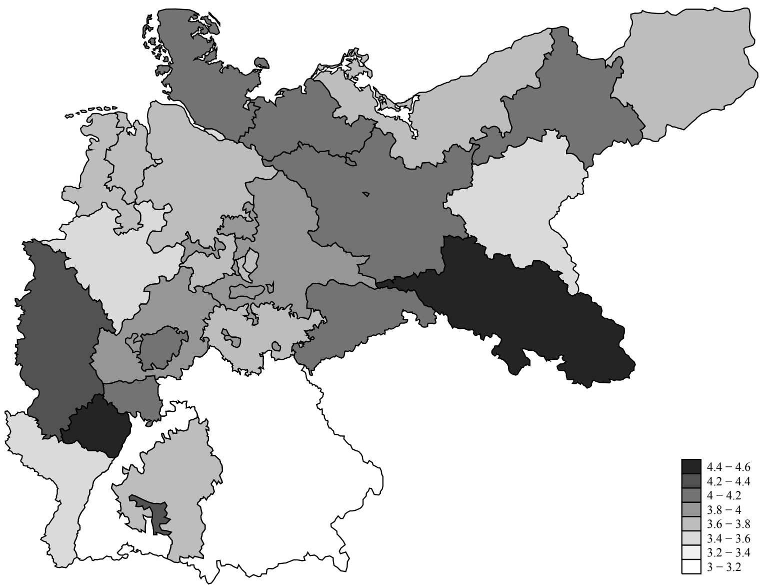
To investigate the effect of child mortality on the fertility decline, it is helpful to compare the timing of decreasing child mortality and decreasing fertility. Knodel (1974) reports two measures to date the decline in child mortality: first, a ten percent reduction in child mortality, and second a reduction in child mortality by at least 50 percentage points. Using the first measure, Knodel dates the mortality decline to past 1901 and by using the second measure to past 1907. Moreover, Knodel finds a stronger fertility decline in areas where child mortality was high than in areas where child mortality was low. However, Knodel also reports child mortality to be higher in urban areas. Interestingly, Vögele (1994) reveals that infant mortality in urban areas in Imperial Germany had declined before it declined in the rural areas, i.e. already from 1870 onwards. Knodel records a regional clustering of infant mortality: areas below a diagonal from the southwest corner to the northeast corner mark areas of high infant mortality between 1875 and 1880.

We do not have information on child and infant mortality for our level of analysis. However, we have information on the number of stillbirths for all years 1878–1914. Recent studies on infant mortality have always examined stillbirth, neonatal and postnatal mortality jointly (e.g. Bakketeig et al. 1993). The risks are correlated (e.g. Guildea et al. 2001). Therefore, we use the share of stillbirths as a proxy for child mortality.

Interestingly, the stillbirth rate is the highest in the Prussian provinces, as shown in figure 2.10. The exceptionally high share in the industrialised areas in West Prussia and in Schlesien suggest that this regional distribution is driven by industrialisation. This corresponds to Knodel's observation of a north-south divide in the clustering of child mortality. As the picture is similar to the change in stillbirths and the change variable is better suited to analyse dynamics, we use the change in the stillbirth rate as a proxy for developments in child mortality.

In contrast to Knodel's dating of child mortality – clearly at the beginning of the twentieth century –, the stillbirth rate declined significantly before 1900. The drop in the stillbirth rate in 1890 relative to 1880 was the strongest in Rheinland. There was a significant drop in the East Prussian provinces along with the central Prussian provinces only in 1900 relative to 1880. These are also the provinces, in which the crude birth rate was still relatively high in 1890 (see figure 2.2). Thus the stillbirth rate is more strongly related to the fertility level than to fertility change, but its ability to explain the first demographic transition is clearly limited.

Figure 2.10: Stillbirths in 1880



Source: Annual Yearbook of Statistics, Occupational Census.
Stillbirths as a ratio of total births.

Religion

Children are a blessing from above. So people should leave things alone and not try to make them better. Also my wife wouldn't agree to [control births] at all.

34-year-old Catholic copper from Westfalen

In what fertility is concerned, differences between Catholic and Protestant areas in fertility were noted fairly early (Neumann 1978 summarises some of the debate). There are two main explanations. First, being a member of a religious group introduces peer effects to individual decisions. As the Catholic Church is opposed to all forms of birth control, we would expect fertility to be higher in predominantly Catholic regions. Second, there were different school systems for Protestants and Catholics, which in turn affected human capital and thereby economic prosperity (Becker and Wößmann 2009). According to Becker's (1960) substitution hypothesis, we would expect fertility to be lower among the more affluent protestants.

Knodel (1974) finds that indeed Catholics lagged behind in the fertility decline. He uses a short time series on birth by religion, which is available for Berlin and Munich. In this data, Catholics display the highest and Jews the lowest level of marital fertility. In addition, Knodel uses crude birth rates in relation to the mother's religion for Preußen, Hessen, and Bayern. Knodel finds an earlier tendency for declining birth rates among Protestants in addition to a lower overall level in Prussia. According to Knodel's findings, marital fertility is higher in areas a Catholic population of over 90%; in predominantly Catholic regions the fertility decline is delayed.

Figure 2.11 shows the Catholic share of the population in 1890 in the top panel and the change in the share of Catholics between 1890 and 1900 in the bottom panel. The Catholic share is the highest in the rural South and West and the lowest in Prussia. Within Prussia, the Catholic share is again the highest in the rural areas in the East and lowest in Central Prussia. Not surprisingly, the change in the share of Catholics was the largest in Central Prussia. It only declined in some provinces in the West, and the decline of 2.5% was modest compared to a surge of around 60% in Central Prussia. The initial level of Catholicism was exceptionally low in the predominantly Protestant Prussia.

Comparing figure 2.11 to figure 2.12 however shows that the relative change in the CMBR between 1890 and 1900 was apparently not related to either the level of or the change in the Catholic share of the population. While religion plays a significant role in fertility, its influence during the first demographic transition appears rather limited.

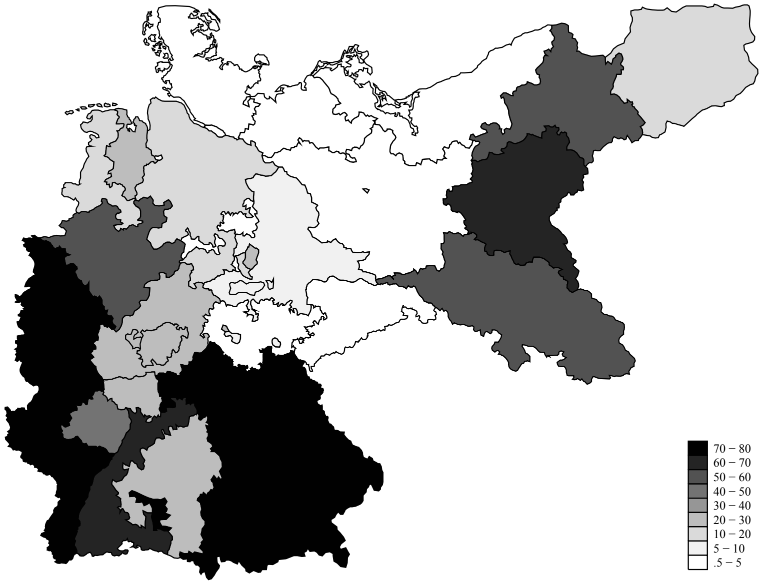
Is it possible that the increase in the share of Catholics in the East Prussian provinces might have delayed the decline in fertility? If predominantly Protestant Germans migrated to West Prussia and predominantly Catholic Slav minorities[15] stayed, the result is an increase in the share of Catholics.[16] But then the delayed fertility decline might rather be related to a larger Slav population in the East Prussian provinces.

[15] According to Belzyt (1998), about 20% of the Polish-speaking population in the East Prussian provinces were Protestant.

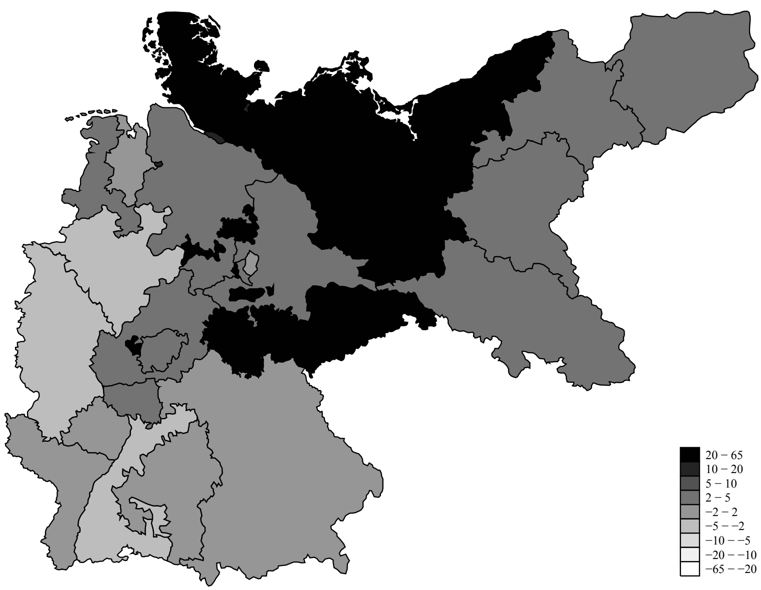
[16] Belzyt (1998) also offers another explanation. The Prussian government pursued an active settlement policy in the East Prussian provinces at the end of the nineteenth and the beginning of the twentieth century, because the share of Slavs was perceived as too high. Slavism was associated with Catholicism. This is why Germanisation was pushed forward for Protestant Slavs, but not for Catholic ones. The Protestant Slavs were those that more likely migrated to West Prussia.

Figure 2.11: Catholics

Share Catholic in 1890



Change in the share Catholic between 1890 and 1900



Source: Annual Yearbook of Statistics, Occupational Census.

Ethnic Minorities

Not French military armaments, not English Superdreadnoughts can ever become dangerous for the German people. The only real external threat is the automatic population growth of Slavs.

Dr. Alfred Grotjahn, Social Democratic physician, July 1913

If the decline in fertiliy lagged behind in the East Prussian provinces and the population consisted of large Slav minorities, one can assume that the Slav minorities displayed a different fertility pattern. Belezyt (1998) confirms a higher level of fertility among the Slav population than among the native German population.

The bottom panel in figure 2.2 shows this regional clustering of fertility, in particular in the East Prussian provinces. This clustering is persistent over time. In addition, fertility is higher in the rural areas Ostpreußen and Bayern. The provinces Ostpreußen, Pommern, Posen, Schlesien and Westpreußen had the largest Slav minorities. Westpreußen and Posen were the only provinces with a CMBR of above 40 per mill for a significant number of years. In these provinces, the CMBR only dropped below 40 after 1900.

Bayern did not have a significant large Slav population, but consisted of largely rural and Catholic areas. However, fertility was also comparatively high in the industrialised areas of Rheinprovinz and Westfalen in West Prussia. Put differently, fertility was particularly high in the more peripheral areas. This observation corresponds to the regional clustering observed by Knodel (1974).

The *level* of the CMBR was higher, but the decline in the CMBR was not significantly different in the provinces with a large Slav minority. The bottom panel in figure 2.5 shows the strongest decline between 1882 and 1895 in the South and the central Prussian provinces. Knodel does not observe significant differences in the decline of birth rates between Slav and non-Slav provinces either. He attaches a greater role to changed marriage patterns, since the proportion of married people rose in Danzig and Ostpreußen between 1880 and 1895, but declined substantially after 1895.

Mombert (1907) as one of the contemporary observers of the fertility decline considered impoverishment as causing high fertility, because a high number of children was a means of insurance against the hardships of life. According to Mombert's argument, it is not surprising to find a higher CMBR in the more rural areas, i.e. the economically less developed areas. Thus, it is possible that a high fertility level in the East Prussian provinces was not driven by the presence of Slav minorities, but caused by the rural character of these regions. Most importantly, relating the fertility decline to the presence of large Slav minorities is not compelling with regard to such a lasting change in fertility.

2.3.5 Indirect Effects on Fertility

Birth Control

It cost five Mark, but after three days it had already worked. In the long run, a child costs a lot more.

30-year-old wife of a tailor on an abortive drug she used.

While more sophisticated means of birth control are often mentioned as one of the main reasons for the first (and the second) demographic transition, it is surprising how widespread abortion was among women in Imperial Germany (Neumann 1978; Woycke 1988). If, however, innovations in contraception had led to lower avoidance costs this would have rendered the alternatives to having children less costly and thus have increased the opportunity cost of children. But were avoidance costs really lower towards the end of the nineteenth century than before? Evidence that is directly related to innovation in contraception is scarce. Bailey (2010) is the only source that uses a variable that is directly related to contraception to control for its effects. She uses laws on contraception and innovations in new contraceptive methods. An alternative way to measure innovation in contraception is to proxy how information is spread, as increased mobility and communication facilitated the spreading of information about contraception according to the innovation/diffusion view. Galloway et al. (1994; 1998), Galloway (1999), and Goldstein and Klüsener (2010) use the number of people employed in communication industries as a proxy.

Goldstein and Klüsener use spatial econometric techniques to account for the diffusion of technologies and information. The main insight from spatial estimation is a geographic clustering of the timing of the decline in fertility that cannot be explained by the standard cultural, economic, and demographic variables. Goldstein and Klüsener conclude that this renders support to the innovation/diffusion hypothesis. The main contribution of Goldstein and Klüsener is including local ‘peer effects’ as a possible explanation for the diffusion hypothesis and using a technique which they claim is able to measure these effects, i.e. spatial correlation.

Knodel (1974) goes further and claims that the use of deliberate birth control increased particularly among the working classes. It is important to devote some attention to this argument, as it would imply that regions with a higher fraction of workers would display a stronger decline in fertility as soon as contraception became widely available. If the diffusion of birth control was indeed lower among the working classes, this would leave room for an increased use.

According to Neumann (1978), an average of two thirds of the population had been practising some form of birth control by 1914. The rate was approximately 45% among farmers, between 65% and 75% among the working class and between 80% and 90% among the middle class. This suggests that provinces with a higher rural population should display a higher birth rate, ceteris paribus. In addition, children could support the family business in the countryside, which made the use of birth control less necessary than in the cities. This suggests that there was indeed more room for working class couples to reduce fertility by increasing the use of birth control. Observing a higher adjustment among workers and among the rural population is therefore not surprising.

However, this does not mean that the availability of birth control or the knowledge of how to control the number of births were pivotal for the decline in fertility. Birth control had already been widely practised before and at the beginning of the first demographic transition, and even among farmers almost 50% of the group used some form of birth control. Perhaps, economic development made it less expensive to use more sophisticated forms of birth control, but Woycke (1988) illustrates that coitus interruptus and abortion were the most common methods of birth control until the late 1920s. Therefore, the information exchange does not sufficiently explain, *why* people resorted increasingly to the use of birth control.

Economic Development

With children you can't amount to anything nowadays, and we're still young and want to have life a little better.

33-year-old lathe operator

Perhaps, economic development is the most undisputed explanation for a change in a households' budget constraint that may have led to a changed consumption pattern. Mombert (1907) documents an inverse relationship between the level of rents and the number of children, i.e. the differential between wealthier and poorer districts of a city. Burgdörfer (1929) takes a slightly different approach. Assuming that increasing household wealth negatively affects the number of children, an ex ante differential between poorer and wealthier districts of a city is not surprising. As the late nineteenth century was characterised by a relative wealth increase among the working classes, Burgdorfer examines the convergence between poorer and richer districts of Bremen after 1900 and indeed finds family size convergence.

Economic development is difficult to measure for Imperial Germany at the provincial level, since corresponding information on production is not readily available. However, the Imperial Statistical Office provided information on growing areas and yields of basic crops, i.e. rye, barley, oat, wheat, hey, and potatoes. This allows us to calculate the productivity within each crop sector by dividing the tons harvested by the area in which it was grown. We can also construct a simple index of productivity in agriculture, which sums up the productivity measure for each crop and divides this sum by the number of crops. This productivity index increases steadily over time in all provinces. The index of agricultural development captures general economic trends well. There is no apparent increase in the productivity index before the mid-1890s, but it increases thereafter, exactly when a boom period set in that lasted until the early twentieth century.

Figure 2.12 shows the correlation between productivity in agriculture and the CMBR for Imperial Germany and selected provinces. The top left panel shows the correlation for Ostpreußen, the most rural province. There is a clear inverse relationship between productivity and the CMBR. We can also observe such a relationship for Sachsen-Anhalt (lower left panel). There was neither a completely rural nor a completely industrial focus of business in Sachsen-Anhalt. The lower right panel then shows the correlation for Westfalen, which was an industrialising region. We observe that the negative relationship between productivity in agriculture and the CMBR is not as strong in Westfalen as in Ostpreußen or Sachsen-Anhalt.

As we measure productivity in agriculture, it should not be surprising to find a stronger effect on the CMBR in rural provinces. It is, however, important to see that there was indeed a correlation between the CMBR and economic development. In addition, our index of productivity in agriculture seems to be an acceptable proxy for economic development, as it also captures the inverse relationship we would expect for industrialised provinces. We conclude that based on the timing expected inverse relationship between productivity and the CMBR, economic development qualifies as a major cause of the fertility decline.

Education

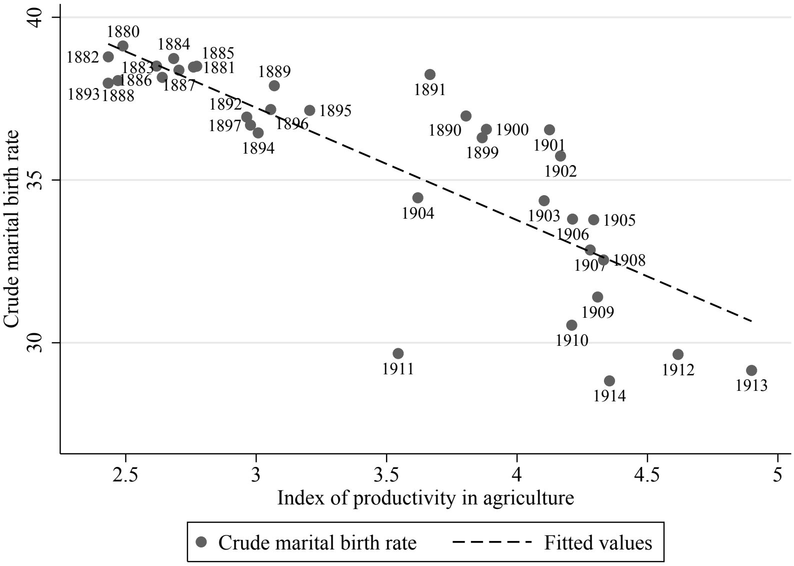
Nowadays a person can't bring up more than two children properly.

37-year-old wagon builder

Sending the children to school can be an investment in the future 'returns' of the children (Becker 1960, 1965, 1991; Becker and Tomes 1976, 1979). It can be more reasonable to invest limited resources in the better education of fewer children. This aspect has received a lot of attention recently, and has mainly been analysed with Prussian data (Caldwell 1980; Becker et al. 2009, 2010). On the other hand, compulsory schooling laws, which were introduced in several German states during the nineteenth century, prevented the children from working. This means that they could not support the family (Caldwell 1980), which in turn had a direct effect on household income.

Figure 2.12: Crude birth rate and economic development

Imperial Germany



Ostpreußen

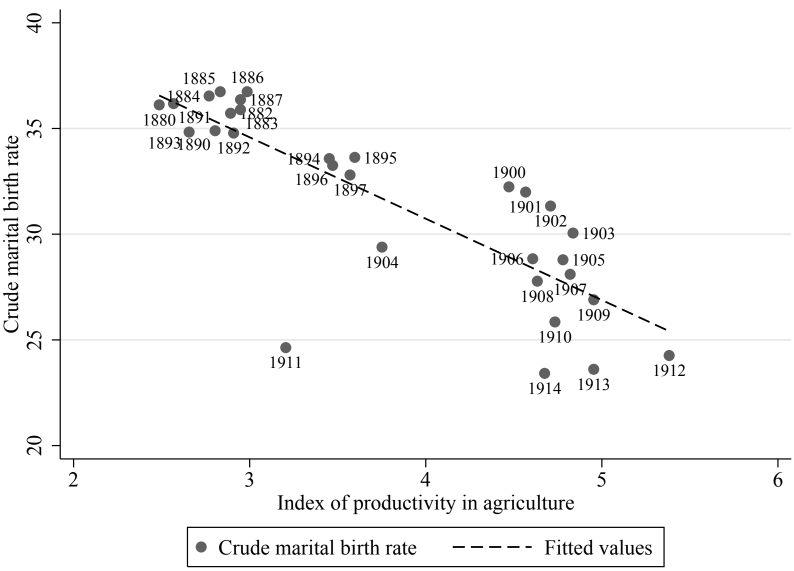
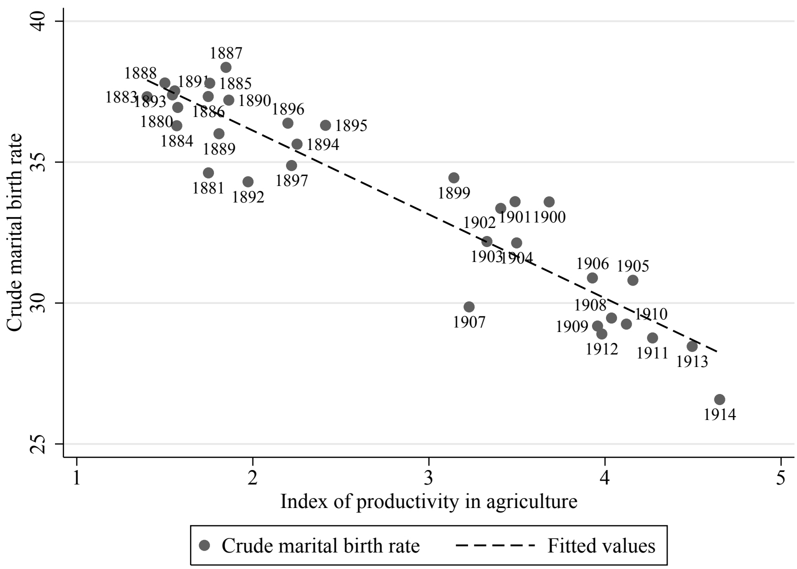
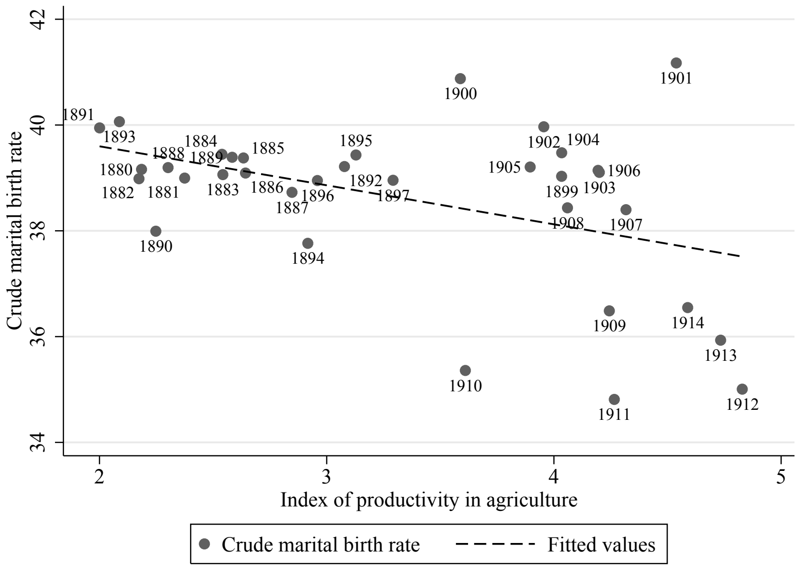


Fig. 2.12 contd.

Sachsen-Anhalt

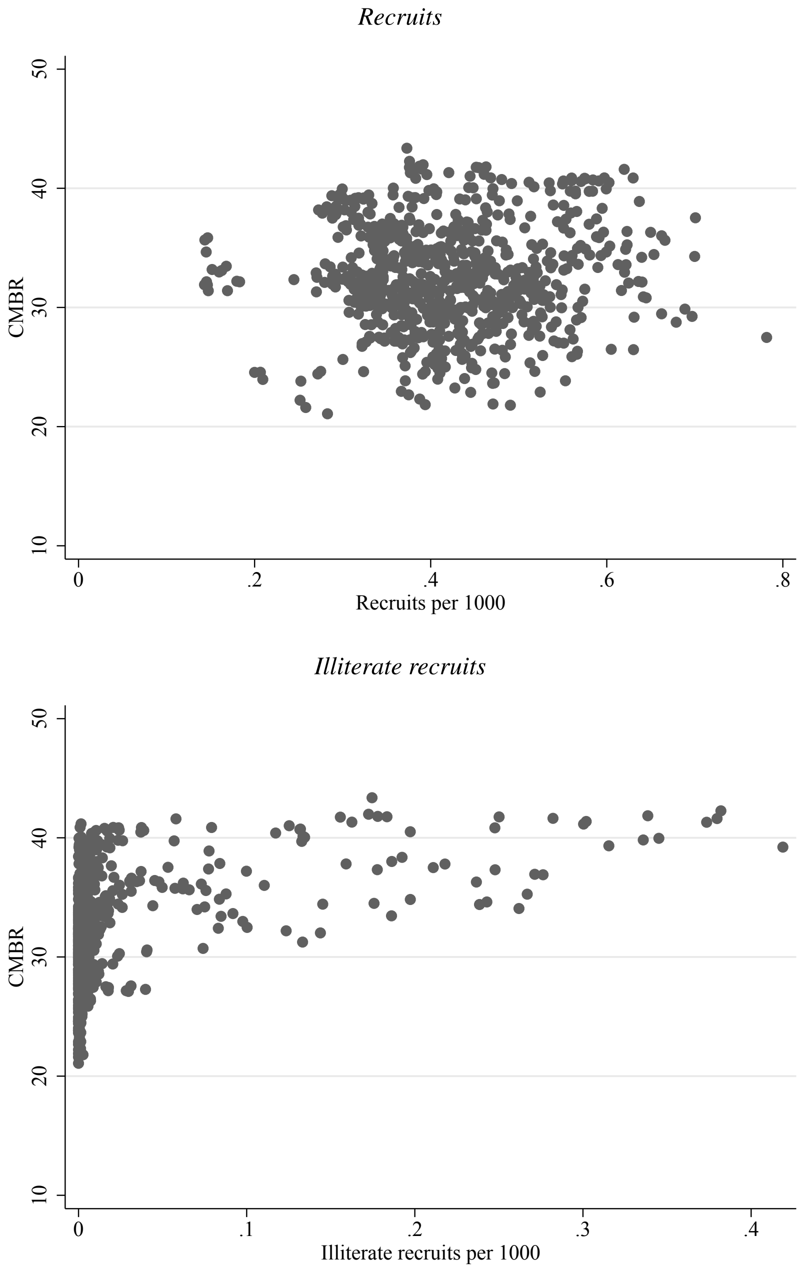


Westfalen



Source: Annual Yearbook of Statistics, Occupational Census. Years 1881, 1888 and 1889 omitted for Ostpreußen; years 1882 and 1889 omitted for Sachsen-Anhalt for clear exposition.

Figure 2.12: Education, recruits and fertility



Source: Annual Yearbook of Statistics, Occupational Census. Figures for all provinces 1878–1911. Years 1912–1914 are excluded because of the mobilisation of troops before World War I.

Household income of course depended on the *parents'* education. The only measure of education that is available for all of Imperial Germany at the provincial level is the number of illiterate recruits in each province. Knodel (1974) also uses this measure, but Knodel rightly concludes that not much information about the educational level of the population can be inferred from it. By the end of the nineteenth century, most people in Imperial Germany benefitted from basic schooling.

Figure 2.12 reinforces this point. The top panel shows the correlation of the CMBR and the number of recruits. The bottom panel shows the correlation of the CMBR and the number of illiterate recruits. Both panels show all provincial/yearly observations before 1912. We exclude all observations after 1911, as the number of recruits increased on the eve of World War I. This timing coincides with the decline in fertility, even though the two phenomena are not directly causally related.

The mode of provincial/yearly observations of illiterate recruits is zero; this reinforces Knodel's (1974) point. Those provincial/yearly observations with a positive number of illiterate recruits indicate a positive relationship between the CMBR and the number of illiterate recruits. This is not the case for the total number of recruits, as shown in the top panel.

Illiteracy among recruits was clustered in the provinces with the highest fertility, but these were also rural provinces (e.g. Ostpreußen and Bayern). The educational level could therefore also be interpreted as a more general indicator of the economic development of a region. It still renders some support to the hypothesis of an inverse relationship between the CMBR and education. Education may qualify as a determinant of fertility, however, it's influence appears to be rather weak.

Female Labour Force Participation

My wife would have been able to get a nice porter's job if there weren't any children.

30-year-old shoemaker

Female labour force participation is the textbook example of the opportunity cost of having children. If women have to choose between work and raising a family, either for cultural reasons, or because external childcare is unavailable or unaffordable, the forgone wage income is the household's opportunity cost of having children. Bernays (1916) as one of the early observers of the phenomenon mentions high employment in factories as a reason for decline in fertility.[17]

[17] However, we also have to acknowledge that contemporary observers also stressed that causality was different. Poor families were larger, and because of the large number of children the women in these families had to work to support the family (Geyer 1924).

Table 2.8 highlights two important observations in this respect. First, the female employment rate increased significantly between 1882 and 1925. This is likely to be related to growing employment opportunities in the industrialising cities, even though Knodel (1974) contrasts the growth of female employment with the growth of the secondary and tertiary sector and concludes that the growth in female employment was stronger.

Table 2.8: Nonagricultural female employment

Year	*All women 14 or over (% employed)*	*Married women (% employed)*
1882	9.4	2.7
1895	11.7	4.3
1907	14.3	6.6
1925	18.0	9.1

Source: Knodel (1974), p. 226.

As we do not have information on the share of working women at the provincial level, we can only approximate this share. We have information on the number of women in working age for 1885. This measure however strongly correlates with the share of women in childbearing age. Is it still an adequate measure of female labour force participation?

Knodel (1974) reports a high correlation between the sector and the share of female employment. Knodel does not find a significant correlation between women's employment outside agriculture and fertility before 1900, and after 1900 he only registers a weak negative correlation. However, he relates the strong increase of female labour force participation as shown in table 2.8 to the rising importance of the secondary and tertiary sector and the declining importance of the primary sector. The left panels in figure 2.13 show the correlation of our proxy of female labour force participation for 1885 and the share of the population working in the primary, secondary and tertiary sector in 1882.[18]

We can conclude from the top left panel of figure 2.13 that the share of women in working age is not strongly correlated with employment in the primary sector and that the correlation is negative. This could suggest that the share of women in working age does not proxy the share of women in working age but the share of the working age population. A higher share of the working age population could indicate a higher potential to move workers from the primary to the secondary sector. The share of women in working

[18] Note that the age structure is only reported for 1880, 1885 and 1890 and information on occupations is only available for 1871, 1882, 1895 and 1907.

Figure 2.13: Sector and share of men and women in working age

Farming

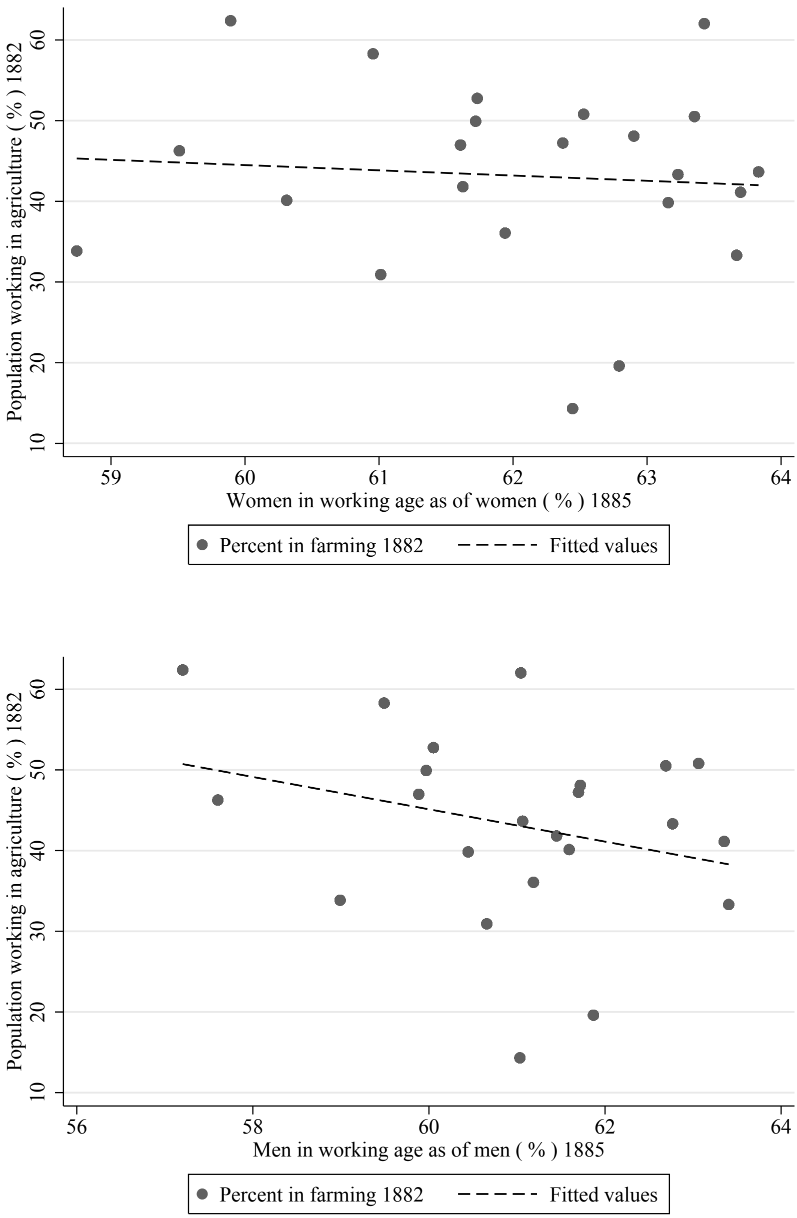
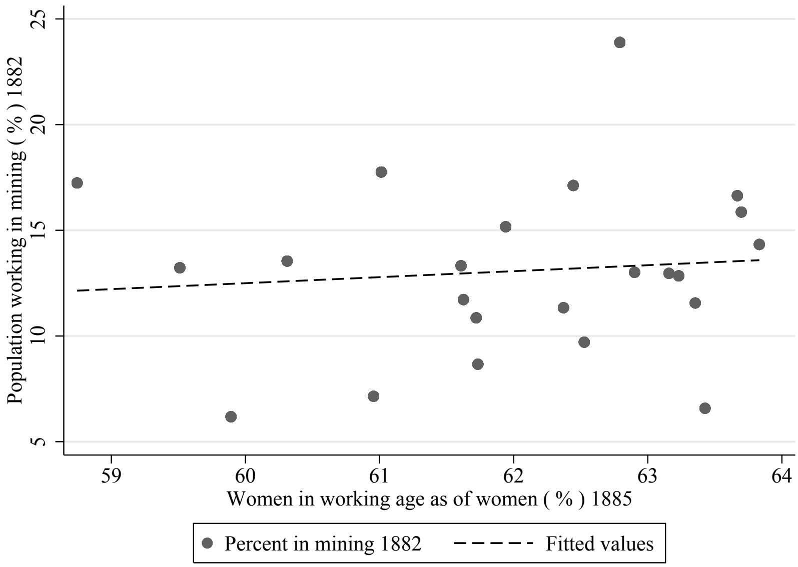


Fig. 2.13 contd.

Mining



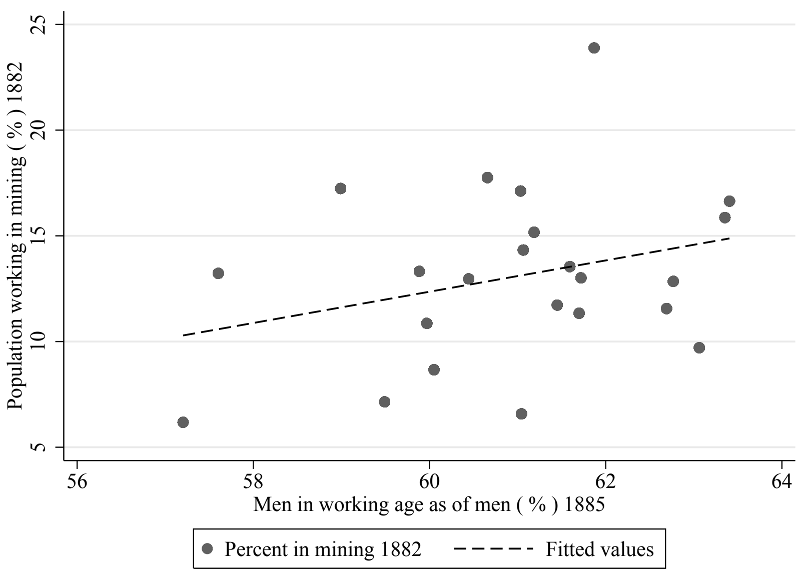
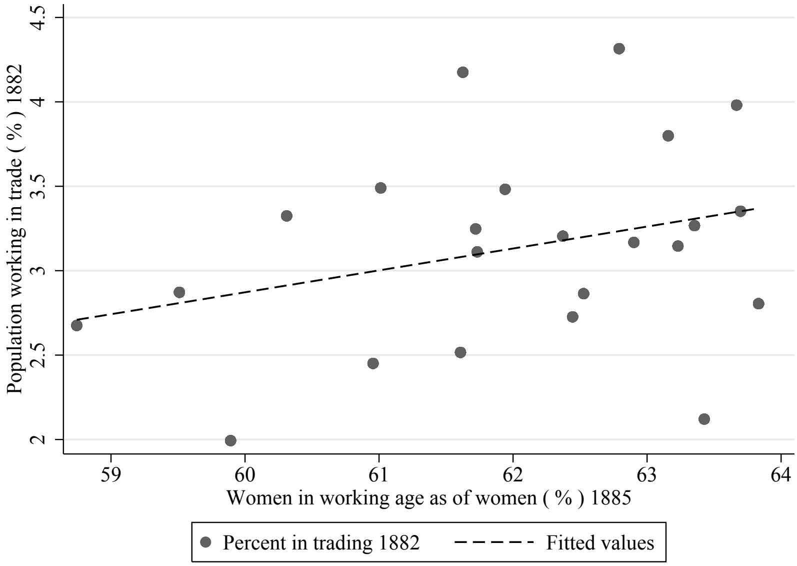
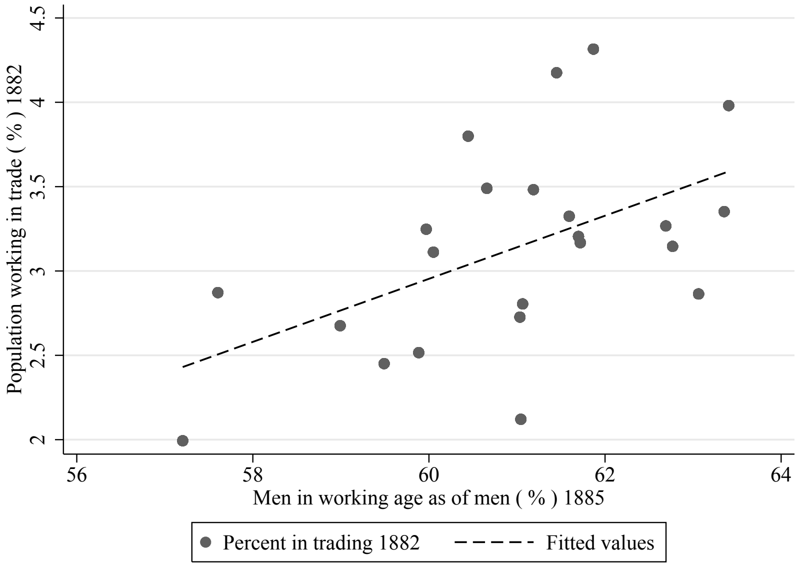


Fig. 2.13 contd.
Trade





Source: Annual Yearbook of Statistics, Occupational Census.

age is weakly correlated with the share of the population working in mining, as shown in figure 2.13. The correlation is the most significant for the share of the population working in trade, also shown in figure 2.13.
To assess whether this relationship also holds for men, the correlation of the share of men in working age with the share of the population working in each sector is depicted in the right panels of figure 2.13. Here we also find the same pattern, but the correlation is much stronger. Indeed, more men than women worked, so the correlation between the share working in each sector and the share of working age is informative with regard to labour force participation. This observation suggests that the correlation between the share of women in working age reflects labour market participation and not primarily the share of women in childbearing age.

The share of women in working age is inversely related to the CMBR in 1885. This is shown in the left panel in figure 2.12. The right panel of figure 2.12 shows the correlation between the share of men in working age and the CMBR in 1885. This correlation is stronger. First, it is possible that we observe a general opportunity cost effect of having children. Second, it is possible that we observe the influence of the industrial structure. If employment in the secondary or tertiary sector is associated with a lower birth rate, and a higher fraction of the population in working age allows these sectors to expand more strongly, we observe the former effect and not a labour market participation effect.

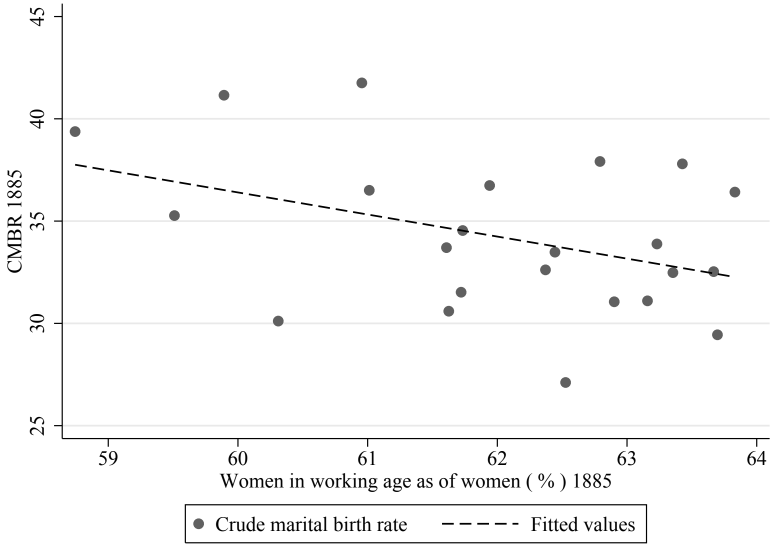
How much of the correlation is driven by the sectoral composition of the workforce? In order to shed light on this, we first regress the share of women in working age in 1885 on the share of the population working in farming, the share working in mining, and the share working in trade in 1882. Then we compute predicted values. We use the same approach for the share of men in working age. The correlation of the resulting predicted values and the CMBR are shown in figure 2.13.

It is apparent from comparing figure 2.13 with figure 2.12 that the correlation has not changed much for the share of working women, but it has become much weaker for the share of working men. We conclude that the negative correlation between the share of the working age population and the CMBR is partly driven by the sectoral shift. If we however control for this sectoral shift, female labour force participation appears to play a role.

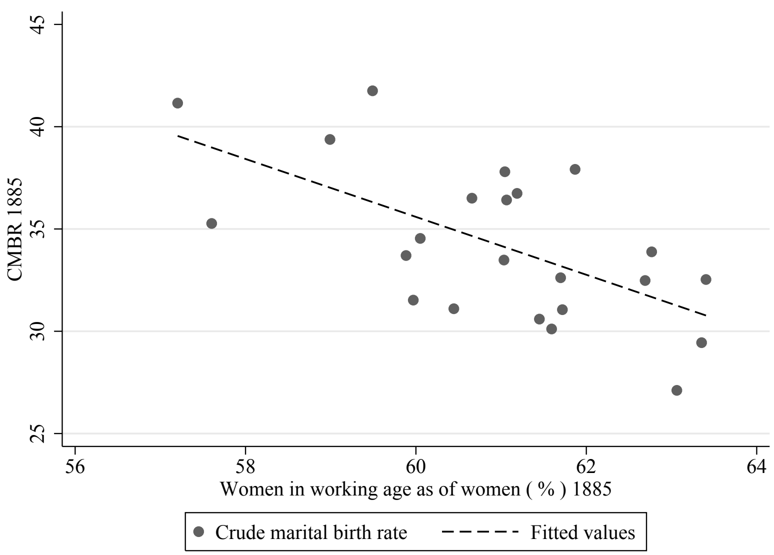
Considering the literature on the situation of women in the late nineteenth century (e.g. Fait 1997), this is not surprising. For example, Fait notes that even though women were not supposed to work after getting married, most of working class women had to in order to support the family. This means that official figures, such as the ones in table 2.8 do not reflect the *actual* labour force participation rate of women.

Figure 2.12: CMBR and labour force participation

Women



Men

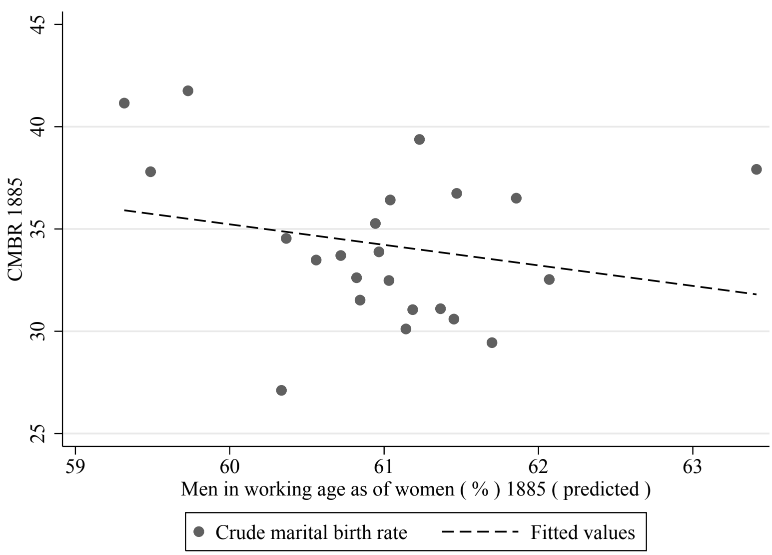


Source: Annual Yearbook of Statistics, Occupational Census.
Figures for all provinces 1878–1911.
Years 1912–1914 are excluded because of the mobilisation of troops before World War I.

Figure 2.13: CMBR and labour force participation (predicted values)

Women

Men



Source: Annual Yearbook of Statistics, Occupational Census.
Figures for all provinces 1878–1911.
Years 1912–1914 are excluded because of the mobilisation of troops before World War I.

However, using data from England and Wales, Crafts (1989) finds that employment opportunities for women had a significant effect on the spacing decisions. Taken together, female labour force participation as an effect of industrialisation appears to have an effect on fertility. Because female labour force participation increased as Imperial Germany industrialised, it also qualifies as one of the more convincing explanations for the first demographic transition.

Politics

The social question can never be solved by self-help, but only by mass-help. As a weapon for the proletariat, child limitation must be rejected categorically. We will never achieve our final goal through child limitation.

Rosa Luxemburg, Marxist theorist, philosopher, economist and activist, July 1913[19]

Policy preference as a determinant of the fertility decline is strongly related to explanations of behaviour according to social norms. This explanation has entered the scientific debate relatively recently (Lesthaeghe 1977; Lesthaeghe and Neels 2002; Galloway 2009; Goldstein and Klüsener 2010). It has been noted much earlier, however, that a stronger decline in the birth rate could e.g. be observed in areas with a large share of votes for the Social Democrats (e.g. Seeberg 1913). The basic line of argument links a strong party preference to the party goals. The Social Democrats were more focused on gender equality and supported the labour market participation of women.

Galloway (2009) adds to his earlier studies by including a variable on the share of votes for the Social Democratic Party. Goldstein and Klüsener also use the share of votes for the Social Democratic Party. This variable has been found a strong predictor of declining fertility (Lesthaeghe 1977; Lesthaeghe and Neels 2002). However, Goldstein and Klüsener interpret its predictive power as an indication for spatial correlation. We agree with this interpretation for two reasons.

Firstly, for this interpretation to hold, support for the Social Democrats must have spread or at least the party must have become more popular. This requires people to have adopted a party doctrine. However, the parliamentary parties were not very influential when it came to shaping legislation (Haerendel 2001). The causality is thus likely to be reverse. As new ideas and attitudes spread, people were more inclined to support the Social Democrats. Secondly, the increasing popularity of Social Democracy also coincided with the introduction of social insurance. Therefore, the spreading of new ideas and attitudes could equally reflect the growing influence of institutions.

[19] At the time of the quote, Rosa Luxemburg was a member of the German Social Democratic Party.

Urbanisation

And anyway in Berlin that doesn't go.

30-year-old shoemaker on a question on his parents' large family.

The effect of urbanisation on fertility is largely an indirect one, as it affected almost all other factors mentioned thus far as well. As noted above, the spreading of information took place from urban to rural areas, which also allowed for the spreading of information on contraceptives. In addition, infant mortality decreased earlier in urban Imperial Germany than in the rural areas (Vögele 1994). Based on the more conservative structures in the countryside, marriage patterns also differed between rural and urban areas; illegitimacy was on average higher in the cities (Knodel 1977; Baten and Murray 1997; Lees 2002).

In a detailed analysis of rural-urban differences in fertility Knodel (1967, 1974, 1977) finds that in all except one of the 14 Prussian administrative areas, rural fertility was higher than urban fertility. Figure 2.14 compares the regional clustering of the CMBR and urbanisation measured as the number of localities with a number of inhabitants larger than 20,000. The left panel in figure 2.14 depicts the degree of urbanisation in 1880. The right panel depicts the CMBR in 1880. The East Prussian provinces appear to be the least developed regions in this context. They are least urbanised and display the highest birth rate. However, it is not necessarily the most urbanised provinces that display the lowest CMBR. The same holds for the *change* in the CMBR. The degree of urbanisation and the *change* in the CMBR do not seem strongly related either. The decrease in the CMBR is not the highest in the most urbanised areas. We do not observe an apparent regional clustering of the change in the CMBR that corresponds to the degree of the change in urbanisation.

It has to be kept in mind, however, that Knodel (1967) used more detailed regional data in his studies on rural-urban differences. The high degree of aggregation in our data could mask effects which are specific to cities. A measure that might be better suited to illustrate urbanisation is the number of people per building and the number of people in a household. These measures of urbanisation are displayed in figure 2.15.

It is clear from the bottom panel in figure 2.15 that the number of people per household in 1880 was roughly the same all over Imperial Germany. The number of people per building however is clearly regionally clustered, as shown in the top panel, with the number of people per building being the highest in the East and Central Prussian provinces. The average household size was higher in Westpreußen and Posen. However, these were the least densely populated areas of Imperial Germany in 1880. Therefore, it is likely that more than one generation lived in one building. This suggests that the higher number of people per building reflects the agricultural character of these provinces, since in most rural families the whole family lived on a single farm.

Both the number of people per building and per household increased between 1871 and 1885 in the South and in the West. The number of people per household decreased in almost all provinces between 1885 and 1910. An exceptionally strong decrease in Bayern is most likely related to the changed nuptiality laws after 1900. Apart from the change in Bayern, household size decreased most in the Central Prussian provinces. These are the areas with the largest decline in fertility by 1910. Therefore, rather than considering urbanisation as a single factor, it appears to be a by-product of economic development and the decreasing importance of the primary sector. In sum, urbanisation does not seem a convincing primary explanation for the first demographic transition.

Institutions and Social Security

After the war, no more children. What a person earns the state takes away. We won't have another live child, I know that much.

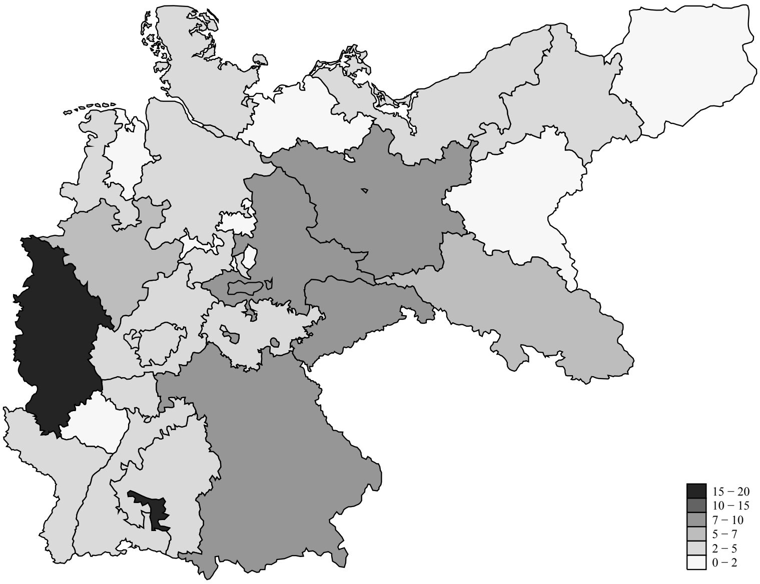
24-year-old painter's helper

The discussion in this chapter highlights that the influence of the traditional determinants of fertility on the fertility decline differs. When more closely examined, it is not the direct effects on fertility that appear to play the greatest role in shaping its decline. Instead, industrialisation is more likely to have had an impact through economic development and (female) labour force participation. However, there is another important aspect that we have not looked at so far: the influence of social security on births.

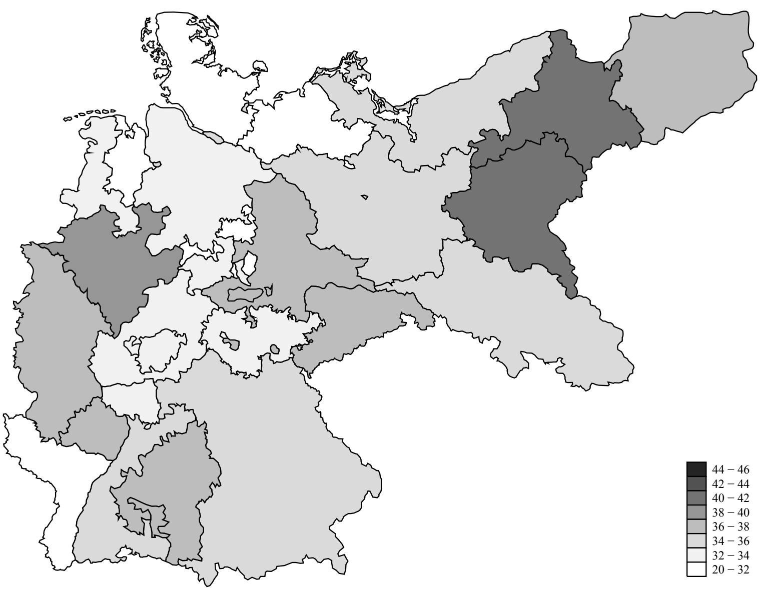
Research on the impact of institutions and social security is vast, even though it has not yet been discussed in depth in the context of the historical fertility transition (e.g. Guinnane 2011). Social security affects fertility indirectly, i.e. mainly by affecting the several determinants of the fertility decline that were discussed in this chapter. Social security tightened the household's budget constraint, possibly to the extent that if a household had to pay social security contributions they would reduce the number of children. However, the reduced investment uncertainty of paying contributions to a scheme guaranteed by the state also reduces the necessity of children as an old age provision and thus relaxed the budget constraint. In addition, the pension system increased the opportunity cost of having children in terms of forgone wage income, particularly for women. As a consequence, the individual decision to have children and making provision for old age are completely decoupled.

Figure 2.14: CMBR and localities larger than 20,000 inhabitants

Localities > 20,000 inhabitants 1880

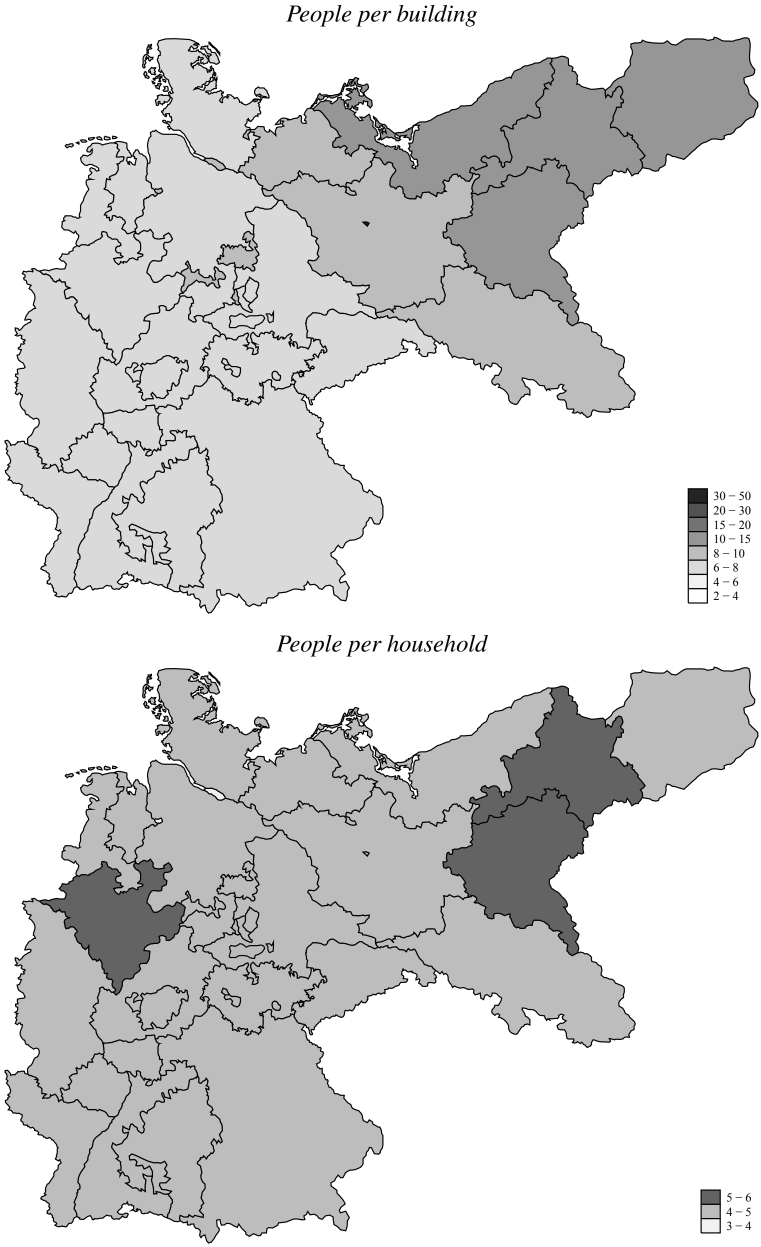


CMBR 1880



Source: Annual Yearbook of Statistics, Occupational Census.

Figure 2.15: Population density



Source: Annual Yearbook of Statistics, Occupational Census.

Social security was introduced during the 1880s. This is the time frame to which most research dates the onset of the first demographic transition in Germany. Social security affects a household's budget, the opportunity cost of working, and saving incentives. The introduction of social security can possibly also be considered an effect of industrialisation. Larger factories required better organised provision for workers. A growing involvement of the state lead spearheaded its task to provide welfare for the working class.

When we discuss the impact of social security, we always have to take into account the forces of industrialisation and economic development. When we accept that factors like the declining importance of the primary sector or the labour force participation of women are a consequence of industrialisation, the impact of social security cannot be ignored. How much importance should we assign to the social security system in shaping the first and possibly the second demographic transition? The next chapter provides an account of the pillars of social security, and in particular pension insurance, introduced in Imperial Germany in the 1880s and highlights the extent to which the state became involved in private decision-making.

To understand the effects of social security on fertility, we discuss the theoretical foundations of the effect of social security and pensions on fertility in chapter 4. Chapter 5 then provides a descriptive and multivariate analysis of the impact of social security on fertility in Imperial Germany.

Chapter 3

Bismarck's Pension System

I do not put my name on a law that exerts a burden on the worker.

Ich schreibe meinen Namen unter kein Gesetz, welches eine Belastung des Arbeiters enthält.

Allegedly claimed by Otto von Bismarck, German Chancellor.

3.1 The Introduction of Social Insurance

The time of the first demographic transition in Germany was also a time of growing involvement of the state in people's lives. Imperial Germany was the first European country that enacted an irreversible transition to a welfare state. The first steps towards a comprehensive welfare state had started decidedly earlier than is commonly believed.

Did the two transitions coincide or did one reinforce the other? Major changes in social policy are interrelated with cultural changes, and both are likely to have influenced fertility at that time. In order to find out how the introduction of comprehensive welfare may have triggered the demographic transition, it is necessary to understand key features of the Bismarckian welfare state and how this could have affected the individual incentive structure. This chapter provides an overview of the institutional changes in Imperial Germany with regard to social security. The next chapter assesses the incentive effects implied by these changes in the institutional structure.

The 1870s and 1880s were years of political turbulence and paved the way for comprehensive social insurance. The introduction of social insurance, and in particular pension insurance, is commonly considered a result of the government's efforts to deal with the popularity of social democratic trends (e.g. Ritter 1998; Wehler 2008).

However, Bismarck had to cope with constantly changing, and thus unstable, party constellations in order to form a majority in parliament prior to 1879 (Nipperdey 1993). Against this background, the introduction of social insurance should rather be considered a part of the endeavour to integrate diverging opinions from very different groups, including both the labour movement and the Catholic movement, possibly to strengthen the centralisation of powers in the new state (Haerendel 2001).[1] To this end, the debate about social security began at the right time.

Comprehensive social insurance was *not* mainly introduced to keep the working classes from sympathising with the social democrats. This party was suppressed by Bismarck's antisocialist law, the *Sozialistengesetz* (e.g. Haerendel 2001). However, the government apparently tried to deliberately convey this impression ex post, in particular during the first discussions on accident insurance in 1880/1881.

The road that the development of social insurance followed was too uneven a path as to be considered a result of strategic planning. Table 3.1 highlights that the legislative process was not a well-organised step-by-step approach with a concise schedule. As a result of different opinions in political camps and among lobby groups, those laws that were easiest to agree on between the groups were passed first.[2] Bismarck did not want to have anything to do with the process and planning on health insurance (Reidegeld 2006). Given that Bismarck was more involved in the development of health and accident insurance and hardly involved in the development of pension insurance (details are given below), the introduction of *comprehensive* social insurance can hardly be considered as a readily prepared plan to ensure the population's loyalty to the government already at the end of the 1870s.

Previously, the individual possibilities of providing for old age were limited. Old people had to rely on less demanding jobs and on the support from their families. However, to a certain extent, insurance against all types of risk (illness, old age, death, disability) existed and could be arranged privately or organised by companies or for example by miners' associations[3] and by the Chamber of Crafts. Thus, it is not surprising that the first ideas on a comprehensive pension insurance were brought forward to parliament by Carl-Ferdinand Stumm in 1878. Carl-Ferdinand Stumm was an entrepreneur, who was concerned about social peace. In the then common patriarchal tradition, Stumm believed that the employer was responsible for the well-being of their employees, but expected the employees to be absolutely loyal in return (Haerendel 2001).

The idea of enhancing loyalty by providing insurance appealed to Bismarck. He believed that statutory pension insurance could ensure the popu-

[1] In the end, health and pension insurance were built on the existing decentralised structures of local insurance schemes and therefore reinforced the decentralised structure, thus the latter argument lacks substance.

[2] For instance, the law on health insurance was passed before the law on accident insurance. This was rather a by-product of the legislative process on accident insurance (Haerendel 2001).

[3] The miners association insurance schemes can be seen as the main precursors for the statutory pension scheme in Imperial Germany. They foresaw compulsory insurance and the employers and employees sharing the burden of payments.

Table 3.1: Social insurance in Imperial Germany

Time	Type of decree	Place of discussion	Main points
March 1881	First draft on accident insurance	Reichstag	Aim: to complete the legislation protective against social democratic endeavors
17 November 1881	Imperial dispatch	Reichstag	Announcement of a programme for the establishment of insurance as regards the risks associated with accidents, illness, and old age, in particular for the working classes
15-16 May 1882	First consultation on health insurance	Reichstag	In connection with the first consultation on accident insurance
1882	Second white paper on accident insurance	Reichstag	Main difference to first white paper: less of a socialist tenor than in the first one; the government really wanted to push this white paper
19, 20, 21, 23, 24, 26, 27, 28, 30 April 1883	Second consultation on health insurance	Reichstag	
22, 23, 25, 26, 29 May 1883	Third consultation on health insurance	Reichstag	
31 Mai 1883	Vote on the final bill on health insurance	Reichstag	The law came into effect on 1 December 1884
15 June 1883	Announcement of the law on health insurance	Reichstag	
1884	Third white paper on accident insurance	Reichstag	
	First consultation on accident insurance white paper		White paper proposed by a committee of 28 members
	Second consultation on accident insurance based on the commission's report	Session 33-38 of the Reichstag	
	Third consultation on accident insurance	Session 43 of the Reichstag	Final vote on the bill
6 July 1884	Approval of final bill on accident insurance (third draft)	Reichstag	
22 November 1888	Final hearing on the law on old age and disability insurance	Reichstag	

Source: Reichsgesetzblatt, Ritter (1998b), Tennstedt and Winter (1994).

lation's loyalty to the government (Stolleis 1979; Tennstedt 1997). Bismarck had already elaborated on similar ideas in the 1860s (Tennstedt 1995), when the German Worker's Association (*Deutscher Arbeiterverein*) also discussed a comprehensive (old age and disability) insurance for workers in cooperation with employers and the state (Vogel 1951).

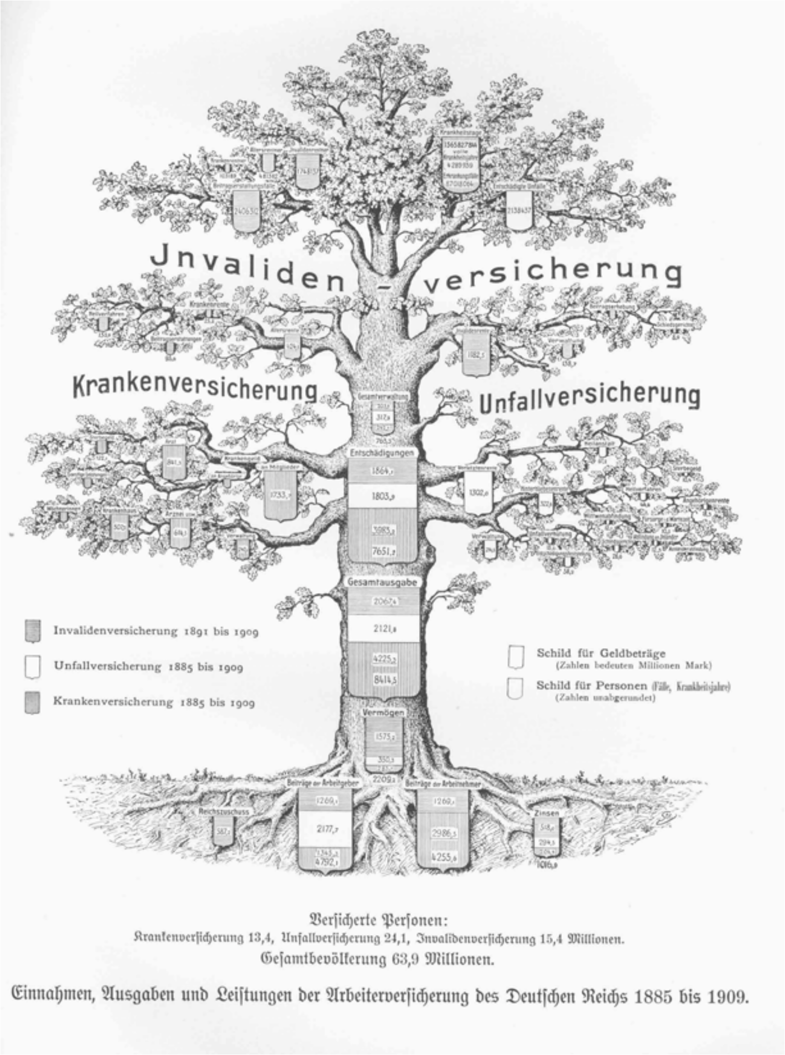
In early 1879, the parliament commissioned a report on the establishment of a compulsory disability and old-age pension scheme for factory workers (Machtan 1985). The initial plans to introduce comprehensive insurance for the working classes were then communicated in an Imperial dispatch in 1881. This triggered discussions among Imperial counsellors, the bureaucracy and representatives of the federal states on introducing health insurance.

The system of social insurance consisted of four pillars of social insurance (Wehler 2008): health insurance, accident insurance, pension insurance and unemployment insurance. The law on health insurance was passed in 1883 while the law on accident insurance was passed in 1884.

The law on the fully fledged statutory and compulsory old age and disability insurance was passed in 1889 and came into effect in 1891. This law was revised 10 years later in 1899. The changes came into effect in 1900. Following this, pension insurance for white collar workers was introduced in 1911. These first three pillars are illustrated in a contemporary exposition of the system of social insurance shown in figure 3.1. The unemployment insurance of 1927 can be considered as a follow-up on this tradition. Table 3.1 provides an overview of the different stages of the process.

Health insurance, introduced as a pay as you go system in 1883, was a by-product of the discussions on introducing accident insurance. Health insurance was compulsory for all workers with an annual income below 2,000 *Mark*. Workers had to pay 2/3 of contributions and employers had to pay 1/3. This means that during the first years, less than 10% of the population was covered by health insurance. Insured people could choose which doctor to consult and were entitled to free medical treatment. If a worker was unable to work because of illness, he received 50% of their wage as sick pay. However, the support was discontinued after 13 weeks. In the event of death, dependants received an allowance in the form of a death benefit. The administration of health insurance was built on the already existing system of cooperative local health insurance initiatives *(Hilfskassen)*. In addition, the government established autonomous local health insurance agencies *(Ortskrankenkassen)*. Some of today's health insurance providers in Germany can still be traced back to this system, e.g. the Allgemeine Ortskrankenkasse (AOK). Autonomy implied that the local health insurance agencies were responsible for the collection and administration of revenues.

Figure 3.1: Contemporary exposition of social insurace



Source: Reichsversicherungsamt (1910).

In contrast to the discussions on health insurance and pension insurance, Bismarck was strongly involved in the discussions on accident insurance. The industrialist Louis Baare first circulated a memorandum on turning employers' general liability insurance into a comprehensive accident insurance scheme in 1880 as a reaction to Carl-Friedrich Stumm's endeavours to promote a disability and old-age pension scheme. Bismarck adopted the idea relatively quickly.

Before accident insurance was introduced in 1884, a worker who had an accident at work had to prove that the employer was responsible for the accident. If the employer was deemed responsible, the worker could receive compensation from the employer's general liability insurance. The introduction of accident insurance can be considered a type of employers' liability insurance association, regulated by the government. In case of an accident, the insurance would pay the medical treatment or 2/3 of the workers' wage if they were unable to work for the rest of their lives. In the event of fatal occupational accidents, widows would receive 20% of their late husband's annual wage. Statutory accident insurance initially covered workers in factories, mining, and quarrying, but it was soon extended to also cover workers in forestry and farming.

When Bismarck adopted the idea of introducing statutory accident insurance for the working classes in approximately 1880/81, he also came up with the idea of providing pension insurance, which he had already developed earlier. The ideas on accident insurance surfaced at a time, when Bismarck aimed to reform the government's funding by introducing a new tax on tobacco that could provide additional revenues. These additional revenues had to be used particularly for comprehensive pension insurance (Haerendel 2001; Ritter 1998b; Tennstedt and Winter 1994).[4] His plan on a government monopoly on tobacco did not, however, survive the election campaigns of 1881. As a consequence, he communicated the idea of caring for the old and disabled in an Imperial dispatch in 1881, but did not put much effort into pursuing it.

The draft law on pension insurance, which the Ministry of the Interior presented in 1887, foresaw a funding scheme with contribution payments. This funding scheme was similar to the pay as you go funding in health insurance. Bismarck was not really involved in the design, as the envisaged system was too different from his idea of providing welfare for the poor.

The disability and old age pension system (hereafter: the pension system) was designed to pay a disability pension if the insured were unable to work

[4] Bismarck expected the population to oppose his plans, since the plans implied a major involvement of the state in private affairs. Bismarck expected less resistance if the working classes would not have to pay extra for insurance.

before they reached the age of 70 and to pay an old age pension for workers unable to work because of old age (Bismarck 1888). The difference between disability and old age pensions was only a question of definition. After 1900, every worker who reached the age of 65 was automatically classified as disabled. The artificial division of these conditions was abolished in 1923.

However, the pension level was different for old age and disability pensions. The conditions for the application for a specific type of pension were also different.[5] These conditions were more rigid for receiving an old age pension. If a worker reached the age of 70 and had paid contributions for 30 years, his pension application would automatically have to be approved. Hardly any insured people met these conditions, since life expectancy for a boy born in Prussia between 1865 and 1867 was 32.5 years (Marschalck 1984). The average life expectancy for a child born between 1881 and 1890 in Germany was 42.3 years (Marschalck 1984).

The conditions a worker had to meet in order to qualify for a disability pension were less clear and subject to interpretation. Any worker who was classified as disabled and had paid contributions for at least five years could receive a disability pension if he met the criteria. This fact and the decentralised organisation of the pension legislation (see appendix section 3.4) provoked substantial regional variation in the application of the pension system operated. Appendix D provides a detailed analysis of the variation in the interpretation of disability definitions.

Neither the disability pension nor the old age pension was designed as the only source of income, but as a supplement. A worker was expected to earn as much as he (physically) could. Note that disability insurance was introduced in addition to already existing health insurance.

Similar to the process leading to the first three pillars of social insurance in Imperial Germany, the road to comprehensive pension insurance was not smooth. The legislative process on pension insurance started with the Imperial dispatch in 1881, which was rather a signal of the state's intention to get involved in the population's concerns than a serious attempt to establish a pension insurance scheme. Haerendel (2001; 2000) is the most important source for the analysis of the legislative processes. Haerendel (2001) shows that Robert Bosse, department head in the Ministry of the Interior, and Erich von Woedtke, imperial first government Privy Councillor and council speaker at the Ministry of the Interior, started the main initiative to present a draft framework and supporting documentation for the introduction of pension insurance in 1887.

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[5] Appendix section 3.5 provides details on the differences in the pension level and in the conditions a worker had to meet to qualify for a specific type of pension.

Before the Bosse/Woedtke draft was published, representatives of the federal states had engaged in a lively discussion with Bosse, von Woedtke and other public officials from the Ministry of the Interior. The resulting draft was amended in the Prussian Economic Council and in the upper house of parliament and the final version was passed on to the lower house. The final 1889 bill strongly differed from Bismarck's original intentions. This final legal framework establishing the disability and old age insurance (*Invaliditäts- und Alterssicherungsgesetz*) was passed in 1889 and came into force in 1891.[6]

The administration of the pension system was decentralised. Regional authorities, the so-called Regional Insurance Agencies (Landesversicherungsanstalten), could autonomously decide on contribution rates and on the approval of pension claims. Section 3.4 provides a detailed discussion on the administrative areas and regional differences between the Regional Insurance Agencies.

The 1889 law was revised in 1899 and became the law on disability insurance (*Invalidenversicherungsgesetz*).[7] The change after only 10 years was remarkable, above all because the funding scheme of the system was replaced by a pure pay as you go system. At the time, social responsibility was a common topic in public discussions. Moving to a pay as you go system was perceived to be more 'socially just'.

Chapter 4 illustrates that the incentive effects in a funded system can differ substantially from the incentive effects in a pay as you go system. The effect on fertility is weaker in a funded system. To assess the impact of the pension system on fertility, it is pivotal to understand its characteristics. As the pension system was not purely funded for the first 10 years, it is often mistaken for a pay as you go system (e.g. Boeri et al. 2002).

The next section however shows that the pension system should be considered predominantly funded for the first ten years of its existence. We both classify the pension system after 1891 and the pension system after 1900 and give an account of other changes that were associated with the 1900 revision of the 1891 law.

3.2 Pension System Classification

The debate on the classification of pension systems is as long-standing as the debate on the introduction of pension systems. The problem in correctly classifying Bismarck's pension system is that contemporary observers used a different terminology from the terminology used today. This has led to

[6] RGBl 1889/13.
[7] RGBl 1899/33.

confusion and an inconsistent classification of the system in modern literature. This section first defines the terms used to classify a pension system at present and relate these to the terminology used at the end of the nineteenth and the beginning of the twentieth century. We classify Bismarck's pension system according to these definitions. The resulting division into a funded and a pay as you go period is important for assessing the pension system's effect on fertility in chapter 5.

3.2.1 Fully Funded versus Pay As You Go

The distinction between a *fully funded* and a *pay as you go* system is of particular importance, not only because of the different fertility incentives, but also because the pension system was changed from a fully funded to a pay as you go system in 1900. A pure fully funded system invests contributions in assets and thereby accumulates a capital stock. The return on these assets is used to finance pensions when they are claimed. A pure pay as you go system does not accumulate a capital stock, but finances current pensions from current contributions.

Typically, the pay as you go system is associated with temporary arrangements. This means that at the time of its introduction t=0 contributions in year $t = 0$ are used to pay pensions in year $t = 0$. The generation that reaches the retirement age in year $t = 0$, could not accumulate entitlement claims in $t = -1$, as the system was only introduced in $t = 0$. The resulting burden is then shifted forward to be carried by future generations, which exacerbates the problems that population ageing imposes on pay as you go systems (e.g. Börsch-Supan and Reil-Held 2001; Kifmann and Schindler 2001; Börsch-Supan and Schnabel 1998). These temporary arrangements for expenditures for pensioners at the introduction of a pension system lower the internal rate of return of the pay as you go system, and are a cause for the implicit tax in the contributions to such a system (e.g. Sinn 2000).[8]

Clearly, a (pure) pay as you go system redistributes resources between generations as soon as career paths and demographic variables change between generations, while a fully funded system does not.

Entitlement Coverage System versus Expenses Coverage System

Contemporary observers did not use the terms fully funded and pay as you go in the sense described above. Instead, they used the terms *entitlement coverage system, liability coverage system*, and *expenses coverage system* to describe the funding scheme of a pension system The systems discussed at the end of the nineteenth century were all based on current contributions fi-

[8] Chapter 4 discusses these issues in detail.

nancing current pensions, but they differed in the extent to which they were meant to accumulate a capital stock.

Assume for simplicity a population with only two generations, a young generation N_t^Y that works and an old generation N_t^P that receives a pension. The young generation contributes C_t to the pension system such that the current volume of contributions is $N_t^Y C_t$. In line with the above description of the pension system classification common at the end of the nineteenth century, assume that only a part of the contribution volume is needed to finance the current volume of pensions $N_t^P P_t$. Let this part be $N_t^Y c_t$. Thus, $N_t^Y s_t = N_t^Y C_t - N_t^Y c_t$ is saved in each period. Consequently, the system has accumulated reserves of $K_t = \sum_{j=1}^{t} \left(N_t^Y s_j R_j\right)$ in period t since period j, with $R_j = \prod_{k=t-j}^{k=1} (1 + r_k)$ for $t > j$ and with $R_j = 1$ for $t = j$ and r_k denoting the capital market rate of return. The following systems had been discussed before the introduction of the first pension system in Imperial Germany:

Entitlement coverage system (Anwartschaftsdeckungsverfahren):

In the entitlement coverage system, current pensions are financed by current contributions, but contributions and reserves must be sufficient to cover current pensions and all existing entitlements. In our simple setting with only two generations, an entitlement coverage system must fulfil the following condition:

$$K_t + c_t N_t^Y = P_t N_{t-1}^Y + \frac{1}{1 + r_{t+1}} P_{t+1} N_t^Y.$$

More generally, if there is more than one generation that accumulates future entitlements, the condition is

$$K_t + c_t N_t^Y = P_t N_{t-1}^Y + D_t,$$

with D_t denoting the present value of all entitlements earned until t. This implies that the system has to accumulate substantial reserves if the mass of entitlements is expected to increase. When the system is introduced, K_t is zero by definition, so for the system to fulfil the condition it needs a substantial (government) grant in the first period(s).

Liability coverage system (Verbindlichkeitsdeckungssystem,Rentenwertumlagesystem):

The liability coverage system only forsees the coverage of all current pensions. Existing entitlements to be paid in the future need not be covered. This requires a buffer fund that can at least finance current pensions even if the system is stripped of all current contributions. A liability coverage system must fulfil the following condition:

$$K_t + c_t N_t^Y = P_t N_{t-1}^Y.$$

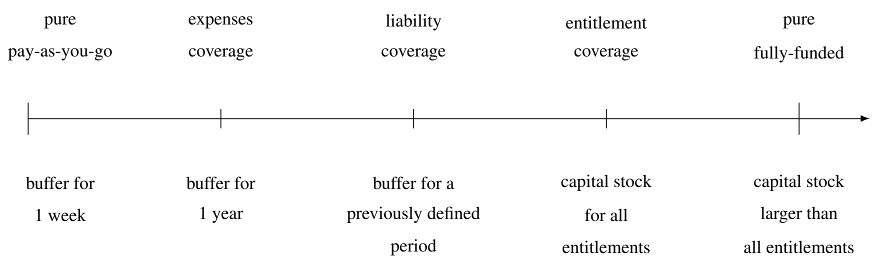
(Annual) expenses coverage system ((Jahres-) Aufwandsdeckungsverfahren):

The expenses coverage system is essentially a liability coverage system without or with only a small buffer fund.[9] Only current pensions have to be covered. If the system is stripped of current contributions, neither pensions nor liabilities in the form of future entitlements can be covered. An expenses coverage system must fulfil the following condition:

$$C_t N_t^Y = P_t N_{t-1}^Y.$$

Figure 3.2 illustrates that the entitlement coverage system, the liability coverage system, and the expenses coverage system only refer to the funding mechanism and can thus be classified according to the amount of capital reserves they accumulate.

Figure 3.2: Classification of pension systems



Premium System versus Average Premium System

Contemporary authors also characterised the 1889 system as a so-called *Premium System* (*Prämiensystem*), and the 1899 system as a so-called *Average Premium System* (*Durchschnittsprämiensystem*) (e.g. von Bortkiewicz 1909; Rosin 1914; Rosenstock 1934). The term premium system referred to the fact that contributions should be calculated like insurance premia.[10] According to Rosin (1914), after 1899 the average premium for each insured at all points in time could be calculated by dividing the present value of all liablities by the present value of all contributions. Therefore, he referred to the system as an average premium system. Unfortunately, even around 1890–1910, the terms

[9] The pension system that is in place in Germany today is an expenses coverage system. The buffer fund would be sufficient to cover only about a week of current pension payments.

[10] The statistical annex to the 1888 draft law indeed shows that policy makers had a standard actuary insurance system in mind. For example, the statistical annex shows that the calculation of contribution rates was based on the annual wage and on projections of the activity and disability rate in the groups of the population that were supposedly covered by pension insurance.

Entitlement Coverage System and Premium System were frequently mixed up (e.g. Rosin 1914).

Remarkably, even today, all of the above terms are used to describe Bismarck's pension system while sometimes the terms are used to describe a pay as you go system and sometimes to describe a fully funded system (e.g. Fait 1997; Manow 2000; Kaschke and Sniegs 2001). The most obvious explanation for this is that the organisation of the system did change during the first twenty years, which is often disregarded in the literature.

Classification of the 1889 System

... that the [pay as you go system], within which the burden rises gradually, can only be recommended where a certain solidarity of the present and future contributors justifies such a burden on their future. [... The workers] however can only be considered as generations, as the whole of their population living at the same time; in their case it is a merely personal burden, which has to be carried completely by the present generation and which cannot be transferred to the next one.

..., daß das [Umlageverfahren], bei welchem die Last allmählich steigt, nur da empfehlenswerth erscheint, wo eine gewisse Solidarität der jetzt und künftig beitragenden Personen eine derartige Beschwerung der Zukunft rechtfertigt. [... Die Arbeiter] kommen vielmehr nur als Generationen, als die Gesammtheit der gleichzeitig Lebenden in Frage; bei ihnen handelt es sich um eine rein persönliche Last, welche von den Lebenden selbst voll getragen werden muß und nicht füglich auf die Nachkommen gelegt werden kann.

Otto von Bismarck, Chancellor, in a speech on the draft law on old age and disability insurance, 1888

Source: Bismarck (1894), p. 611.

Bismarck himself, who clearly spoke in favour of the 1888 draft law in parliament, decidedly opposed introducing pension insurance as a pay as you go system. Every individual should bear the burden of providing for old age instead of shifting this burden on future generations. His view of population dynamics was more forward-looking than Adenauer's view mentioned in chapter 1. Bismarck considered a pay as you go system infeasible precisely because future generations could not be relied on.

The discussion between chancellor, the parliament, and the bureaucracy before the introduction of the pension system revealed that there was consensus on introducing an actuarially sound system that would insure people against the imponderable risks of life: disability and old age. The motive was clearly paternalistic (e.g. Tennstedt 1981).[11] However the system had to

[11] Fait's (1997) discussion on widow's and orphan's pensions within the accident insurance system illustrates the paternalistic attitude of the government nicely. Within accident insurance, widows and orphans should receive a pension if the head of the family suffered from reduced earnings capacity or died in the follow-up of an accident, but only if the marriage was concluded before the accident. Doubtlessly, a marriage that was concluded after the accident was

be implemented as a fair insurance.The notion of a pay as you go system in insurance was considered dubious up to the 1930s (Manow 2000).

Nevertheless, the 1889 pension system can neither be classified as pure fully funded nor as a pure pay as you go system. It accumulated a capital stock and expenses resulting from temporary arrangements were covered by a government grant. However, current pensions were partly funded by current contributions. As the system had more funded than pay as you go elements, it was an entitlement coverage system.

Lobby groups, such as employers who would be coerced to pay part of the contributions, favoured a pay as you go system. The main reason was evident: in a pay as you go system, contributions could be relatively low at the beginning and employers would face only a slowly rising volume of contributions (Sniegs 1998; Manow 2000). Interestingly, public officials in the Ministry of the Interior did not share this view. They complained that the employers' attitude proved their lack of solidarity and accused the employers of trying to shift the burden to future generations (Rosenstock 1934).

Finally, pensions were financed through current contributions and a government subsidy, but the system was supposed to accumulate enough reserves to cover all existing entitlements. Given the financial situation in Imperial Germany and its federal structures, the introduction of some pay as you go elements was hardly avoidable (Haerendel 2001). From 1877, Imperial Germany took up new debt every year, but had to pay surpluses from customs duties to the federal states. Bismarck's idea of a monopoly on tobacco failed. Thus, Imperial Germany did not have the financial leeway to finance pensions completely. In the end employers and employees paid 1/2 of the contributions and the government provided a fixed subsidy.

The capital stock to be accumulated had to be partly used to adjust the government subsidy to the system every year.[12] The capital stock had to be sufficient to cover the discounted value of $t+10$ years of pension entitlements.

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a marriage in order to legalise an immoral liaison. In the end, only children from such relationships were granted an orphan's pension, but not their mothers in order to punish the mothers for their previously immoral behaviour.

[12] The reserves had to be invested gilt-edged according to §§1807, 1808 of the German Civil Code. As a result, most resources were invested in real estate, i.e. houses for workers. In effect, the Regional Insurance Agencies became lenders for building loans at favourable conditions for the rural population. In general, safe investments were thought to be considerably more important than high returns. The Regional Insurance Agencies were however allowed to invest 1/4 of resources in riskier assets, i.e. mainly securities. Interestingly, the government forced the administration of the pension insurance to invest at least 1/4 of assets in government bonds before World War I. For investments in riskier assets the 13 Prussian and 6 non-Prussian insurance agencies subordinate to the Imperial Insurance agency had to consult the Imperial Insurance Agency. Guarantees for such investments had to be assumed by regional bodies.

This means that, although not being a fully funded in the pure sense (see figure 3.2), the system had more features of a fully funded system than of a pay as you go system. The law states that "the contribution in each category must be set such that the revenues in each category are sufficient to finance the burden that the insurance agency will presumably face on the basis of the estimated claims accruing from these contributions"[13]. In other words, the law calls for actuarially reasonable calculations of the contribution rate in each wage category. The 1891 system was an entitlement coverage system.

In 1899, the law on disability insurance was passed and a capital stock to cover existing entitlements was not required any longer. This law also changed the organisational structure.

Classification of the Pension System after the 1899 Amendment

A combination of financial difficulties of some Regional Insurance Agencies, the general fear of the government touching the system's capital reserves, and the general public campaigning for more solidarity in society led to a major revision of the law on pension insurance in 1899. The new law on disability insurance (*Invaliditätsversicherungsgesetz*) provided two main changes. First, it defined disability more broadly. Second, it defined the insurance system as a so-called Average Premium System (*Prämiendurchschnittsverfahren*). The Average Premium System was perceived as socially just, since it was widely believed that the state should treat all citizens equitably.

According to Manow (2000), it was commonly believed that this redesign brought the system closer to an entitlement coverage system. In effect, however, the system became a pay as you go system. At any given point in time contributions should be calculated such that they cover "the cash value of all pension expenses, of all contribution reimbursements, and of all other expenses of the insurance agencies."[14] In other words, contributions were used to finance pensions and other expenses, and were not required to sufficiently cover future claims. This effectively turned the pension system into a pay as you go system.

The 1899 law also changed the waiting period for receiving a pension, the categories based on which contributions were paid and it intensified the link between contributions and pensions.[15] The contribution rates were now set by the upper house of parliament. The 1899 law also provided a definition of disability that was more general than in the 1889 law and thus substantially facilitated the approval of disability pensions. Appendix C provides a detailed account of the definition of disability and how it was interpreted.

[13] RGBl 1889/13, §24.
[14] RGBl 1899/33, §20.
[15] These changes are discussed below.

Temporary Arrangements and Intergenerational Redistribution

Most pay as you go pension systems are characterised by an implicit tax in contributions that increases over time, not only because of population ageing. Often, the implicit tax in pension contributions is needed to finance the pensions for the first generation that received a pension without contributing (e.g. Lüdecke 1988; Sinn 1990. Cigno and Werding 2007 give a concise summary).

For example, after World War II pensions were paid immediately following the introduction of the new social security system. The cost for this had to and has to be paid by the following generations as an implicit tax in their contributions. Both the 1889 law on pension insurance and the 1899 revision provided for temporary arrangements.[16]

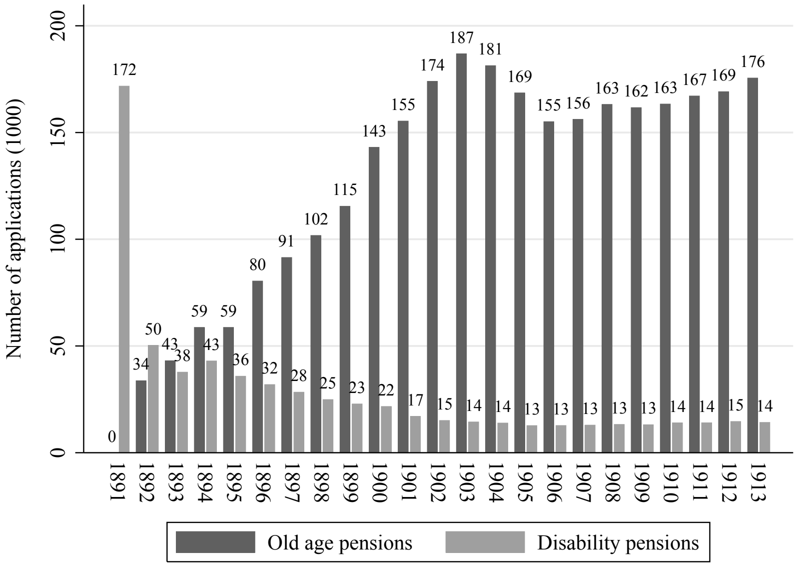
Disability pensions: Generally, a worker had to pay contributions for at least five years before they could receive a disability pension. However, insured people, who met the eligibility criteria for a disability pension within the first five years after the law came into force would only have to prove the payment of contributions for at least one year instead of five years. For workers, who had been working in a profession that would qualify for pension insurance during the five years preceding 1891, the waiting period could be reduced by the number of weeks they had been working in this profession. This means that the maximum reduction of the waiting period was five years, and that a disability pension could be paid immediately.

Old age pensions: To be eligible for an old age pension a worker had to prove contributions for at least 30 years. This implied that at the time when the law came into force, every worker over the age of 40 would not be able to accumulate sufficient claims to receive an old age pension even if they reached the age of 70. This is why the temporary arrangements reduced the waiting period of 30 years by the number of years by which the age of the worker exceeded the age of 40.[17] In addition, workers had to prove that they would have been eligible for insurance based on their occupation in 1888, 1889 and 1990 and that they had been employed in this occupation for at least 141 weeks.[18] As a consequence, the number of old age pension applications and accordingly the number of pensioners were extraordinarily high in 1891 (also see figure 3.3).

The number of old age pensioners was expected to be much larger in the earlier than in the later years because of the temporary arrangements (Verhandlungen des Reichstages 1888/89). As the state was supposed to pay a fixed amount of each pension, a part of the burden related to the temporary

[16] RGBl 1889/13, §§156–157 and RGBl 1899/33 , §§156–157.
[17] RGBl 1889/13, §157.
[18] RGBl 1889/13, §157.

Figure 3.3: Pension applications in Imperial Germany



Source: Data from Kaschke and Sniegs (2001).

arrangements was immediately borne by the taxpayer. Thus, the system did not exhibit an implicit tax in contributions due to initial pension payments.

The temporary arrangements may however have influenced regional variation in the pension system. The organisation of the pension system was decentralised. So-called Regional Insurance Agencies (*Landesversicherungsanstalten*) administered applications, the approval of applications, and the payment of pensions autonomously. Section 3.4 provides details on the administrative structure.

The Regional Insurance Agencies were supposed to carry their part of the burden of additional pensions without sufficient preceding contribution payments. But they could autonomously decide on the level of contributions for five-year periods and could even levy contributions differentiated by profession. Therefore, they were expected to levy contributions that were sufficient to cover the Regional Insurance Agencies' proportion of pension payments, the payments to accumulate a certain capital stock and a reserve fund to cover the potential refund of contributions.[19]

[19] This mainly referred to women who paid contributions when working and single, but who would not be eligible for a pension after their marriage. If they married, they could apply for a refund of their contributions.

However, the contributions for the first 10 years after the introduction of the pension system were set at the federal level. If a Regional Insurance Agency decided to set different contribution rates the approval of the Imperial Insurance Agency (*Reichsversicherungsamt*) would be required.[20]

3.2.2 Bismarckian versus Beveridgean

The lower the pensions the lower the contributions, [...]

Je niedriger die Renten, desto geringer sind auch die Beiträge, [...]

Otto von Bismarck, German Chancellor, in his speech on the introduction of pension insurance 1888 Source: Bismarck (1894), p. 606.

Do we mean a Bismarckian pension system when we talk about Bismarck's pension system? Today it is common to classify pension systems according to the incentive effects that the link between individual contributions and individual pensions provides (e.g. Cigno and Werding 2007). The two main types of linkages are termed after of their founding fathers.

A *Beveridgean* pension systems is named after William Beveridge whose report on Social Insurance and Allied Services (Beveridge 1942) became the basis for the reorganisation of social security in the United Kingdom. Therefore, Beveridge can be considered the intellectual father of the type of pension system that was introduced in the United Kingdom after World War II. The Beveridgean type of pension system links contributions to wages, but pensions are not linked to wages and possibly means-tested. This implies that replacement ratios decrease with income. As a consequence, a Beveridge system does not need individual accounts.

Table 3.2: Wage categories for pension contributions

Category	Average day labourer's annual wage (Mark)	
	1889 law	*1899 law*
I	up to 350	up to 350
II	350–550	350–550
III	550–850	550–850
IV	850–2000	850–1150
V		1150–2000

Source: RGBl 1889/13.
Note that category V was only introduced with the 1899 revision of the law.

[20] A much easier way to affect the financial situation that did not require the approval of the Imperial Insurance Agency was the interpretation of the eligibility criteria. As the eligibility criteria left enough room for interpretation, the Regional Insurance Agencies had some discretion as to whether they approved such a pension application.

A *Bismarckian* pension system links individual pensions directly to individual contributions. The level of the pension depends on individual lifetime contributions. This means that such a system needs individual accounts. According to the 1889 law[21], contributions had to be paid according to income, which was divided into four categories. The 1899 revision of the law introduced a new wage category V. Table 3.2 reproduces these categories, as mentioned in §22 of the 1889 and the 1899 law.

Note that only workers with an annual income below 2000 Mark were subject to compulsory insurance. Contributions, shown in table 3.3, and pension payments were based on the annual wage categories. In contrast to the 1888 draft, the 1889 law did not fix different contribution rates for men and women. Correspondingly, the pension level in the 1889 law did not differ for men and women.

The Regional Insurance Agencies issued self-adhesive stamps (so-called *Klebemarken*), which workers had to collect for later claiming their pensions. If an application was approved, the annual pension would then be based on the number of stamps and the contributions associated with them. The payment of a pension was bound to strict eligibility criteria. To be eligible for a disability pension, a worker had to prove that they were disabled and that he had paid contributions for at least five years.[22]

Table 3.3: Pension contributions according to wage categories

Category	Average day labourer's wage *(Mark)*	Weekly contrib. *(Pfennig)*
I	up to 1	12
II	from 1 to 1.40	14
III	from 1.40 to 1.80	20
IV	from 1.80 to 2.20	24
V	from 2.20	30

Source: RGBl 1889/13.
Note that category V was only introduced with the 1899 revision of the law.

Such a form of means-testing was not necessary for receiving an old-age pension. Workers were eligible after their 70th birthday if they had paid contributions for at least 30 years.[23] Certain exceptions could justify an old-age pension payment before the 70th birthday. As only few workers reached the age of 70, and the disability pension was by far the more important pension,

[21] RGBl 1889/13.
[22] Appendix C gives an analysis of the definition of disability.
[23] RGBl 1889/13. A full year equivalent of contributions was 47 weekly stamps.

the system was effectively means-tested. However, the pension level was linked to contributions, i.e. based on individual accounts. Thus Bismarck's pension system can indeed be considered a Bismarckian pension system in the sense in which we use this term today.

Often, the Bismarckian system is referred to as the Continental model or social insurance model and the Beveridgean system is referred to as the Anglo-Saxon model or social security model. Note that a Beveridgean pension system involves substantial redistribution within a generation, while a pure Bismarckian pension system does not.

3.2.3 Defined Benefit (DB) versus Defined Contribution (DC)

Pay as you go systems rely on the contributions of future generations and therefore cannot guarantee a fixed relationship between contributions and pensions. It rather depends on the proportion of contributors relative to pensioners in each time period.

A pay as you go system can either be a *defined benefit (DB)* system, in which contributions are adjusted to maintain a certain benefit level, or a *defined contribution (DC)* system, in which the contribution level is maintained and the pension level is adjusted accordingly (e.g. Barr 1993; OECD Working Party on Private Pensions 2005). Funded private pension schemes, mainly offered by employers, are also often organised as DB plans. This means that the investment risk with regard to individual contributions is pooled and, if necessary, borne by the employer.

It is not as easy to classify the pension systems discussed in section 3.2.1 with regard to redistribution within a generation. Every system presented in figure 3.2 can either be DB or DC. Even a fully funded scheme can redistribute within a generation. If the contributions are calculated as fair insurance premia, an individual's contribution is directly related to their pension. As soon as the insurance raises some form of average premium that is not associated with individual characteristics and thus the individual risk, it contains redistributive elements (e.g. Sinn 1996, 1997). For example, if contributions are only levied according to income categories, there is redistribution within each category. The case is even stronger for contributions dependent on income in connection with a Beveridgean scheme, i.e. flat-rate pensions.

According to the 1889 law, every autonomously operating Regional Insurance Agency could in principle decide on the level of contributions in each category for a period of five years. The introduction of the Imperial Insurance Code (*Reichsversicherungsordnung*) in 1912 changed the contribution level in each category. As the system was flexible in adjusting contributions, we can consider the system a DC system after 1900.

3.3 The Impact of Pension Insurance

Nowadays, if people think about having children, they do not think about their pension. Provision for old age and having children have been completely decoupled. Did this happen immediately when public pensions were introduced? At the end of the nineteenth century, pensions were meant as a supplement to paid work. So would they really make a difference that would induce people to adjust their behaviour?

The average annual old age pension in 1892 ranged from 111.41 Mark in Ostpreußen to 159.58 Mark in Hansestädte. The average disability pension in 1892 ranged from 112.82 Mark in Ostpreußen to 117.84 Mark in Bayern.

Pensions consisted of a lump-sum annual payment and a variable component based on the number of stamps that a worker had collected. Section 3.5 provides details. To prove this, all insured people had their personal book of receipts, in which they had collected their stamps, to prove their claim. As the pension level was more or less set at the federal level for the first 10 years, the variation in the pension level was not substantial.

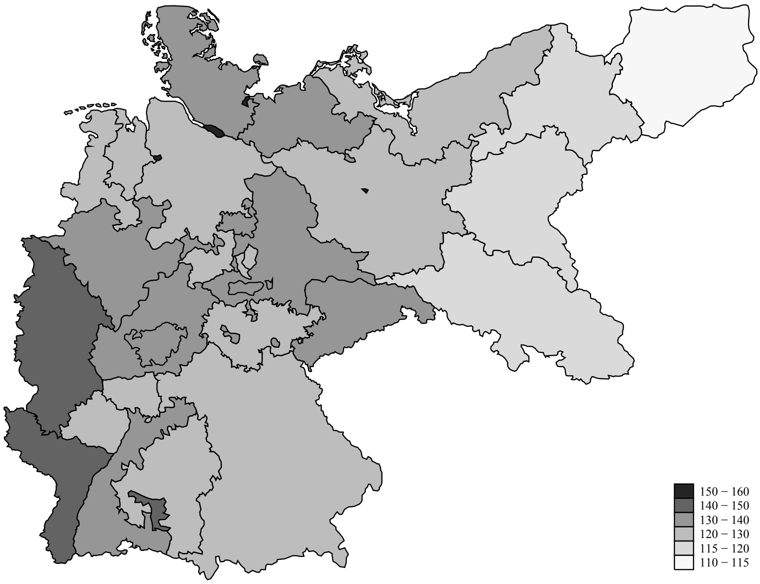
Even though the variation in the pension level was not substantial, its regional distribution deserves some attention. Kaschke and Sniegs (2001) claim that the old age pension was higher than the disability pension during the first years, as the increase in rates was higher for old age pensions. This is, however, only true on average.

Figure 3.4 shows the regional distribution of the old age pension level in 1892 in the top panel and the regional distribution of the disability pension level in 1892 in the bottom panel. It seems that the disability pension level was indeed very similar across all provinces, while the old age pension level is clearly higher in the western regions. However, the old age pension level was not universally higher than the disability pension level. The old age pension level in Ostpreußen was lower than the disability pension level in the South and the West.

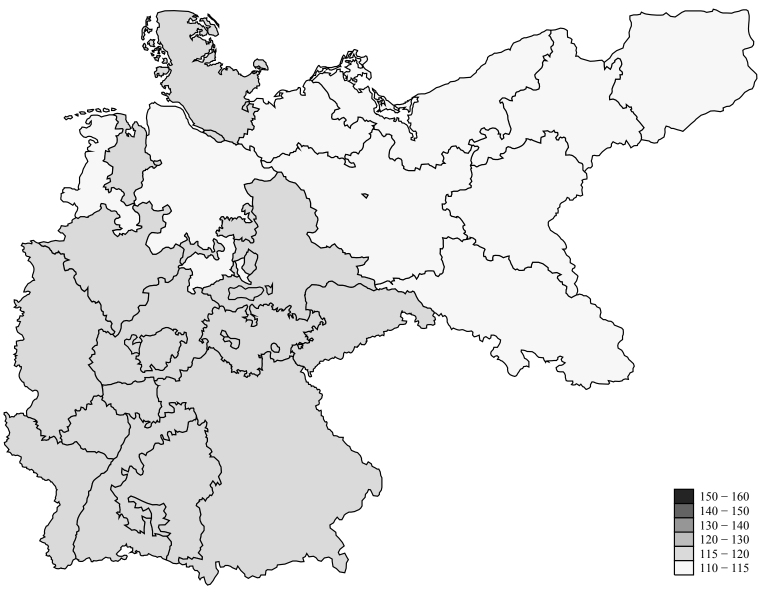
Figure 3.5 shows the difference between average old age pension and average disability pension. A negative difference indicates a disability pension that is higher than the old age pension. The disability pension was only higher than the old age pension in the province with the lowest absolute pension level, in Ostpreußen. In addition, the old age pension level did not exceed the disability pension level in the rural areas (the East Prussian provinces and Bayern) like it did in the central Prussian provinces and the West. It is thus more likely that the pension level and the relation between old age and disability pension were related to the insurance agencies code of practice rather than to differences in the rate of increase. Appendix D provides a detailed analysis of these differences.

Figure 3.4: The pension level in 1892

Old age pension

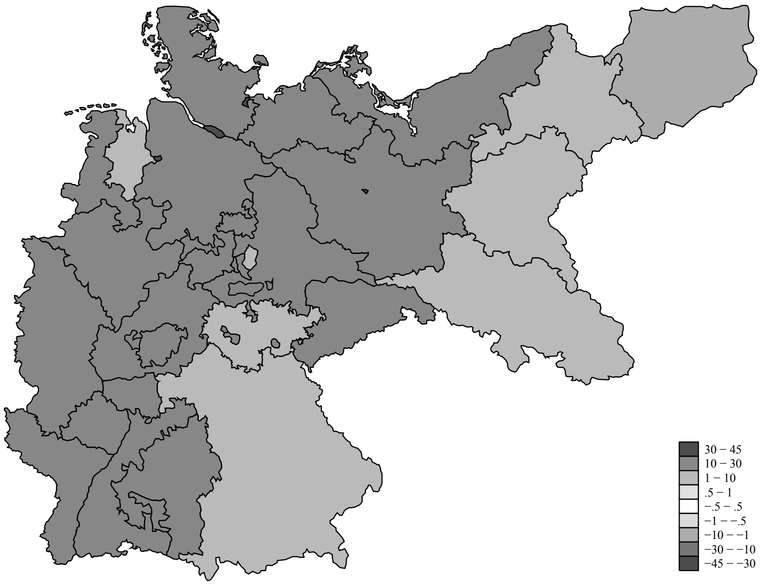


Disability pension



Source: Data from Kaschke and Sniegs (2001).

Figure 3.5: Difference between average old age and disability pension level 1892



Data from Kaschke and Sniegs (2001).

Relating the pension level to the average earnings of a worker helps to provide a context for the impact of the pension system on people's lives. An important source for comparing workers' wages in different sectors is Grumbach and König (1957). Between 1888 and 1913 wages grew on average 2% annually (Grumbach and König 1957). Wages were the highest in mining and the lowest in the textile industries. Grumbach and König however do not provide absolute wage levels, which makes a comparison with average pensions difficult. In particular, it is difficult to find regional data on workers' wages. Lotz (1905) provides some information on regional variation in the wage level in public railway services. Table 3.4 compares this information to average pensions in the regions for which wage information is available.

The wage level for supervision and track maintenance largely corresponds to the average wage level in industry and handcraft (Hoffmann et al. 1965). The average old age pension in Imperial Germany was 21.88% of the average annual wage in supervision and maintenance. The average disability pension in Imperial Germany was 21.36% of the average annual wage in supervision and maintenance.

The average old age pension in Baden was 18.81% of the annual wage in supervision and maintenance and the average disability pension in Baden was 18.49% in supervision and maintenance. Following 30 to 50 years of contribution, this fraction could increase to approximately half of a worker's wage in category I and to approximately 40% of a worker's wage in category III.[24]

It is unlikely that a worker could rely only on such a pension for a living. As a consequence, most pensioners had to continue working – as intended by policy makers. Nevertheless, the assistance which pension insurance provided if a worker was unable to work was still considerable. This means that an insured worker would be less dependent on financial assistance from relatives. Having different wage categories even introduced a form of equivalence principle, i.e. pensions in relation to wages, but the pension insurance socialised some of the risks associated with disability and old age as contributions were averaged within each wage category. In addition, the government subsidy for a basic pension was a first form of redistribution of resources to the poor.

When the parliament discussed the first drafts on pension insurance it was clear that pensions would be a supplement to paid work. Every person, regardless of age, was supposed to work to earn a living to the extent that he could. In addition, the disabled, resultant from difficult working conditions, bad health, or age, would also be expected to earn as much as they could. Introducing supplementary benefits by the state was explicitly meant to make workers independent of the mercy of their children.[25] Thus, even if the pension level was low in relation to today's standard, it was a perfect substitute for financial support from grown-up children. Therefore, it is likely that this also had an effect on the individual decision to have children.

In addition to this pure investment decision, the pension system also affected work incentives. Economic theory provides a reliable framework to illustrate the income and substitution effects that accompany social security contributions and coverage. The next chapter provides such a framework for formulating the hypotheses that we test in chapter 5.

3.4 Regional Insurance Agencies

The pension system was administered in a decentralised way. This means that Regional Insurance Agencies operated autonomously in the provinces and reported to the Imperial Insurance Agency. The Imperial Insurance Agency

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[24] Also refer to Reichsversicherungsamt (1910).

[25] This means that if children became less and less committed to their responsibility for the wellbeing of their parents, the state should not leave the fate of the old and disabled in the hands of irresponsible children. Sinn (2004b) formalises that a pay as you go pension system can work as an enforcement device for such irresponsible children.

Table 3.4: Average annual wages in railway services and average pensions in 1903 (Mark)

	Administrative service	Supervision and track mainte-nance	Train station services and train services	Train mainte-nance	Average dis-ability pension	Average old age pension
Imperial Germany	1155	705	1068	1197	150.57	154.22
Preußen/Hessen	1041	709	1007	1127	153.87	161.66
Bayern	1264	758	1006	1079	147.33	150.2
Sachsen	1129	761	1008	1264	149.22	154.04
Württemberg	1069	750	962	1147	153.55	162.16
Baden	1332	834	1141	1156	154.2	156.88

The average pension level for Preußen/Hessen is the Hessen average.

was located in Berlin and was established on July 14, 1884 together with the health care system (Reichsversicherungsamt 1910). It supervised health insurance, accident insurance, and pension insurance, and was the highest authority of social insurance. It was only subordinate to the chancellor, i.e. the Ministry of the Interior. The Imperial Insurance Agency was both responsible for the administration of e.g. the federal buffer fund, and had the authority to arbitrate in procedures relating to pension applications. Ostensibly, the board of the Imperial Insurance Agency also consisted of representatives of the insured.

In the northern provinces, Regional Insurance Agencies would report to the Imperial Insurance Agency, which would in turn report to the Ministry of the Interior. The southern Regional Insurance Agencies directly reported to the Ministry of the Interior.[26] The 1889 law on pension insurance established the formation of 31 Regional Insurance Agencies as the executive bodies of the pension system. This regional division into areas of administration was closely related to division of Imperial Germany into provinces (Gladen 1974). Figure 3.6 shows the administrative areas of the Regional Insurance Agencies in 1911.

The insurance agencies were classified as either rural, industrial, or mixed (e.g. Kaschke and Sniegs 2001). This classification is shown in table 3.5. Ten additional, but much smaller insurance agencies were in charge of administering the insurance scheme for employees in shipping, railways and insurance for miners (Frerich and Frey 1996).

[26] The 1912 Imperial Insurance Code stated very clearly that the insurance agencies in Baden, Bayern, Großherzogtum Hessen, Sachsen, and Württemberg assumed the responsibilities of the Imperial Insurance Agency in the Southern regions (Reichsversicherungsordnung 1912).

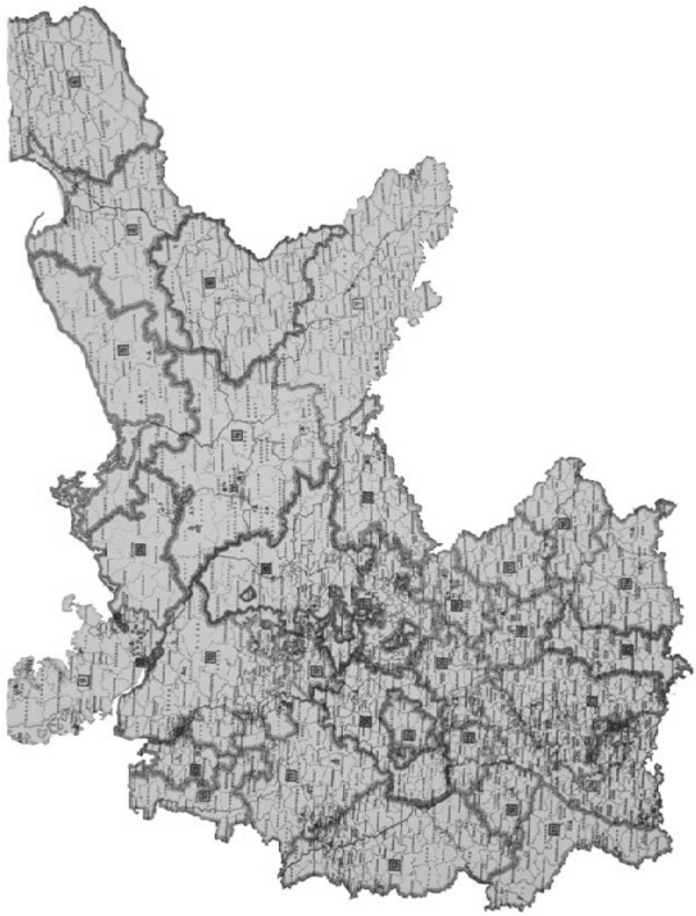
Table 3.5: Classification of regional insurance agencies

(1) Rural	(2) Industrial	(3) Mixed
Ostpreußen	Westfalen	Brandenburg
Westpreußen	Rheinprovinz	Schlesien
Posen	Pfalz	Sachsen-Anhalt
Pommern	Mittelfranken	Schleswig-Holstein
Niederbayern	Sachsen	Hannover
Oberpfalz	Thüringen	Hessen-Nassau
Unterfranken		Oberbayern
Schwaben		Oberfranken
Mecklenburg		Württemberg
Oldenburg		Baden
		Hessen
		Braunschweig
10	6	12

Source: Kaschke and Sniegs (2001)

Variation in the structure of industry and therefore the composition of the population insured caused variation in revenues from contributions and the total amount of pension payments. The Ministry of the Interior and the Imperial Insurance Agency took note of this as early as 1895. As a consequence, the bureaucracy discussed the introduction of a financial equalisation scheme between the Regional Insurance Agencies. The financial equalisation scheme was introduced with the changed law on the disability insurance in 1899, and is still an element of Germany's social insurance today.

Figure 3.6: Jurisdictions of the regional insurance agencies 1911



Source: Statistisches Landesamt Bayern (2010).

3.5 Details on Pensions

Pensions were paid in monthly instalments. Both pensions consisted of a fixed annual amount. The fixed annual amount was equivalent to the federal subsidy of 50 Mark for the old age pension and equivalent to the sum of the federal subsidy of 50 Mark and an additional 60 Mark for the disability pension.[27]

A pension consisted of this flat-rate payment and a specific amount that the insurance institution would top up depending on the category in which stamps were collected. The insurance system recognised up to a 1,410 weeks equivalent of stamps to calculate the pension. For each completed week of contributions, the pension increased by the factor displayed in table 3.6.

Table 3.6: Pension increase (1889)

Category	Old-age pension *Pfennige*	Disability pension *Pfennige*
I	4	2
II	6	6
III	8	9
IV	10	13

Source: RGBl 1889/13.

In order to receive a pension, a worker had to apply for it with the local lower administrative authority and prove that they met the eligibility criteria. The approval procedure consisted of three steps. First, the insured had to provide the necessary documentation. The application could then be immediately denied or approved. The insured received an official notification. Second, if the insured did not agree with the officially set pension level or with the denial of an application, they could appeal. An arbitration body was responsible for the decision on the appeal. Third, both parties, i.e. the insurance agency and the insured, could file for appeal on the arbitration body's decision. The Imperial Insurance Agency had to decide on this appeal. Importantly, if a pension application was finally denied, the applicant had to wait for at least another year to be allowed to apply again, unless they could prove a change in circumstances.

[27] In the following, also for table 3.6, refer to RGBl 1889/13.

Chapter 4

From the Social Security Hypothesis to Pensions and Fertility

When it comes to social welfare for those classes of society of small means, Germany is leading in the world and will be unequalled at all times in the future.

In der sozialen Fürsorge des Staates für die minderbemittelten Volksklassen steht Deutschland an erster Stelle und für alle Zukunft unerreicht in der Welt.

German leaflet, around 1913
Source: Ansichtskartencenter (2011).

4.1 The Social Security Hypothesis and Fertility

It is clear that people have children to provide for old age (e.g. Leibenstein 1957; Neher 1971; Nugent 1985; Cigno 1993). If the state assumed the provisioning for old age, it would be rather surprising if this did not affect fertility. The primary motive for having children was replaced gradually by the state's responsibility to provide for its citizens with public pension schemes.

In Imperial Germany these developments were initiated in 1891 when the first comprehensive statutory public pension system came into effect, at exactly the same time as the first demographic transition. Among all explanations for both the first and the second demographic transitions, institutional factors have received little attention. This is astounding, since institutions – above all social security – are often accused of having too large an influence on people's lives. And it may be more than a mere coincidence that social security was introduced in Imperial Germany just when the decline in fertility hit the hardest.

Why was this link ignored for such a long time? Considering the abundance of factors that influenced the fertility decline, it appears reasonably plausible that the link between social security and individual behaviour only became clear gradually (as discussed in chapter 2). In addition, the link between social security contributions or benefits and individual consumption opportunities is relatively direct, while the link between the pension system and fertility runs through more than just one channel.

Only towards the mid-twentieth century did the impact of social security on individual behaviour become an issue, initially in social science research and laer in economics. The so-called *social security hypothesis* is therefore a relatively old concept in economics. It proclaims a significant effect of social security on individual behaviour. Early research mainly concentrated on labour supply, life-cycle saving, and retirement decisions. Accepting this influence also paved the way for looking at other aspects apart from saving and retirement behaviour.

Feldstein (1974) is the seminal work, analysing the effect of social security on retirement decisions and saving. Feldstein finds that saving through the social security system dampens private saving substantially and interprets this as a confirmation of the life-cycle hypothesis. Wilcox (1989) comes to similar conclusions through his evidence that changes in social security benefits affect aggregate spending. The debate triggered a series of follow-up research on the life cycle hypothesis, international differences, and econometric issues (e.g. Feldstein 1976; Feldstein and Pellechio 1979; Hayashi 1982; Leimer and Lesnoy 1982; Hubbard and Judd 1987; Wilcox 1989; Leimer and Richardson 1992; Euwals 2000; Feldstein and Liebman 2002; Attanasio and Brugiavini 2003).

Social security contributions and social security benefits affect disposable income, and thereby life-cycle consumption smoothing. If they affect disposable income, and are moreover linked to labour income, it is natural to assume that the labour supply decision is affected as well. The effect of taxes on the labour/leisure choice has already received extensive treatment in Becker (1965). The strand of literature that links social security to labour supply treats social security contributions like a tax on labour, which consequently also causes distortions similar to taxes on labour (e.g. Burkhauser and Turner 1978; Parker 1999). The labour supply effects of social security contributions have secondary effects on the pension level in any Bismarckian type pension scheme (e.g. Boskin and Hurd 1978; Crawford and Lilien 1981; Börsch-Supan and Schnabel 1998).

Establishing this connection is not far from establishing a connection between the effects of statutory pension insurance and fertility. We have seen in chapter 2 that fertility is affected by disposable income, and also by female labour supply if having children and working are two mutually exclusive options. The pension system also affects both disposable income and labour supply, as we will see below. Nevertheless, it took some time until this connection received more attention. One reason might be that early research on institutions and fertility was mainly pursued in the social sciences, and mostly related to development issues (e.g. Hohm 1975; McNicoll 1980; Smith 1989).

Hohm (1975) provides a first assessment of existing literature on how social security leads to decreased fertility and puts the theories to test using cross-country data mostly from the UN and the ILO. Hohm finds a negative relationship between institutions and fertility confirmed by the data and claims that long-term security is less important than short-term programmes. He concludes that social security programmes could be considered as a means to bring down fertility where desired, in particular with a view of developing countries facing large population growth. An interesting unexpected result of this literature is that it focuses extensively on cultural explanations for the decline in fertility. The impact of institutions is thus not viewed in the light of changing economic incentives, but changing cultural habits.

Recent literature has then finally taken up the link between the public pension system and fertility. As the pension system affects economic incentives, these economic incentives should ultimately also affect fertility. In the economic models, investment theories of fertility are combined with consumption theories of fertility (e.g. Becker 1960, see also chapter 2) and augmented by public pension system dynamics. Cigno (1993) first developed an overlapping generations (OLG) model to analyse fertility. Cigno and Rosati (1996) and Sinn (2004b) consider the joint decision of fertility and saving in an OLG model. The focus of these analyses is whether an additional investment opportunity, i.e. a statutory pension system, results in a crowding out of children as an investment for old age provisioning. Such an effect is even illustrated empirically (e.g. Cigno and Rosati 1992; Cigno et al. 2003).

To gauge the effects associated with such a massive change to the institutional framework, we use a simple model to illustrate them. The rest of this chapter models the influence of public pensions on fertility. The model assists in developing the hypotheses for the empirical analysis in chapter 5.

4.2 Pensions and Fertility in a Simple Model

In order to distinguish between the effects of a pension system on fertility, we focus on the investment motives for having children, but also allow for an intrinsic (consumption) motive for having children. In line with Cigno (1993), Sinn (2004b) and Fenge and Meier (2005), we use an overlapping generations (OLG) model. Our notation corresponds to a modified version of the Fenge and Meier model in Fenge and Scheubel (2013). In line with Fenge and Meier (2005) we do not consider the decision to invest in children's education, although this decision is also affected by the existence of pension insurance (e.g. Meier and Wrede 2010). The model assists to illustrate mainly the income and substitution effects of a compulsory pension system, both for the fully funded and the pay as you go scenario. It is tailored to fit the situation in Imperial Germany: individuals have children for intrinsic motives, but also for old age provisioning, since children provide intra-family transfers. The model also allows for private saving and then introduces compulsory investment in a public pension scheme.

Individuals live for three periods: as children, as adults, and when they are old. We consider the decision of an adult on the number of children n_t and savings s_t in period t. The utility of the adult depends on consumption c_t in the second and z_{t+1} in the third period and on the individual number of children n_t. Note that fertility also enters the utility function, having children is thus also induced by a consumption motive. Every individual participates in their parents' consumption in the first period. The utility function $U(c_t, z_{t+1}, n_t)$ is increasing in all three arguments, strictly concave and additively separable: $U_{cz} = U_{cn} = U_{zn} = 0$.

In the adult stage of life, each individual can work and earn wage w_t. Children reduce the time available for labour by $f(n_t)$.[1] Normalising total time to unity, the working time is given by $1 - f(n_t)$ with $f'(n_t) > 0$ and $f''(n_t) \geq 0$. If an individual has a child, he also has to incur the cost $\pi_t(n_t)$, which covers the cost of raising the child, such as the child's consumption.

Assume first that in old age the individual can only receive income from two sources: a transfer B from the grown-up children and a pension p from the statutory pension system. Each grown-up child pays a transfer B_t to the parents. Then, the individual is forced to pay contributions at the rate τ into the pension system. We assume this contribution rate to be constant. Again, as every individual participates in their parents' consumption in $t-1$, consumption in t is equal to:

$$c_t = w_t(1 - f(n_t))(1 - \tau) - s_t - \pi_t n_t - B_t. \tag{4.1}$$

Consumption in period t is equal to disposable income net of savings, the direct cost of children and the transfer to the parents.

Consumption in $t+1$, z_{t+1}, consists of the statutory pension p_{t+1}, the returns on savings with interest factor $1 + r_{t+1} = R_{t+1}$, and the intra-family transfer B_{t+1}. The budget constraint in $t+1$ thus reads:

$$z_{t+1} = p_{t+1}(n_t) + R_{t+1}s_t + B_{t+1}n_t. \tag{4.2}$$

Note that $p_{t+1}(n_t)$ holds for a pay as you go system, but not for a fully funded system. In a pay as you go system with a constant contribution rate,

[1] Note that this assumption can be relaxed. It does, however, correspond to the fact that at the time when the pension system was introduced, unmarried women were supposed to be working, while married women were still supposed to stay at home and care for the children.

the pension level depends on contributions in $t+1$, and these in turn depend on the number of children n_t in t.

Since the wage rate and the contribution rate are identical for all households we may write the pension level as

$$p_{t+1}^{FF} = R_{t+1}\tau w_t(1-f(n_t)) \tag{4.3}$$

for the fully funded scenario or

$$p_{t+1}^{PAYG} = \tau w_{t+1}(1-f(\overline{n_{t+1}}))\overline{n_t}\frac{1-f(n_t)}{1-f(\overline{n_t})} \tag{4.4}$$

for the pay as you go case. Note that in the fully funded system individual pensions are directly linked to individual contributions. There is neither intergenerational nor intragenerational redistribution. This matches the situation between 1891 and 1899. Individual pensions were directly linked to individual contributions. After 1899, people would still collect the stamps they could claim the pension with. Thus there was a relation between income and pensions. However, the pension level now also depended on contributions, since the funding of current pensions was related to contributions. This means that only after 1899 we would classify the system as a typical Bismarckian pension system.

If the pension is of the Bismarckian type, the individual Bismarckian pension is identical to the average pension weighted by an individual factor, which relates the individual pension contribution payment of a household of generation t to the generation's average. In contrast to the Beveridgean pension, the Bismarckian pension comprises no intragenerational redistribution. If the individual contribution, $\tau w_t(1-f(n_t))$, is above the average contribution $\tau w_t(1-f(\overline{n_t}))$, the individual pension, p_{t+1}, is higher than the average pension $(1+\overline{n_{t+1}})\tau w_{t+1}(1-f(\overline{n_{t+1}}))$. The factor by which individual contributions and individual pensions are linked is called the Bismarck factor, $\frac{1-f(n_t)}{1-f(\overline{n_t})}$. If the pay as you go pension is of the Beveridgean type the Bismarck factor is identical to unity.

A higher number of children reduce pension claims both in the fully funded case and in the pay as you go case. In both cases, pension claims are earned by contributions from paid work and children reduce the time available for paid work. In the case of a fully funded pension another child reduces the pension proportional to the interest factor:

$$\frac{\partial p_{t+1}^{FF}}{\partial n_t} = -\tau w_t f'(n_t)R_{t+1} < 0.^2 \tag{4.5}$$

---

[2] Note that a Beveridgean pension is not affected by fertility: $\frac{\partial p_{t+1}^{BEV}}{\partial n_t} = 0$.

Similarly, a higher number of children reduces the pay as you go pension claims proportional to the internal rate of return of the pension system:

$$\text{(4.6)}\quad \frac{\partial p_{t+1}^{PAYG}}{\partial n_t} = -(1+\overline{n_{t+1}})\tau w_{t+1} f'(n_t) \frac{1-f(\overline{n_{t+1}})}{1-f(\overline{n_t})} = -\tau w_t f'(n_t)\Omega_{t+1} < 0,$$

with Ω denoting the internal rate of return of the pension system, $\Omega_{t+1} \equiv \frac{p_{t+1}}{\tau w_t(1-f(n_t))}$.[3]

The individual determines the number of children and the amount of savings by maximising utility subject to the budget constraints (4.1) and (4.2). Substituting these constraints for the consumption variables in the utility function results in a maximisation problem of a function depending on n_t and s_t:

$$\text{(4.7)}\quad \max_{n,s_t} V(n_t, s_t) = U(w_t(1-f(n_t))(1-\tau) - s_t - \pi n_t - B_t,\ p_{t+1}(n_t) + R_{t+1}s_t + B_{t+1}n_t, n_t).$$

4.3 Model Implications for the Introduction of the Pension System

The following analysis provides a condensed version of the discussion in Fenge and Scheubel (2013). Here we focus on comparative statics with regard to the effects of introducing a fully funded system as opposed to a pay as you go Bismarckian system if there is additional access to capital market saving.

The first-order conditions of the maximisation problem in equation (4.7) are:

$$\text{(4.8)}\quad V_n = -U_c((1-\tau)w_t f'(n_t) + \pi_t) + U_z\left(\frac{\partial p_{t+1}}{\partial n_t} + B_{t+1}\right) + U_n = 0$$

and

$$\text{(4.9)}\quad V_s = -U_c + U_z R_{t+1} = 0,$$

Note that the second term in equation (4.8) is reduced by $U_z \frac{\partial p_{t+1}}{\partial n_t}$ for the fully funded scenario. The second-order conditions for a maximum are satisfied (see Fenge and Scheubel 2013).

[3] Note that in the case of constant contribution rates this is equal to the payroll growth factor: $\Omega_{t+1} = (1+\overline{n_{t+1}})\frac{w_{t+1}}{w_t}\frac{1-f(\overline{n_{t+1}})}{1-f(\overline{n_t})}$. We assume the Aaron condition (Aaron 1966) to hold, i.e. $R_{t+1} > \Omega_{t+1}\ \forall\ t$, such that any equilibrium is dynamically efficient.

Our main interest lies in the impact of a higher contribution rate on fertility. This effect is given by:

$$\frac{\partial n}{\partial \tau} = -\frac{V_{n\tau}V_{ss} - V_{ns}V_{s\tau}}{V_{nn}V_{ss} - V_{ns}V_{sn}} \tag{4.10}$$

The denominator in the right hand side of equation (4.10) exhibits a positive sign due to the strict concavity of the utility function $V(n_t, s_t)$ (Fenge and Scheubel 2013).

The impact of extending the pension system on savings is given by:

$$\frac{\partial s_t}{\partial \tau} = -\frac{V_{nn}V_{s\tau} - V_{n\tau}V_{sn}}{V_{nn}V_{ss} - V_{ns}V_{sn}}. \tag{4.11}$$

The denominator is positive for both the fully funded and the pay as you go scenario (Fenge and Scheubel 2013). The following discussion therefore focuses on the sign of the nominator for both scenarios to derive testable hypotheses.

In order to determine the direction of the fertility effect, we have to evaluate the sign of the second derivatives of the utility function $V_{n\tau}$ and $V_{s\tau}$. These differ for a fully funded and a pay as you go system because of the different pension formulae. The second derivatives of utility with respect to the contribution rate for a fully funded system are given by:

$$\begin{aligned} V_{n\tau} = \quad & w_t(1-f(n_t)) \\ & \left[U_{cc}((1-\tau)w_t f'(n_t) + \pi_t)\right. \\ & \left. +U_{zz}\left[B_{t+1} - R_{t+1}\tau w_t f'(n_t)\right] R_{t+1}\right] \end{aligned} \tag{4.12}$$

and

$$V_{s\tau} = w_t(1-f(n_t))\left[U_{cc} + U_{zz}R_{t+1}^2\right] < 0 \tag{4.13}$$

The second derivatives of utility with respect to the contribution rate for a pay as you go Bismarckian system are given by:

$$\begin{aligned} V_{n\tau} = \quad & w_t f'(n_t)U_z(R_{t+1} - \Omega_{t+1}) + w_t(1-f(n_t)) \\ & \left[U_{cc}((1-\tau)w_t f'(n_t) + \pi_t)\right. \\ + \quad & \left. U_{zz}\left(B_{t+1} - \Omega_{t+1}\tau w_t f'(n_t)\right)\Omega_{t+1}\right] \end{aligned} \tag{4.14}$$

and

$$V_{s\tau} = w_t(1-f(n_t))[U_{cc} + U_{zz}\Omega_{t+1}R_{t+1}] < 0 \tag{4.15}$$

Contributions to the pension system affect the individual's budget. This implies that the consumption bundle is adjusted, and we observe both an income effect and a substitution effect. Cigno et al. (2003) find that compulsory saving in a public pension scheme displaces intergenerational transfers. In theory, however, there is no clear implication of a crowding out, even if people only have two alternative options available. In our simple model, this is intergenerational transfers and capital market saving. Together with saving in the public pension scheme this provides three options, which are traded off against one another, so that the model does not yield unambiguous conclusions on a crowding out when a pension system is introduced, i.e. on $\frac{\partial n}{\partial \tau}|_{\tau=0}$ and $\frac{\partial s}{\partial \tau}|_{\tau=0}$. The pension system may crowd out either of them, or both. We evaluate the effects of both types of systems in this section.

The crowding out depends primarily on the income and the substitution effect. As we consider children as normal goods (Becker 1960), the total income effect is negative. So is the substitution effect, but its extent depends on how the alternative investment options are traded off against one another. The pension system may however also reduce the opportunity cost of having children, which can have a partially positive effect on fertility.

In the following, we will jointly consider the direct income effect, which results from a change in lifetime income, and the direct substitution effect, which results from compensating the change in lifetime income. These result in a crowding out of fertility, which we term the investment effect. We will separately consider the opportunity cost effects of the pension system that contribute to the income and substitution effect. This separation of effects helps us to derive testable hypotheses for the empirical analysis in chapter 5.

4.3.1 Fully Funded System

The case is quite obvious for a fully-funded pension system. It has no effect on fertility if there is an interior solution. Using equations (4.12) and (4.13) the numerator in the right hand side of equation (4.10) reduces to zero: $V_{n\tau}V_{ss} - V_{ns}V_{s\tau} = 0$, which is a different way of saying that the effect on fertility is zero. The reason is that neither the cost of children, both in terms of opportunity cost and direct cost, nor the lifetime income are affected by the contribution rate. Instead, increasing forced savings for old age is completely compensated by changes in private savings so that the optimal amount of savings remains unchanged with access to a perfect capital market. The effect on savings is given by the numerator of the right hand side of (4.11):

$$\begin{aligned} V_{nn}V_{s\tau} - V_{n\tau}V_{sn} = & \quad w_t(1-f(n_t)) \\ & \left[\left(U_{nn} - U_c w_t f''(n_t)\right)\left(U_{cc} + U_{zz}R_{t+1}^2\right) \right. \\ & \left. + U_{cc}U_{zz}\left(R_{t+1}(w_t f'(n_t) + \pi_t) - B_{t+1}\right)^2\right] \\ > & \quad 0 \end{aligned} \tag{4.16}$$

Some simple manipulation (see Fenge and Scheubel 2010) yields

$$\frac{\partial s_t}{\partial \tau} = -w_t(1-f(n_t)).$$

This means that private savings are reduced exactly by the amount at which forced savings increase in the fully funded system. The intertemporal budget set is the same as without a fully-funded pension and the optimal allocation of the number of children and consumption is unaltered. Note that this result rests on the assumption of an interior solution. As soon as we assume binding budget constraints, i.e. contributions to the pension system reduce the budget by an amount larger than the optimal level of savings in the absence of pension insurance, expenditures for children have to be reduced.

Put differently, in a fully funded system, we only observe a negative income effect on fertility if budget constraints are binding. Otherwise, there is a full substitution of private saving by forced public saving.

Hypothesis 1 (FF): Investment effect in a fully funded system

The compulsory investment in a fully funded public pension scheme has a depressing effect on fertility if either budget constraints are binding or there is no possibility for capital market saving. The compulsory investment in a fully funded public pension scheme completely crowds out capital market saving. There is no substitution effect with regard to fertility. The overall effect of a fully funded pension scheme on fertility is either negative or zero and only depends on the income effect.

As the link between contributions and pensions is perfect in this fully funded scenario, the pension system acts as a quasi private investment. This is why we do not observe opportunity cost effects. If the internal rate of return of the pension system differs from the capital market rate of return and children reduce labour supply, we observe opportunity cost effects.

4.3.2 Pay As You Go System

In the pay as you go Bismarckian system, we always observe opportunity cost effects, i.e. the sign of the numerator of equation (4.10) is ambiguous. This is because a pay as you go system alters lifetime income based on the internal rate of return of the pension system Ω. If this were equal to the capital market rate of return R_{t+1} the sign of the numerator of equation (4.10) would be zero,

$$
\begin{aligned}
V_{n\tau}V_{ss} - V_{ns}V_{s\tau} = \quad & (R_{t+1} - \Omega_{t+1}) \left[w_t f'(n_t) U_z (U_{cc} + U_{zz} R_{t+1}^2) \right. \\
& \quad + w_t (1 - f(n_t)) U_{cc} U_{zz} \\
& \quad \left(R_{t+1} ((1-\tau) w_t f'(n_t) + \pi_t) \right. \\
& \quad \left. \left. - \left(B_{t+1} - \Omega_{t+1} \tau w_t f'(n_t) \right) \right) \right] . \qquad (4.17)
\end{aligned}
$$

The income and the substitution effect now depend on the relation of the internal rate of return of the pension system and the capital market rate of return.

Income and Substitution Effect

In a dynamically efficient equilibrium, i.e. $R_{t+1} > \Omega_{t+1} \ \forall \ t$, compulsory contributions mean a loss in lifetime income, as they could have been invested in the capital markets instead of in the pension system. One reason for a lower rate of return in the pension system is the well-known implicit tax incurred by the Bismarck pension system (e.g. Barro and Becker 1988; Sinn 2000, 2004b). If the first generation of pensioners receives pensions without (sufficiently) contributing, this has to be financed with higher contributions than necessary to finance own pensions by the following generations. The higher the contribution rate, the lower the internal rate of return of the pension system.

The reduction in lifetime income can be compensated by decreasing the number of children and the amount of savings. The question of whether expenditures for children or savings decrease more depends on the relative return of children (i.e. the relation of the intra-family transfer in relation to the direct cost of children) and private saving. Fenge and Scheubel (2013) show that the effect on fertility is unambiguously negative, as children reduce consumption in the first period by $w_t f'(n_t) + \pi_t$ and the pension in the second period by $\tau w_t f'(n_t)$. Now, if the intra-family transfer is *higher* than the reduction in the pension, i.e. $\tau w_t f'(n_t) < \frac{B_{t+1}}{\Omega_{t+1}}$, but still lower than the reduction of consumption in the first period, $\frac{B_{t+1}}{\Omega_{t+1}} < w_t f'(n_t) + \pi_t$, only the second effect has a fertility-reducing effect, but not the first. Instead, the fall in income is partially offset by lower savings if $\tau w_t f'(n_t) < \frac{B_{t+1}}{\Omega_{t+1}} < w_t f'(n_t) + \pi_t$ holds.

Hypothesis 1 (PAYG): Investment effect in a pay as you go Bismarckian system

The compulsory investment in a pay as you go public pension scheme reduces the budget available for other investments. This effect is reinforced by having children, as children reduce both consumption in t and the pension in $t+1$, such that fertility is partially crowded out. Savings may be partially crowded out depending on the relative return in relation to children.

The crowding out of private saving by public saving may have another interesting secondary effect on fertility. Even though lifetime income may be reduced, the statutory pension guarantee also reduces the income risks associated with old age.

First, fertility can be an adjustment to income risk if old age income proves to be insufficient, e.g. due to an exceptionally long life (Cain 1983). Put differently, fertility acts as a longevity insurance, while other investment options do not – except for a statutory pension system. A statutory pension system can insure against longevity, because risks are pooled (e.g. Meier and Wrede 2010). In addition, children may decide not to provide the intra-family transfer B_t. Without altruism (e.g. Prinz 1990) or family rules (e.g. Cigno 1993) there is no effective enforcement device. A pay as you go pension system can both insure against longevity (e.g. Cigno and Werding 2007) and act as an enforcement device (Homburg 2000; Sinn 2004b; Cigno 2006). In the sense that a public system may be an improvement where private markets are inefficient (Diamond 1977), a pension system as longevity insurance is superior to having children. This should reinforce the crowding out effect of the pension system on fertility.

Hypothesis 2a (PAYG): Insurance effect in a pay as you go Bismarckian pension system

The insurance against longevity inherent to any statutory pension system should reinforce the crowding out of fertility. The character of the pay as you go system as an enforcement device should result in a stronger insurance effect of the pay as you go system.

Second, however, the longevity insurance effect implies more income certainty. Fraser (2001) shows that individuals may decrease fertility as a reaction to increased income uncertainty. The reverse argument should hold for the introduction of the pension system. If having children is risky in the sense that there is uncertainty with regard to their survival (Cigno and Werding 2007), the educational outcome (Meier and Wrede 2010), and their provision of the intra-family transfer (Sinn 2004b), the welfare state in general and the pension system in particular may reduce the individual income risk and thus encourage other risk-taking behaviour (Sinn 1996). This may include having a larger family.

Hypothesis 2b (PAYG): Risk effect in a Bismarckian pay as you go pension system

The reduction of income risk should encourage fertility.

Overall Effect in a Pay as you go System

Hypothesis 3 (PAYG): Overall effect in a pay as you go Bismarckian system

The overall effect of a pay as you go Bismarckian pension scheme depends on (a) the reduction in lifetime income, and (b) on the value of the investment in the public pension scheme relative to the value of intra-family transfers and the value of private saving. In a dynamically efficient equilibrium, the total fertility effect is negative (see Fenge and Scheubel 2010).

4.3.3 The Timing Effect

The marriage effect, which is in fact a timing effect, cannot be classified as either an income effect or a substitution effect, as it purely causes a postponement of family formation. It is specific to Bismarck's pension system and appears both in the fully funded and the pay as you go scenario. However, it is interesting to analyse, since delayed fertility has been mentioned as one of the primary causes for lower total fertility because of the tempo effect (e.g. Bongaarts and Feeney 1998; Bongaarts 1999). If we find that incentives to postpone fertility significantly affected behaviour during the first demographic transition, this renders further support to the tempo argument as an explanation for the second demographic transition.

The 1889 law[4] allowed for the reimbursement of contributions to women within three months following the conclusion of their marriage. This was motivated because of §32, which stated that anyone who would contribute less than a year's value of stamps to the system within four years would lose all their pension entitlements. As women were not supposed to work after they got married, it was perceived as just a reimbursement, as they would have accumulated substantial claims by the time they got married (Bosse and von Woedke 1891).[5]

Both women and men lost their entitlement four years after they ha resigned from a job, unless they had collected at least a 47 weeks worth of stamps in every year. Women could get their contributions reimbursed within the time frame of three months after they got married only if they had paid contributions for at least five years. So even if a woman had started paying contributions in 1891, when the law on pension insurance came into effect, the earliest year for reimbursement would have been 1896.

Fait also shows that the idea of reimbursing women when they got married illustrates that men were the main beneficiaries of the new pension sytem. She provides an detailed analysis of the impact of the 1889 pension insurance on the lives of working women and shows that the system of contributions and the concept of receiving a pension only after a lifetime of contribution payments was targeted at working class men. Unmarried women, who had worked and had accumulated pension entitlements before they got married, faced a strong incentive to apply for partial reimbursement of contributions,

[4] RGBl 1889/13, §30.

[5] As Europeans married rather late, it was not unusual for single women to work. So if a woman started to work at the age of 15, she would contribute a significant sum to the pension system, even if she already married in her early 20s.

which would then serve as some form of dowry. This implied that the pension system did not lead to statutory old age provision for women. In old age, they had to continue working, resort to poorhouses, or depend on their children. In addition, there were no pensions for widows or orphans.[6] If a household head died, there was the possibility of a partial reimbursement of his contributions to his dependants, but not if he died as a result of an accident. In this case, the widow would receive a widow's pension from the funds of the accident insurance.

Single working class women worked as a means of accumulating a dowry (Kuhn 2000). If working implied that they had to pay contributions to the pension system after 1891, this could have reduced income disposable for saving. Therefore, a woman would never cease to work before she could get back the money she could not save for her dowry.

Moreover, women who would not have saved for a dowry otherwise, possibly because of budget constraints, were now forced to save. The pension system therefore institutionalised and guaranteed this form of saving. It acted as a commitment device for saving. The women who would otherwise not have saved then became a more attractive marriage partner. Indeed, Kuhn (2000) notices that the attitude towards single working women slowly changed between the end of the nineteenth and the beginning of the twentieth century.

The likely effect of the pension system on marriages is therefore twofold. First, the pension system should have suppressed the marriage rate for the first five years of its existence. Women who might have decided to look for a marriage partner earlier might have postponed this move in order to receive the reimbursement. This should have suppressed the fertility rate, too.

The pension system forced women to work and save for at least five years if they started to work in an occupation covered by pension insurance. As long as five years were longer than the common span of working before marriage, the postponement effect was permanent. The corresponding shifting of family formation to later years should result in a lower total fertility rate, but need not result in a lower completed fertility rate.

Hypothesis 4: The timing effect in Bismarck's pension system

The introduction of the pension system increased the opportunity cost of early marriage and had a postponing effect on marriages and fertility.

[6] The literature on Bismarck's pension insurance is unambiguous here. The parliament and decision makers considered the provision for dependants as desirable, but not the main focus of the pension insurance. Thus plans on a provision for dependants were postponed. Ellerkamp (2000) gives a detailed analysis of the history of the provision for widows and orphans.

4.3.4 Labour Market Effects

Labour market effects are mainly opportunity cost effects of the pension system, which are part of the overall effect we find to be negative in *Hypothesis 3*. As their effect on behaviour is substantial, they deserve to be analysed separately. In fact, the labour market effects of a pension system have received a great deal of attention. We can distinguish between labour supply and labour demand effects. First, interpreting the contributions to the pension system as an additional tax on labour (Cigno 2008), this tax wedge distorts both labour supply (Becker 1965; Mirrlees 1971; Stiglitz and Dasgupta 1971; Cigno 2008) and labour demand (e.g. Hamermesh 1996; Alesina and Perotti 1997).[7]

Theoretical work discusses labour supply effects in the context of the opportunity cost of having children in terms of foregone wage income, which in turn depends on the pension formula (e.g. Meier and Wrede 2010). In a Beveridgean pension system, the pension level does not depend on the level of individual contributions. Ceteris paribus, the opportunity cost of the foregone pension income is therefore lower than in a Bismarckian system. In addition, if there are child-related elements in the pension formula (e.g. Cigno and Werding 2007), the externality is reversed and the pension system provides incentives to have children. Second, if the opportunity cost of having children in terms of foregone wage income is low because of the universal availability of childcare (e.g. Blau and Robins 1989; Brewster and Rindfuss 2000; Ahn and Mira 2002; Hank and Kreyenfeld 2003), it is easier to pay pension system contributions, and thus the opportunity cost in terms of foregone pension benefits is also lower.

Using our model to illustrate the effect, a larger pension system that reduces lifetime income however also reduces the loss in terms of lifetime income that have to be incurred in t. The opportunity cost of a child is reduced by $w_t f'(n_t)$ in t. However, the reduction in lifetime income implies a reduction in pension income in $t+1$, since the pension is related to income. Having a child in t would reduce the pension even further. This increase of the opportunity cost of a child in the second period is expressed by $\frac{\Omega_{t+1}}{R_{t+1}} w_t f'(n_t)$ in present values of period t. Thus, a higher contribution rate lowers the opportunity cost of having a child in the first period, but increases the opportunity cost of having a child in the second period in terms of pension entitlements. The total opportunity cost falls if the equilibrium is dynamically efficient, i.e. $R_{t+1} > \Omega_{t+1} \; \forall \; t$, implying a positive substitution effect.

[7] Note that the magnitude of the former effect is debated in the literature, e.g. Burkhauser and Turner (1978). Disney (2004) highlights that the measurement of the tax wedge, in particular by accounting for the accrual of future pension claims, is crucial to the magnitude of the effect that is measured.

Hypothesis 4a (PAYG): Social security tax wedge effect in a pay as you go Bismarckian public pension scheme

If the internal rate of return of the pension system is lower than the capital rate of return, compulsory contributions lower lifetime income. They work similar to a tax on labour. This affects the labour-leisure choice and reduces the opportunity cost effect of having children and thus has a *positive* effect on fertility.

Contemporary work on the effects of social security on labour supply is much more abundant than on labour demand. For most countries with a pay as you go system, the pension system is found to depress labour supply, albeit to different extents and depending on the size of the social security system (e.g. Stock and Wise 1990; Gustman et al. 1993; Aronsson and Walker 1997; Börsch-Supan and Schnabel 1998; Börsch-Supan 2001; Gruber 2000; Krueger and Meyer 2002). This would imply per se that the opportunity cost of having children is lowered. However, Disney (2004) notes that social security contributions cannot be treated the same as a pure income tax. In fact, if the earning of pension claims is taken into account, Disney does not find significant negative effects of social security contributions on labour supply. Evidence on labour demand is more scarce, but also tends to postulate negative effects of social security (Hamermesh 1996 provides a comprehensive treatment of the effects on labour demand).

As both labour supply and labour demand may fall, the direction of adjustment of wages is not clear a priori. It is, however, more likely that we observe the wage adjustment rather than the separate adjustment of labour supply or labour demand. Any wage adjustment affects disposable income, and thus also the opportunity cost of having children. Depending on whether wages rise or fall, the opportunity cost of having children in a pay as you go system may rise or fall.

Hypothesis 4b (PAYG): Wage effects in a pay as you go Bismarckian pension system

Changes in labour demand and supply as a response to the social security tax wedge trigger an adjustment of wages. If wages rise, the opportunity cost of children increases. If wages fall, the opportunity cost of having children falls.

Among the labour supply effects, female labour supply deserves special attention. In general, the discussion on labour supply effects particularly apply to women, because they typically exhibit a higher labour supply elasticity (e.g. Apps and Rees 2004). The effect of taxation in general, and social security contributions in particular, on female labour supply has been theoretically extensively analysed (e.g. Mincer 1962; Becker 1991; Browning 1992; Fenge and Meier 2005, 2009) and empirically (Kalwij 2000; Bloom et al. 2009; Michaud and Tatsiramos 2011).

While women in Imperial Germany faced the trade off between (registered) paid work and marriage before the introduction of the pension system, the opportunity cost of having children of foregone (higher) wage income increased by the foregone pension income after the introduction of the pension system.

Hypothesis 4c (PAYG): Female labour supply effects in a pay as you go Bismarckian pension system

In Imperial Germany, women faced a trade off between marriage and children and paid work and pensions. As the pension system increased the opportunity cost of children in terms of foregone pensions, the fertility effect is negative.

4.3.5 The Moral Hazard Effect

The ex ante moral hazard effect is specific to a pay as you go system. A pay as you go system is a de facto fertility insurance. This induces a particular type of ex ante moral hazard that has also been termed the fiscal externality of a pay as you go pension system (e.g. Prinz 1990; Kolmar 1997; van Groezen et al. 2003; Sinn 2004; von Auer and Büttner 2004; Fenge and Meier 2009; Meier and Wrede 2010). In simple terms, as the pension system provides for the case of not having children, the incentive to have children is reduced.

The ex ante moral hazard effect can indeed be viewed as an externality. Having children reduces the pension in the pay as you go system because of the foregone wage income:

$$\frac{\partial p_{t+1}^{PAYG}}{\partial n_t} = -(1+\overline{n_{t+1}})\tau w_{t+1} f'(n_t) \frac{1-f(\overline{n_{t+1}})}{1-f(\overline{n_t})} = -\tau w_t f'(n_t)\Omega_{t+1} < 0.$$

In addition, having a child also reduces consumption in t:

$$\frac{\partial c_t^{PAYG}}{\partial n_t} = -((1-\tau)w_t f'(n_t) + \pi_t).$$

As shown above, these effects are traded off against the discounted value of the intra-family transfer, but the overall effect is negative. Importantly, however, when deciding on the number of children n_t, individuals do not take into account the effect of their fertility decision on the internal rate of return of the pension system $\Omega_{t+1}(n_t)$:

$$\frac{\partial \Omega_{t+1}}{\partial n_t} = \frac{(1-f(\overline{n_{t+1}}))\frac{\partial \overline{n_t}}{\partial n_t}((1-f(\overline{n_t})) + \overline{n_t} f'(\overline{n_t}))}{(1-f(\overline{n_t}))^2} > 0,$$

since $\frac{\partial \overline{n_t}}{\partial n_t} > 0$. The positive effect is not internalised, and thus we can speak of a positive externality of a pay as you go pension system. The benefit of children in terms of pension income is socialised, but the cost in terms of current consumption is not. As this socialisation of the benefits of children in the context of a public pay as you go pension system has an impact on society as a whole (e.g. von Auer and Büttner 2004), the effect of children in a pay as you go system has also been interpreted as a public good (e.g. Folbre 1994).

Hypothesis 5 (PAYG): Ex ante moral hazard effect in a pay as you go Bismarckian pension system

A pay as you go system as a de facto fertility insurance induces ex ante moral hazard in the form of reduced fertility.

4.4 Implications

Even though we might suspect that a growing involvement of the state with regard to fertility must crowd out fertility, this chapter shows that there are both positive and negative effects associated with forced saving in a public pension scheme.

The effects which we can test empirically are the crowding out caused by the investment effect reinforced by the insurance effect and the social security tax wedge effect in combination with the female labour force supply effect. We also test separately for the timing effect on marriages and for the moral hazard effect.

The investment and the insurance effects are closely linked to income and thus to economic development. The female labour force participation effect amplifies the general trend towards increasing female labour force participation. The timing effect on marriages is naturally closely linked to marriage patterns. This leaves us with the question whether the influence of the pension system is sufficient to explain a long term decline in fertility, i.e. the first and the second demographic transition.

As mentioned in chapter 1, the existence of the public pension system effectively decoupled the old age provision motive from the motives for having children. However, it is difficult to isolate this effect. The decoupling was likely driven mainly by the combination of the income and substitution effect, which we term the investment effect. However, this crowding out is reinforced by the moral hazard effect. This reinforcement appears to be the more important driver of long-term effects. Therefore, our empirical approach aims to provide an approximation of the contribution of the different effects to the observed crowding out.

First, we estimate the total effect of the introduction of pension insurance on fertility. This establishes a benchmark value for the total crowding out effect. Second, we add variables which we claim capture the internal rate of return of the pension system and the value of statutory insurance as opposed to intra-family transfers. We also show a way in which we can capture labour market effects. Third, we control for these effects to derive a ‘residual’ total effect. This estimate can be considered an upper bound for the remaining opportunity cost effects, of which the most important effect is the moral hazard effect. The next chapter first details our econometric approach and then presents the results from our multivariate analysis.

Chapter 5

The Fertility Decline and the Pension System

“ [...] An institution that would provoke the insured’s ignorance of their own responsibility for the arrangements with respect to their future would bear fatal consequences [...].”

“[...] Eine Einrichtung, bei welcher dem Versicherten das Bewußtsein der eigenen Verantwortlichkeit für die Ausgestaltung seiner Zukunft verlorenginge, würde für unser Volksleben verhängnisvolle Folgen haben, [...].”

Otto von Bismarck, Imperial Chancellor, 1888
Source: von Bismarck (1894), p. 608.

The impact of social insurance, and in particular pension insurance, on people’s lives was enormous. However, the identification of an effect of social security on fertility is complex. This chapter develops an approach to identify an effect of the introduction of pension insurance on fertility. This is difficult because of the other factors at play at the time when pension insurance was introduced. We evaluate these effects in chapter 2.

Fertility has been declining for over a century. In this context, we are particularly interested in how this development was initiated and whether the introduction of pension insurance qualifies as an explanation for the *sustained* decline in fertility. After all, chapter 2 shows that the traditional explanations for the first demographic transition fall short of being able to explain an ongoing decline in fertility for over a century. In chapter 4, we describe the theoretical predictions of how pension insurance can influence the individual decision of having children. This chapter tests for these effects and discusses the potential of social insurance to explain the first and the second demographic transition. It complements the analysis in chapter 2 with an evaluation of the effects of pension insurance and has three main parts. First, we provide details on how we identify the effect of pension insurance on fertility. Second, we estimate the total effect of pension insurance on fertility by means of our identification strategy. Third, we investigate how the effects described in chapter 4 contribute to the total effect. After all, the decline in fertility is sustained and ongoing. In order to mitigate the effects, it is important to find out more about the causes.

5.1 Identification and Econometric Model

Owing to the various factors that influenced fertility at the end of the nineteenth century, the identification of an exclusive effect of pension insurance with a simple multivariate analysis is difficult. First, this means that we need a variable to measure the impact of pension insurance. Naturally, even if we can properly measure the effect of pension insurance this does not help identifying the effect of the *introduction* of pension insurance. Second, a multivariate model requires a full set of covariates. The other factors discussed in chapter 2 are, however, potentially related to pension insurance. For example, pension insurance mainly covered workers, but workers were also most strongly affected by the forces of industrialisation. If we cannot sufficiently control for industrialisation, the effect of industrialisation on fertility will be captured by the error term. Both the dependent variable – fertility – and the pension system measure would then be related to the error term, a classic endogeneity problem. Given that historical data is not available at the individual level, it is also challenging to collect all covariates necessary to avoid endogeneity.

An easy way to circumvent this problem is to use an approach for identification that does not require covariates. A difference-in-differences (DD) estimator constitutes such an approach. If the introduction of the pension system would have been truly random and if only a subgroup of the sample would have been exposed to it, a simple comparison between the groups before and after the introduction of pension insurance would be sufficient to estimate a causal effect. However, this approach entails some caveats when applied to our setting.

First, it is difficult to define a clear point in time that indicates the introduction of social insurance. Guinnane (2011) claims that the identification of such a clear point in time is hardly possible, since there had been many privately organised, employer-based, or union-based insurance schemes in place before comprehensive statutory social insurance was introduced. While it is true that such schemes existed, such as the miners' associations or company schemes, e.g. the Krupp's insurance for their employees (Lindsay 1892), these schemes cannot be considered nearly as comprehensive as statutory social insurance. Chapter 3 shows that both 1891 and 1900 were crucial years for the pension insurance system. The first comprehensive statutory pension insurance came into effect in in the form of a funded system in 1891. Coverage was extended and the system was transformed into a pay as you go system in 1900. The identification of such a point in time rests decisively on the fact that there was no other major change in 1891 and 1900 which could have affected fertility.

Second, our measure of pension insurance is continuous and bounded. An additional complication results from the fact that statutory pension insurance was introduced in all provinces of Imperial Germany. Thus, there is no control group and our identification strategy also has to account for that. We discuss these complications and how we deal with them, which subsequently take us to the econometric model.

5.1.1 The Introduction of Social Security

To identify the timing of the introduction of pension insurance correctly, we evaluate two aspects in particular. First, we evaluate whether there could have been anticipation effects before legislation came into effect (in the spirit of Ashenfelter's dip). Second, we evaluate whether there were other policy changes that could confound the effects of pension insurance. This is similar to evaluating the necessary conditions for a true natural experiment, exogeneity and exclusive relevance. We acknowledge, however, that the introduction of pension insurance was not a true natural experiment in the classical sense as defining a clear point in time is difficult due to the various reforms and because all provinces were affected to some extent.

Timing of the Introduction of Pension Insurance

The pension system, as it was set out in the law passed in 1889 did neither resemble the first 1887 drafts nor Bismarck's 1882 ideas (see also chapter 3). The 1887 draft was subject to substantial discussion between representatives from the federal states and policy makers, but the discussion did not extend beyond these political circles.

The intention of introducing social insurance in general was communicated in the Imperial dispatch of 1881. Further communication to the public only took place after its introduction. For example, Ritter (1998a) reproduces a Protestant theologian's description of the discussion of the laws on social insurance among politically active Social Democrats in 1891 who mentions that the laws were mainly discussed among the politically active. Vogel (1951) also notes that discussions on social insurance among workers were only recorded by employers and party officials in the 1890s.

During the 1870s and 1880s, the concerns of workers did not focus on statutory social insurance. Vogel (1951) also reports that a representative of the Nuremberg Worker's Council (*Nürnberger Arbeiterbildungsverein*) discussed the issue of pension insurance for members of the Worker's Associations at the first federal meeting of the Worker's Councils (*erster Vereinstag der deutschen Arbeitervereine*). These discussions focused on decentralised solutions to the questions disability provisioning and providing old age. The discussions did not focus on the federal endeavours to introduce comprehensive social insurance for workers. However, the protection of workers has been an important topic for almost all parties since 1870 (Vogel 1951). It is important to note that whenever workers' representatives participated in the discussions on the statutory old age and disability insurance, which was as early as the 1970s, they strongly opposed the plans, as the drafts on statutory social insurance foresaw compulsory insurance (Vogel 1951).

The implications are twofold. First, even though workers' representatives took part in the discussions on insurance as early as the ideas surfaced, it is unlikely that these ideas had also been discussed among the populace prior to the 1890s. We do not, therefore, consider exogeneity a problem for those who were affected by the introduction of social insurance. Second, even if most workers had been informed about the implications of the pension system before it came into effect, they were largely opposed to it, since they did not view it as effective insurance. Therefore, if at all we should observe an *increase* in the CMBR before the pension system came into effect. We evaluate potential anticipation effects below but do not find indications of anticipation effects.

As noted above, previous fertility developments should not have caused the introduction of pension insurance. Chapter 3 shows that there was a general trend of improving workers' welfare during the second half of the nineteenth century. This trend was not based on the observation that the workers' situation was so dire because they had too many children. Put differently, the pension system was neither introduced to reduce the number of children nor to reduce hardships that resulted from having many children.

However, pension insurance was introduced in stages. To account for the fact that the introduction of pension insurance was the last of several reforms to be introduced during the 1880s, we look at three different periods. First we look at the period between 1883 and 1890 compared to the years 1878 to 1882. This first treatment period covers the introduction of all social insurance other than the pension system. Second, we look at the period between 1891 and 1899 compared to the years 1883 to 1890. This covers the effects of the first law on pension insurance. Third, we look at the period after 1900 compared to the years 1891 to 1899. This covers the effects of the second law on pension insurance and potentially lagged effects of the first law on pension insurance.

Relevance of other Policy Changes

The only major policy change that took place at the same time as pension insurance came into effect was the 1891 change to the laws on child labour for the industrial sector and the service sector (Boentert 2007). The 1891 amendment to the Industrial Code (*Gewerbeordnungsnovelle*) prohibited child labour in factories and applied to all children of school age.[1] This did not apply to children working at home or in the agricultural sector or in small businesses.

As the value of children also depended on the potential income they could generate, this law reduced the value of children ceteris paribus (e.g. Becker 1971). Income from child labour mostly mattered in working class households. This means that the share of the population affected by the restrictions on child labour is largely congruent with the share of the population affected by pension insurance. However, the implementation of the child labour laws depended on the definition of school age. This definition varied across provinces. The variation in this definition and thus the application of the law is not identical to the variation in the share of insured people in pension insurance. Therefore the effect of pension insurance and the effect of child labour restrictions must be different.

As the child labour restrictions were tightened again in 1903,[2] we can also assess the significance of the 1903 policy change and compare it to both the 1891 policy change and the 1900 policy change. In 1900, there were no changes to laws on child labour, but the German Civil Code was introduced. This mainly created certainty regarding the rights of citizens and should not have had a direct effect on fertility.

Another important concern is that fertility may follow the business cycle. This argument is close to the Malthus doctrine, which states that if people are better off, they have more means to raise children. We have to make sure that we do not measure an economic boom that coincidentally started in 1891. The business cycle however only turned in 1896, which marked the beginning of a boom period (Wehler 2008). Therefore, the introduction of pension insurance did not coincide with an economic boom. If the business cycle mattered, fertility should be affected differently between 1891 and 1896 as compared to 1896 and 1900, which we can test.

5.1.2 Measuring the Effect of the Pension System

Only parts of the population were covered by pension insurance, but as our level of observation is at the provincial level there is no subgroup in our sample that was not affected at all. This raises the question of how to best measure the impact of pension insurance. Only workers with an annual income equal to or below 2000 Mark were compulsorily insured. This means

[1] Before, children from age 10 were regularly employed in factories (Boentert 2007).

[2] In 1903, a child protection law was passed with regard to child labour in industrial businesses. It specifically named the types of business that were affected. Boentert (2007) provides the details.

that there were workers in jobs that qualified for pension insurance in all provinces. However, we can use the information on the extent to which the population in a province was covered by pension insurance to get an approximation of the effect we are interested in. We proceed in three steps.

First, we establish a measure to map the extent to which the population in each province was covered by the pension system. Second, we transform this continuous treatment into a binary treatment variable. Third, assuming a continuous response to coverage, we can use the estimate of deviation from the mean to calculate the fertility response for the average province. Put differently, we can calculate the extent to which fertility must be reduced if coverage rises from a share of zero to the mean share.

Table 5.1: Share of the working population

Province	1882	1895	1907
Ostpreussen	.42	.40	.40
Westpreussen	.40	.38	.38
Berlin	.47	.46	.43
Brandenburg	.44	.44	.42
Pommern	.41	.40	.40
Posen	.40	.38	.38
Schlesien	.45	.44	.41
Sachsen-Anhalt	.43	.42	.42
Schleswig-Holstein	.45	.43	.40
Hannover	.43	.42	.43
Westfalen	.40	.38	.37
Hessen-Nassau	.41	.42	.42
Rheinland	.42	.40	.39
Bayern	.53	.51	.49
Pfalz	.48	.44	.44
Koenigreich Sachsen	.46	.46	.41
Wuerttemberg	.44	.47	.46
Baden	.46	.51	.49
Mecklenburg	.44	.45	.39
Thueringen	.35	.43	.41
Oldenburg	.44	.42	.38
Braunschweig	.47	.44	.42
Hansestaedte	.45	.44	.64
Elsass-Lothringen	.49	.50	.49
Deutsches Reich	.44	.44	.43

Source: Annual Yearbook of Statistics.

Our measure of coverage is related to the share that is insured in each province. The law defined certain job categories that would qualify for pension insurance coverage. These job categories were based on the job categories used in the regular occupational censuses. Appendix A provides details on these occupational censuses.

The Imperial Statistical Office reported the share of insured people in each province for 1895 and 1907. Are these numbers a reliable measure of pension insurance coverage if the size of the workforce changed because of pension insurance? We could imagine that more people tried to work in order to enjoy pension insurance coverage. This is not the case, as the occupational censuses show that the share of the workforce as a share of the total population hardly changed between 1882 and 1907. We provide the figures in table 5.1.

How about a change in the composition of the workforce? It is possible that more people tried to find employment that qualified them for pension insurance. According to our data, the fraction of insured of the population was 21.59% in 1895 and 21.87% in 1907. This represents only a minor increase. The fraction of insured of the working population was 49.26% in 1895 and 51.35% in 1907. Thus our data suggest an *increase* in the fraction insured. Variation across provinces shows a decline in Westpreußen, Posen, Bayern, Pfalz, Hansestädte and Elsaß-Lothringen.

We can also measure coverage on the basis of the composition of the workforce *before* pension insurance was introduced in order to make sure that identification is not driven by endogenous changes in the composition of the workforce. The Imperial Statistical Office provided projections of the number to be insured based on the 1882 occupational census. Verhandlungen des Reichstages (1888/89) provides further details on this projection. We can use the information on how projections were made to calculate a regional 'projected' number based on the 1882 occupational census figures. Appendix A details how we derive these estimates.

The official projections overestimated the number of insured, as projections were rather conservative. If we use the classification in Verhandlungen des Reichstages (1888/89), we arrive at roughly similar numbers. If we measure coverage on the basis of the 1882 occupational census, this is unrelated to changes in the composition of the workforce because of pension insurance, which could have taken place only after 1891.

Consequently, we have three different measures of coverage, which are, however, bounded between 0 and 100. This raises the case for an estimation approach that accounts for potential nonlinearities (Papke and Wooldridge 2008). At the same time, even a method omitting the top or bottom 5% or 10% would be difficult to implement in our scenario, because of the small cross-sectional sample size. In addition, the continuous dependent variable is available only for three different points in time.

Therefore, we choose a more parsimonious approach given the data limitations: we transform our measure of coverage into a binary variable. Then we apply a parsimonious DD estimator. We measure coverage based on the 1882 census, for 1895, and for 1907. Denote the measure I for the share of insured people in province i in year t as $I_{i,t}$, with $t \in (1882, 1895, 1907)$, and $i \in$ *(Baden, Bayern, Berlin, Brandenburg, Braunschweig, Elsass-Lothringen, Hannover, Hansestädte, Hessen, Hessen-Nassau, Königreich Sachsen, Mecklenburg, Oldenburg, Ostpreußen, Pfalz, Pommern, Posen, Rheinland, Sachsen-Anhalt, Schlesien, Schleswig-Holstein, Thueringen, Westfalen, Westpreußen, Württemberg).* Let $sd(I)_t$ denote the standard deviation of I_i in year t and $m(I)_t$ the mean of I_i in year t. Then we consider a province as treated in year t, i.e. $D_t \equiv 1$, if $I_{i,t} > (m(I)_t + sd(I)_t)$.

Table 5.2: Provinces according to the number of insured in 1895

Province	Insured
Oldenburg	157.8642
Westfalen	173.6124
Wuerttemberg	185.9548
Rheinland	192.1978
Hannover	194.373
Hessen-Nassau	195.6389
Posen	197.9594
Elsass-Lothringen	198.6611
Westpreussen	200.7548
Pfalz	202.3522
Hessen	203.076
Ostpreussen	204.815
Baden	210.3782
Sachsen-Anhalt	211.575
Pommern	212.8137
Thueringen	221.4748
Schleswig-Holstein	226.2099
Brandenburg	227.5228
Schlesien	235.7706
Bayern	239.6808
Braunschweig	246.4228
Koenigreich Sachsen	248.9645
Hansestaedte	253.8071
Mecklenburg	256.0889
Berlin	270.0763

Source: Annual Yearbook of Statistics.
Insured per mill.

There is variation in this 'treatment' indicator over time, but some provinces always appear as treated, such as Braunschweig, Königreich Sachsen, and Mecklenburg. In addition, we assume that the share of insured people has converged somewhat, since there are not as many provinces classified as treated in 1907 as compared to 1895 and 1882. We consider the bounded nature of the treatment variable not a major concern, because it never takes the minimum or maximum values of 0% or 100% and only ranges between 15.8% and 27%, as illustrated in table 5.2.

We also have to verify that the share insured is not too highly correlated with other determinants of fertility. Social insurance and in particular pension insurance covered a certain fraction of people working in farming and a large fraction of the population in industry. Therefore, coverage should be higher in provinces with a larger secondary sector. But a higher share of workers in the secondary sector can also be a proxy for industrialisation. So we have to make sure that the share insured does not proxy industrialisation, but does effectively measure pension insurance coverage. To address this issue, we relate insurance coverage to the sectoral distribution across provinces. Figure 5.1 examines the spatial distribution of the share of insured people and the share employed in mining.

The upper panel in figure 5.1 shows the share of insured people in 1895. The lower panel contrasts this with the share working in mining. The industrial regional pattern does not correspond to the regional pattern of the share of insured people.[3] This means that it was not just people from a particular sector, but people from all sectors who were classified as workers were eligible to be covered by pension insurance.

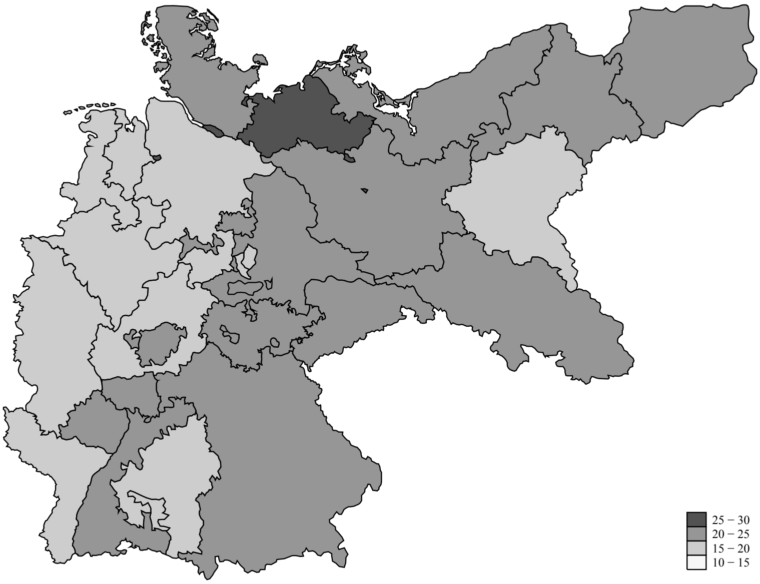
The share of insured people could also be related to the share of working women. Women earned only about 2/3 of men's wages so it is possible that women were more likely to work in jobs that qualified for pension insurance coverage. Pension insurance was targeted at low-income workers. As the working age is largely correlated with the childbearing age, the share insured could simply reflect the share of women in childbearing age, and not the influence of the pension system. To address this concern, we relate the share of insured people to the demographic structure of a province and we specifically relate it to the share of working women. If the share of working women is highly correlated with the share of insured people, it could be possible that we measure demographic effects instead of pension insurance coverage.

Haerendel (2001) and Fait (1997) provide important information that helps to proxy the percentage of working women in each province, at least following the introduction of the pension system. As described in chapter 3, contributions to pension insurance were based on separate wage categories. There were four wage categories until 1900 and five wage categories from 1900 onwards. Haerendel describes that parliament deemed it unnecessary to have a separate category for women, since working women would be contributing only in the lowest category I. Figure 5.2 shows that the share of revenues in

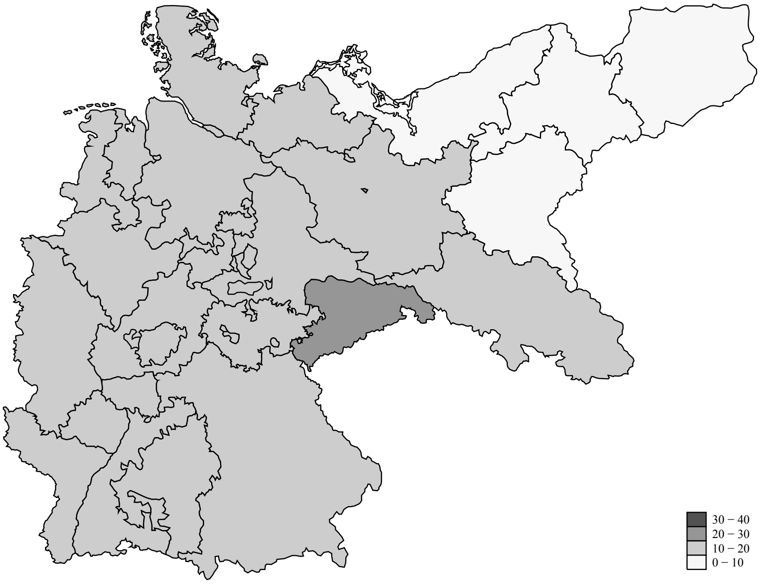
[3] The same holds for the share employed in trade and agriculture.

Figure 5.1: Spatial distribution of insurance coverage and primary sector 1895

Share insured



Share in mining



Source: Occupational census 1895, own calculations.

each category as of total revenues from contributions in 1891 is related to the share of women in 1890. A higher share of women in the population is correlated with higher revenues in category I and lower revenues in category IV. We therefore use the share of contributions in category I as a proxy for the share of working women.

Figure 5.3 then relates the share of revenues in category I to the share of insured people in 1895 in the top panel and in 1907 in the bottom panel. We cannot observe a relationship between revenues in category I and the share of insured people neither in 1895 nor in 1907. The negative slope of the fitted values in the right panel is completely driven by the capital Berlin and the Hanseatic cities (Bremen, Hamburg, and Lübeck). Therefore, we are confident that our treatment variable is not related to the share of working women in the provinces.

5.1.3 Difference-in-Differences Approach

In order to use the introduction of pension insurance for identification, we implement a difference-in-differences (DD) model. It is uncomplicated to set up if relatively strong assumptions hold. Alas, it does not allow us to differentiate between the economic effects of the pension system on fertility that we identified in chapter 4 and in particular not the indirect ones. Therefore, we use the DD approach to identify the overall effect of the pension system on fertility.

In our basic difference-in-differences framework, the outcome of interest is $y_{i,g,t}$ for province i in group g in year t. $g = 1$ if a province is defined as treated, and $g = 0$ otherwise. It is also determined by time-specific effects $T(t)$, by an error term $\alpha_{i,g}$ that is time-invariant and that may be correlated within each group g, and an error term $\varepsilon_{i,t,g}$, which is i.i.d.:

$$y^{DD}_{i,t,g} = D_{g,t} + T_t + \mathbf{DD_{g,t}}\gamma_{DD} + \alpha_{i,g} + \varepsilon_{i,g,t}. \tag{5.1}$$

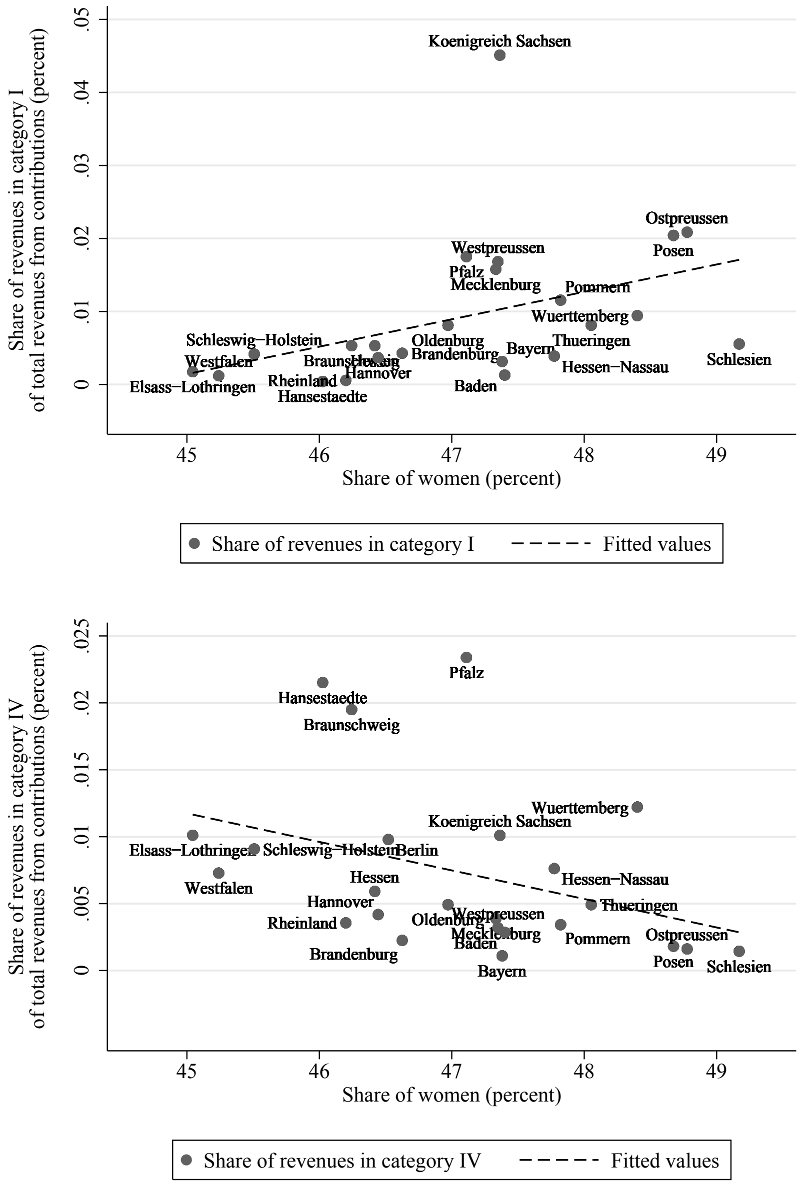
The outcome of interest $y_{i,t,g}$ for province i in group g at time t is either the crude marital fertility rate $CMBR_{i,g,t}$, the number of marriages per 1000,[4] $CM_{i,g,t}$, or the relative change year on year of the respective variable,

$$\Delta CMBR_{i,g,t} = (CMBR_{i,g,t} - CMBR_{i,g,(t-1)})/CMBR_{i,g,(t-1)} \cdot 100$$

and $\Delta CM_{i,g,t} = (CM_{i,g,t} - CM_{i,g,(t-1)})/CM_{i,g,(t-1)} \cdot 100$.

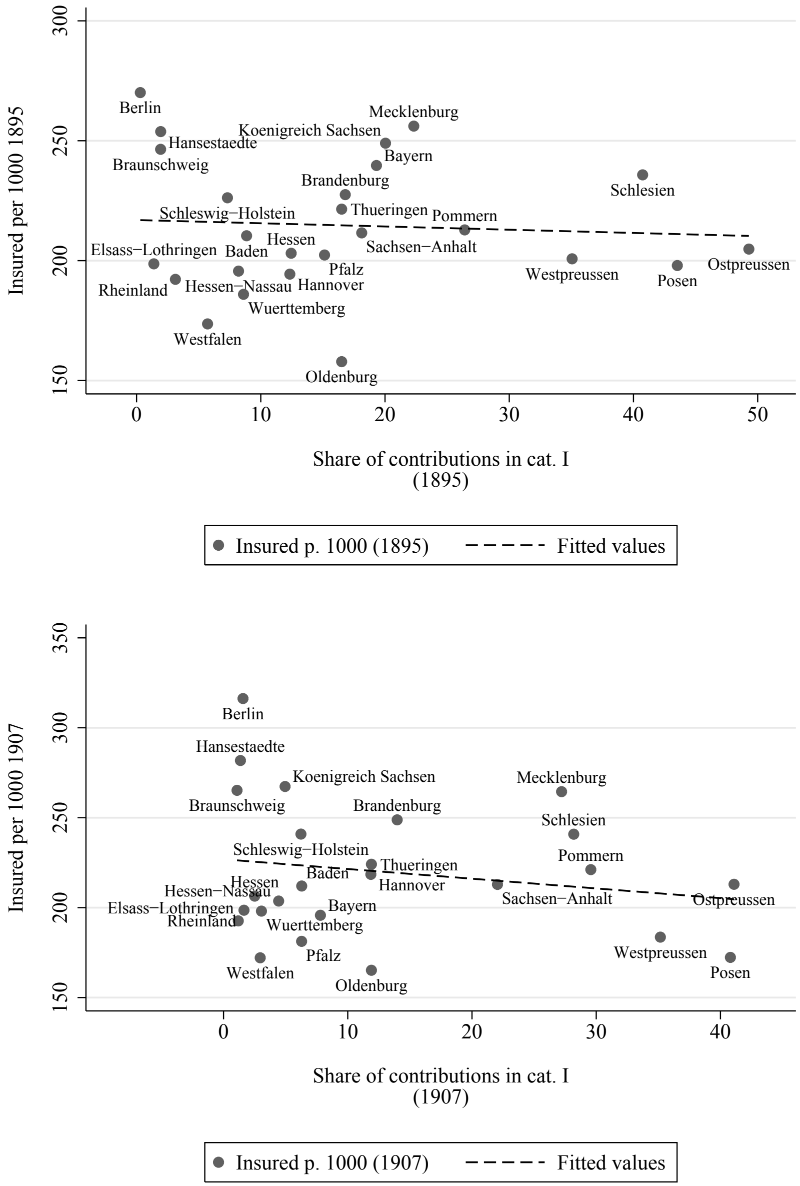
[4] We use this to test for the dowry effect discussed in chapter 4.

Figure 5.2: Contribution categories and share of women



Source: Annual Yearbook of Statistics, Annual Report of the Regional Insurance Agencies, own calculations. Berlin, Sachsen-Anhalt and Elsaß-Lothringen excluded for category I; Sachsen-Anhalt excluded for category IV for clear exposition.

Figure 5.3: Share of contributions in category I and share of insured



Source: Annual Yearbook of Statistics, Annual Report of the Regional Insurance Agencies, own calculations.

The canonical two-by-two difference-in-difference approach, as first laid out concisely in Ashenfelter and Card (1985) and neatly summarised e.g . in Abadie (2005), then assumes that between a pre-treatment period ($t = 0$) and a post-treatment period ($t = 1$), in which the population is observed, a fraction of the population is exposed to some form of treatment. In our setting this corresponds to the fact that provinces with a higher share of the population being eligible for pension insurance coverage are more strongly exposed to the impact of pension insurance. The set of treatment indicators $\mathbf{D_{g,t}}$ switch to 1 if province i has been exposed to the treatment, i.e. if a province has an above average share of insured people as projected based on 1882 figures, in 1895, or in 1907. The indicator variables $\mathbf{DD_{g,t}}$ switch to 1 for the treated provinces in post-treatment years, i.e. for the years after 1891 or after 1900 for provinces with an above average share of insured people in 1882, 1895, or 1907.

The difference-in-difference estimator γ_{DD} is equal to a comparison of means

$$\hat{\gamma}_{g,t} = \left(\bar{y}_{g=1,t=1} - \bar{y}_{g=1,t=0}\right) - \left(\bar{y}_{g=0,t=1} - \bar{y}_{g=0,t=0}\right).$$

Section B.1 in appendix B provides more details on the difference-in-difference estimator. The simple setup makes this estimator very appealing, especially when information on covariates is lacking. The estimator then still yields unbiased results if the assignment to treatment and control group is truly random.

The simple comparison of means is only unbiased if there is no initial difference in trends between the treatment and the control group. In practice, this assumption is rather unrealistic. The provinces differ with regard to key variables, which are unlikely to remain completely unaffected by the introduction of pension insurance. For the estimator to be unbiased, we have to make the assumption that we can control for all covariates that potentially matter for trend differences between treatment and control group, which is also known as the selection on observables assumption.

Province-Specific Effects

Unbiasedness of the DD estimator may be jeopardised by the so-called group-correlated error problem (e.g. Moulton 1990; Wooldridge 2003). If the province-specific errors $\alpha_{i,g}$ are correlated within a group of provinces, that are e.g. adjacent to each other, the resulting standard errors may exhibit a severe downward bias. Note that this does not refer to province-specific effects, which are differenced out, but to the correlation of province-specific effects between provinces.

When using pooled OLS, the Liang and Zeger (1986) correction is a first step to mitigate this problem. Neither this correction nor using a fixed effects estimator will however completely solve it (e.g. Bertrand et al. 2004). There are several possibilities to account for this. Donald and Lang (2007) propose a simple two-step estimator that involves aggregation after a first-step regression and is similar to one of the solutions in Bertrand et al. (2004) that uses crude aggregation. Section B.2 in appendix B discusses these options. Unfortunately, the data are already highly aggregated. This implies a loss in efficiency, as discussed in Brown and Guinnane (2007). Some provinces may consist of very heterogeneous regions. Aggregation can mask differences in the birth rate that could emerge from intra-province heterogeneity.

We also acknowledge the difficulty in reaching meaningful estimates in such a small sample. This makes the correction for group-correlated errors beyond adding province-specific fixed effects difficult. However, we use the simple aggregation technique discussed in Bertrand et al. (2004) as a robustness check for our DD estimates. This effectively reduces the 925 province/year observations to 50 observations, 25 provinces before the policy change and 25 provinces after the policy change.

Spatial Correlation

Errors can be correlated not only between provinces in the treatment group, but also across adjacent provinces, also known as spatial correlation. This may significantly affect both estimated coefficients and the corresponding standard errors. For example, Goldstein and Klüsener (2010) re-analyse the Galloway data to examine the potential impact of spatial correlation. In particular, Galloway (2009) finds that the share of votes for the Social Democrats is a significant determinant of fertility. Goldstein and Klüsener link this finding to spatial correlation. In order to account for spatial correlation, Goldstein and Klüsener calculate the average birth rate over all adjacent provinces and include this as an explanatory variable, and in a different approach the birth rate of the neighbouring province with the highest birth rate. We also include such spatial lags to account for spatial correlation.

5.1.4 Multivariate Model

To include information collected by the Regional Insurance Agencies, we specify a multivariate model separately and in combination with the DD model discussed in section 5.1.3. The multivariate model links the outcome of interest $y_{i,t,g}$, again as above the $CMBR_{i,g,t}$, $CM_{i,g,t}$, or $\Delta CMBR_{i,g,t}$,$\Delta CM_{i,g,t}$, to a set of control variables $x_{\mathbf{i},\mathbf{g},\mathbf{t}}$ and a set of pension variables $p_{\mathbf{i},\mathbf{g},\mathbf{t}}$:

$$y_{i,t,g} = y_{0_i} + T_t + x_{\mathbf{i},\mathbf{g},\mathbf{t}}\beta_x + p_{\mathbf{i},\mathbf{g},\mathbf{t}}\beta_p + \alpha_{i,g} + \varepsilon_{i,g,t}. \quad (5.2)$$

We first estimate the model in equation (5.1), then we estimate the model in equation (5.2) and then we combine the two models as:

$$y_{i,t,g}(DD) = D_{g,t} + T_t + \mathbf{DD_{g,t}}\gamma_{DD} + x_{\mathbf{i,g,t}}\beta_x + p_{\mathbf{i,g,t}}\beta_p + \alpha_{i,g} + \varepsilon_{i,g,t}. \tag{5.3}$$

As discussed in chapter 2, we have proxies for all main determinants of the European Fertility Decline available in our data set. We have information on the number of stillbirths, the number of marriages, population density, productivity and the share of illiterate recruits.[5] Population figures are available in at least five year intervals. As we adjust most variables to the population size to make the numbers comparable, we extrapolate for the years for which population figures are not available. Section A.1.1 in appendix A details how we derive the extrapolated numbers. As an alternative specification, we use crude figures and add information on the population as an explanatory variable.

The vector $x_{\mathbf{i,g,t}}$ includes marriages, the change in the share of stillbirths year on year, population density, productivity and the share of illiterate recruits as current variables and first lag. It is surprising that it is not very common to use lagged explanatory variables in the models analysing the European Fertility Decline. While we lose a period of observations, using lagged variables is closer to the microeconomic foundations of fertility models. In general, given the time lag of at least nine months between the decision to have a child and the observation of a birth, the variables from the previous year are likely to play a much larger role. As we however cannot rule out that factors in year t played a role for births late in t, we include both current explanatory variables and the first lag in the set of covariates in $x_{\mathbf{i,g,t}}$.

The vector $p_{\mathbf{i,g,t}}$ includes the pension system variables: the share of contributions in each wage category, the amount of contributions in each wage category, the relative share of contributions in category I relative to category IV or V, the change in the latter, administrative costs, revenues from other sources than contributions, expenditures for pensions, assets, expenditures for other purposes[6], average old age pension, average disability pension, net existing pension entitlements, net (unapproved) pension applications, and the approval rate for both types of pensions.

Even though the Regional Insurance Agencies were operating regionally, and thus ensured more direct interaction with the population, the administrative areas for pension insurance were quite large. It is unlikely that the population in all parts of the administrative area would observe key variables

[5] Section A.1.1 in appendix A details the availability of these variables for all years in the sample.

[6] These were mainly related to the reimbursement of contributions or payments for medical treatments.

such as the average pension level, or the number of approved pension applications without a lag. In particular, with regard to the procedures that led to an approved pension application, the process could take some time if an application had not been approved at first instance. It is unlikely, that the observations from the current year played a significant role in contrast to past values. Therefore we only include the first lags of all variables in $p_{\mathbf{i},\mathbf{g},\mathbf{t}}$ in the models.[7]

The number of illiterate recruits is available for most years, and so is information on production in agriculture. For both variables, however, information is missing for some years for selected provinces (see section A.1.1 in appendix A for details). This introduces a selection problem in the analysis. We evaluate this selection problem by estimating three different models. The first model does not contain covariates, and neither does the second model, but uses the reduced sample for which information on productivity and illiterate recruits is available. The third model uses the smaller sample, but adds the covariates.

We include time fixed effects and use either a within transformation (FE) or a first differences (FD) approach. The first differences approach is another possibility to account for time-invariant heterogeneity between the provinces, which subtracts observations from $t-1$ from observations from t. If heterogeneity is indeed time-invariant, it is less efficient than the within transformation for $t > 2$. Section B.1.3 in appendix B provides details.

The advantage of using a first differences approach is however that we can infer more about additional factors by including level variables in $x_{\mathbf{i},\mathbf{g},\mathbf{t}}$. Level variables that do not change over time cannot be estimated separately from the fixed effects when using the within transformation. Thus in contrast to the within transformation, the first differences approach allows for a change and level model.

By doing this, we can compare our results to other research on the Fertility Decline. Using a first differences model with level variables has been a common approach in previous research (e.g. Goldstein and Klüsener 2010; Becker et al. 2009, 2010, 2011); however, the question on which variables should be included as level variables has been answered relatively arbitrarily. For example, Goldstein and Klüsener (2010) use the share of the population that is Catholic as a level variable, while Galloway et al. (1994) use the same variable as a change variable. We use it as a level variable.

Few people would change their religion during their life, and if included as a change variable, these would determine the effect. In addition, we use three

[7] Note however, that we also ran models with both the contemporary observation and its first lag. This inflates the number of explanatory variables to an extent that makes inference in such a small sample difficult. Results remain broadly the same.

measures of urbanisation as a level variable: the number of towns with more than 20,000 inhabitants in 1880, the number of people per dwelling in 1885, and the number of people per household in 1885. To find out more about the impact of industrialisation, we include the share of the population working in farming, mining, and trade for the years 1882 – before the introduction of the pension system – and for 1895.

Migration plays an important role in marital fertility and the sex imbalances ratio is a good proxy, as discussed in chapter 2. We use the sex imbalances ratio for 1885 and 1890 as level control variables in the first differences models. In addition, we calculate the share of foreign-born people in each province as reported in 1885.[8] Then we derive the province of origin for the majority of foreign-born people. We use the birth rate in this province as an additional spatial lag that also takes into account migration.

To measure the demographic structure of a province we use the old age dependency ratio in 1885 and the share of men entitled to vote in 1885. The first measure captures the pure age structure, whereas the second measures also captures some of the sociodemographic structure.

Covariates in the DD Model

Note that we cannot infer the influence of level covariates for the model in equation (5.3). A DD indicator variable in a first differences model must be interpreted as a difference-in-difference-in-differences (DDD) estimator. Consider the model

$$\Delta CMBR_{i,t,g}(DDD) = D_{g,t} + T_t + \mathbf{DDD_{g,t}}\gamma_{DDD} + \varepsilon_{i,g,t}. \tag{5.4}$$

The coefficient on γ_{DDD} in equation (5.4) would not be comparable to γ_{DD} in equation (5.3): it provides the difference of the *changes*. Results from such an estimator can be interpreted as pace effects. We estimate such a model in section . To use the full set of control variables in the DD model in equation (5.3), we must therefore resort to a simple pooled cross-section OLS model.

5.2 Descriptive Evidence

5.2.1 Insurance Coverage and Fertility

We have established that pension insurance coverage neither measures the degree of industrialisation of a province nor the extent of female labour force

[8] We only use information on *internal* migration, i.e. the resident population born in another province of Imperial Germany.

participation. To be applicable for our study, the variable should of course be significantly related to fertility.

We can use the continuous nature of the share of insured people to show a negative relationship between the share insured and fertility based on cross-sectional variation. To examine the correlation between the CMBR and the share of insured people for each of the years 1882, 1895, and 1907, figure 5.4 shows the correlation of the CMBR (for 1892 in the top panel and for 1907 in the bottom panel) and the share of insured people (according to the projection based on the 1882 occupational census, as measured 1895 and as measured 1907). We choose the year 1892 for the top panel, as it allows for a sufficiently large lag for the composition of the workforce in 1882 to have an effect on fertility. However, as pension insurance only came into effect in 1891, there should be a limited impact on fertility if the measure indeed primarily captures the share insured and not the composition of the workforce. Figure 5.4 shows that there is no clear negative correlation. In the same vein, the share insured in 1895 and 1907 should not be related to the fertility rate in 1892 if this measure only reflected the composition of the workforce. The left hand panel however shows a small negative correlation. Social insurance is an obvious explanation. The first pillars of social insurance (accident insurance, health insurance) were introduced between 1883 and 1885 and the share of the population covered by pension insurance later on is probably correlated with the share previously covered by health insurance.

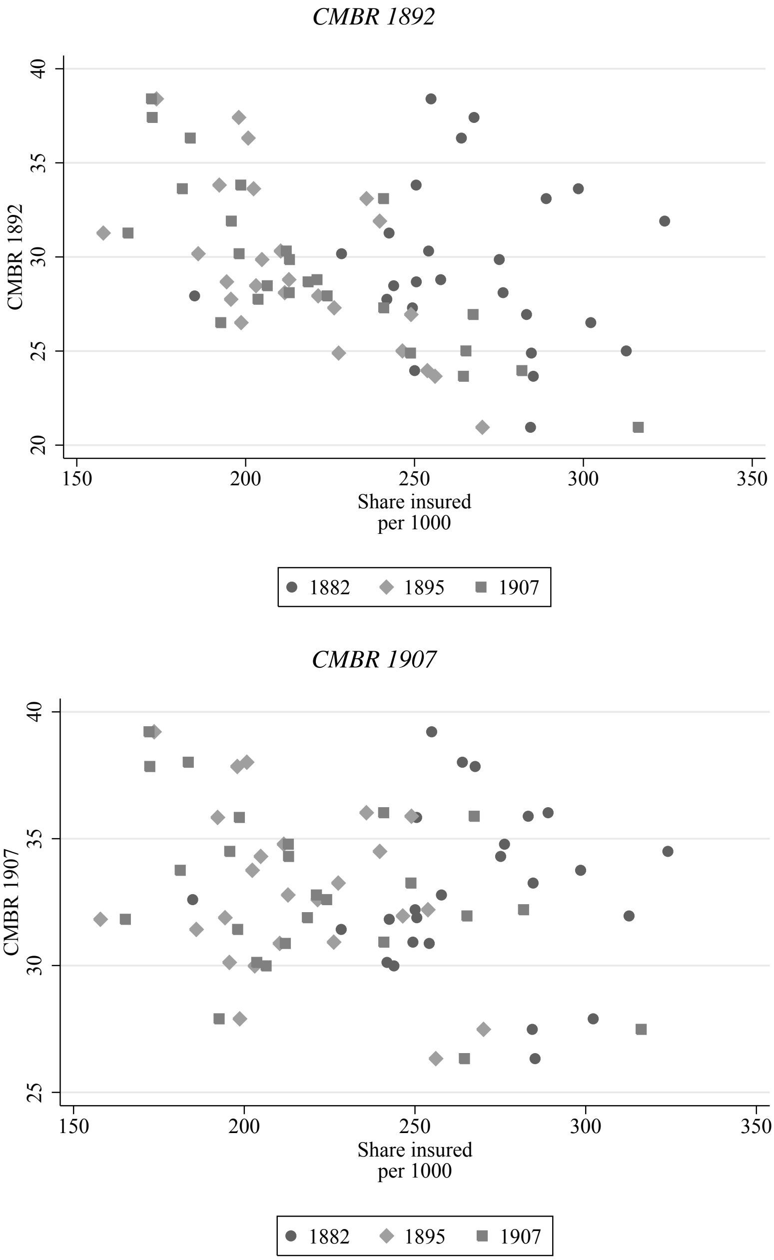
By comparing the top panel with the bottom panel, it is evident that the negative correlation is significantly stronger for the CMBR in 1907. Importantly, this also holds for the measure based on the 1882 occupational census. This yields two preliminary findings. First we find a confirmation that our measure of insurance coverage is indeed related to our variable of interest – the CMBR – in the way which we expected. The introduction of social security, and in particular pension insurance, has a negative effect on the CMBR. Second, it seems that the effect becomes stronger over time.

We can use a multivariate model to test whether the inverse relationship is significant. That is to say, we can run a regression of the CMBR on the share of insured people to establish whether the correlation we observe is significant. As we only observe the share of insured people for two years (and if we include the projected share of insured people based on the 1882 numbers for three years), we cannot use fixed effects on this variable. A solution to the problem is treating the share of insured people the same as a level variable and include it in the FD model from section 5.3.2. Thus, we run the model

$$\Delta CMBR_{i,t,g} = y_{0_i} + T_t + x_{\mathbf{i},\mathbf{g},\mathbf{t}}\beta_x + p_{\mathbf{i},\mathbf{g},\mathbf{t}}\beta_p + l_{\mathbf{i},\mathbf{g},\mathbf{t}}\beta_l + \alpha_{i,g} + \varepsilon_{i,g,t}, \qquad (5.5)$$

where $x_{i,g,t}$ denotes a set of covariates in first differences and the first lag (i.e.

Figure 5.4: CMBR and share of insured people



Source: Annual Yearbook of Statistics, Annual Report of the Regional Insurance Agencies, own calculations. Share of insured people as measured according to projection based on the 1882 occupational census, as measured 1895 and as measured 1907.

the stillbirth change year on year, marriages, and the index of agricultural productivity), $p_{i,g,t}$ denotes a set of pension variables in first differences, of which the first lag is included, and $l_{i,g,t}$ denotes a set of variables, which are not included in first differences (i.e. the share of insured people, the share Catholic, the share in farming, trade, and mining, and the number of savings banks books in 1900).

Table 5.3: Share of insured people and fertility

	(1)	(2)	(3)
CMBR			
Insured p. 1000	-.086 (.017)***	-.006 (.002)***	-.005 (.002)**
Stillbirths change yoy		.040 (.013)***	.047 (.015)***
Stillbirths change yoy (L1)		-.013 (.009)	-.004 (.007)
Concl. marriages pT		.152 (.559)	.265 (.450)
Concl. marriages pT (L1)		.309 (.239)	.034 (.261)
Index of agric. productivity		-.007 (.143)	-.043 (.123)
Index of agric. productivity (L1)		-.055 (.193)	-.077 (.186)
Assets per cap. (L1)		-.066 (.282)	-.452 (.355)
Net disability pension entitlements (L1)		.007 (.112)	.024 (.099)
Year: 1907 (D)		-1.581 (.169)***	-1.236 (.259)***
Share in farming			.020 (.010)**
Share in trade			-.021 (.022)
Share in mining			.018 (.014)
Share Catholic			-.0006 (.003)
Savings bank books p. 100 (1900)			-.001 (.0005)**
Obs.	50	44	44

Estimation with OLS.Explanatory variables are also included as first lag in all columns, pension variables only as first lag. Contribution variables only in columns (2) and (4). Level variables in specification (2) as in specification (10) in table 5.7. Significance level: $^{***}: p < 0.01$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

Table 5.3 shows three specifications. Column (1) provides a raw correlation of the CMBR and the share of insured people. Note that we can use all observations from all years. To keep the analysis comparable with the analysis in column (2), which includes information collected by the Regional Insurance Agencies, we restrict the analysis to 1895 and 1907. The correlation is highly significant. When including both a set of economic determinants of fertility and a selection of pension system variables in column (2) the coefficient on the share of insured people becomes much smaller, but is still highly significant. Even when adding information on sectors of the economy, religion, and saving in column (3), the coefficient remains significant. Thus, the inverse relationship holds even when we account for other confounding factors.

5.2.2 Regional Differences

The treatment variable is negatively related to the CMBR. The time series plots in figure 5.5 help to examine regional differences in the CMBR. Figure 5.5 is set up like the corresponding figures in chapter 2. It shows the CMBR for the geographic regions of Imperial Germany, and also for the provinces with large Slav minorities.

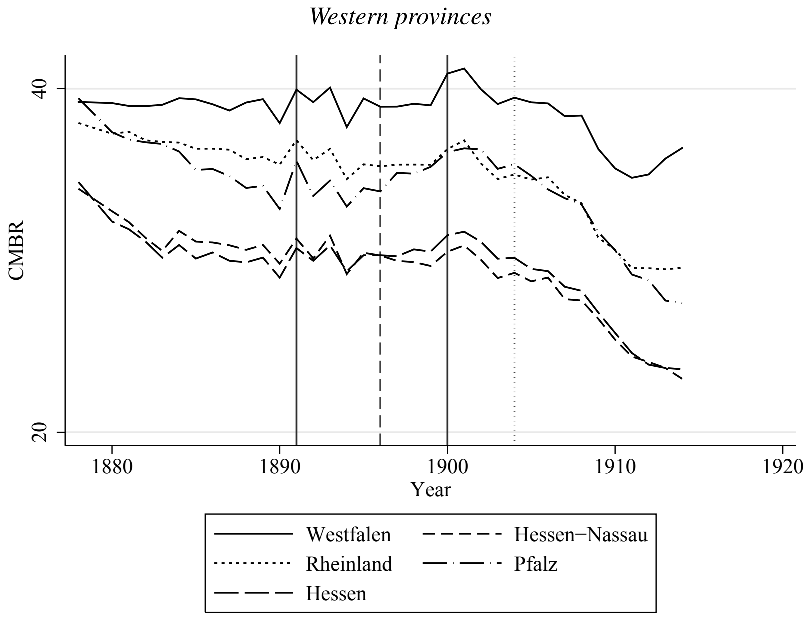
Social security was introduced gradually between 1883 and 1900 (see chapter 3 for details). Pension insurance was enacted in 1889 and came into effect in 1891 (also see chapter 3 for details). The law was amended significantly in 1899, the changes of which came into force in 1900 took place. This confirms 1891 and 1900 as the times in which the most important changes. These are shown by the vertical solid black lines in all panels.

As discussed in chapters 3 and 4, the pension system indirectly affected female labour supply and the incentives for marriage. As women had to contribute for at least five years before they could cash their contributions, any effect related to this fact should not show earlier than 1896. This date is marked by the dashed vertical line in all panels.

For the sake of completeness, the vertical dotted line denotes the year 1904 after which the Imperial Insurance Agency finished the review of the code of practice of the Regional Insurance Agencies (see chapter 3 for details). This change cannot be considered exogenous, as it was caused by rumours of too heavy spending of some Regional Insurance Agencies. Nevertheless, it may have triggered a fertility response. In addition, the orange line helps to locate 1903, when the law on child labour was amended. This may also have triggered a fertility response.

Pension insurance was the last pillar of Bismarck's social insurance. However, accident insurance was introduced as early as 1883. Notwithstanding, most regions do not display a significant dip in the CMBR during the mid-

Figure 5.5: Crude marital birth rate by region



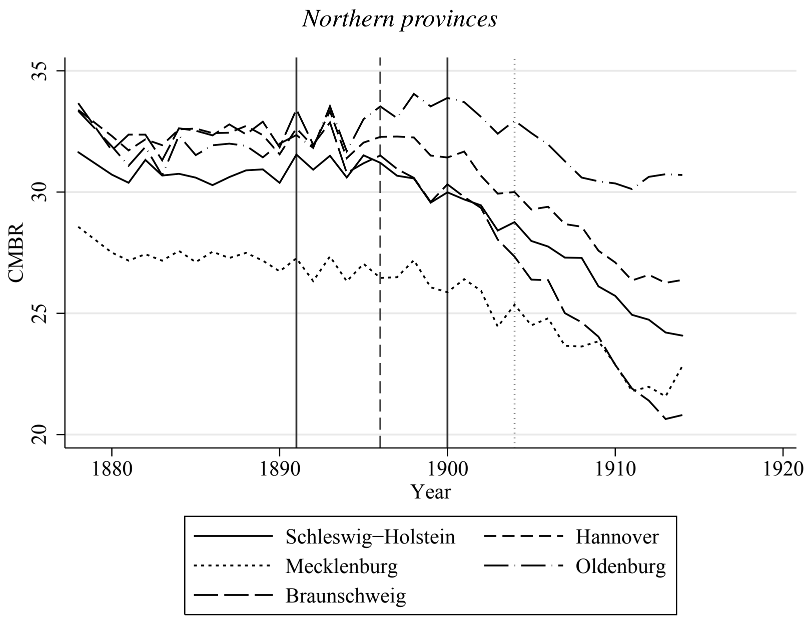
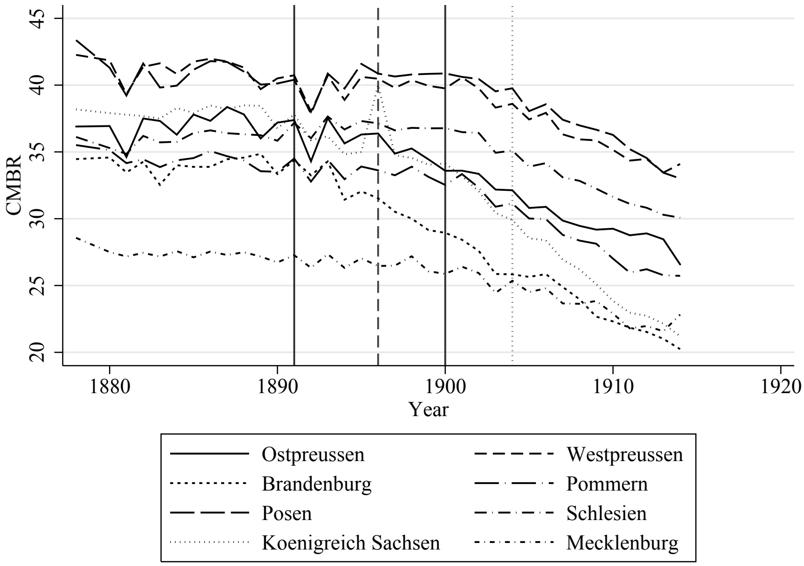


Fig. 5.5 contd.

Eastern provinces



Southern provinces

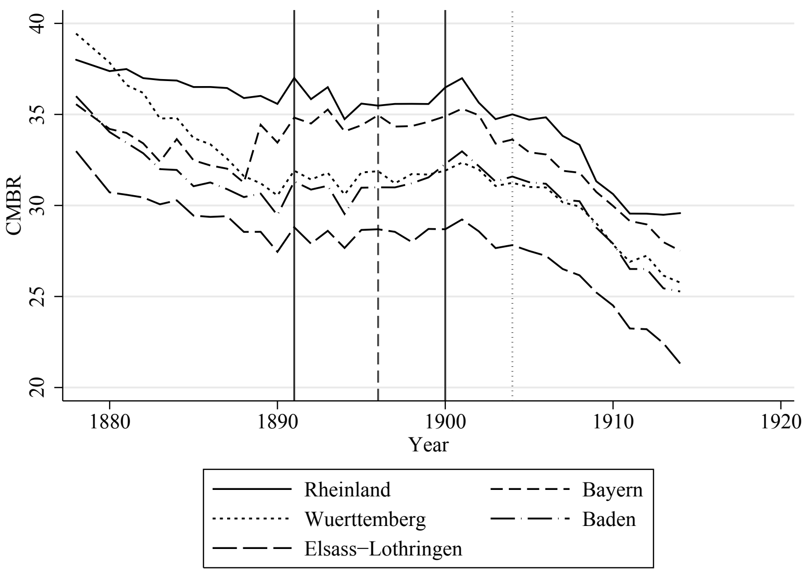
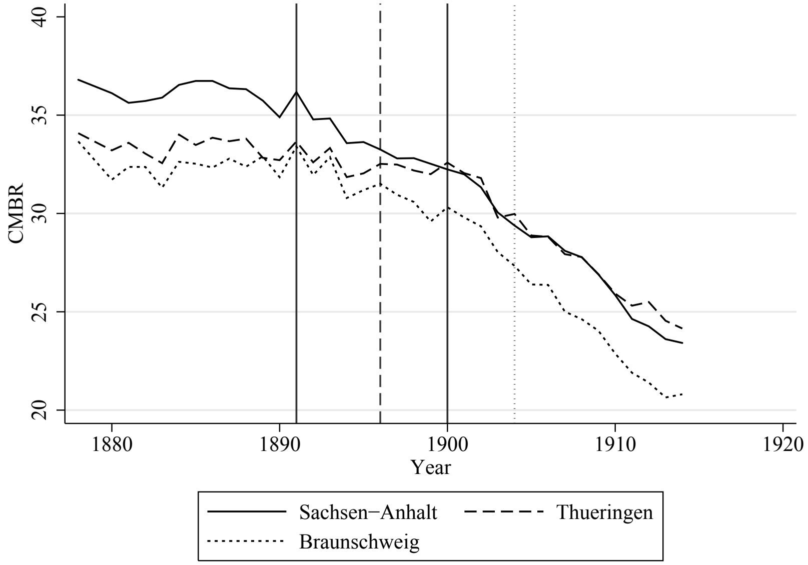
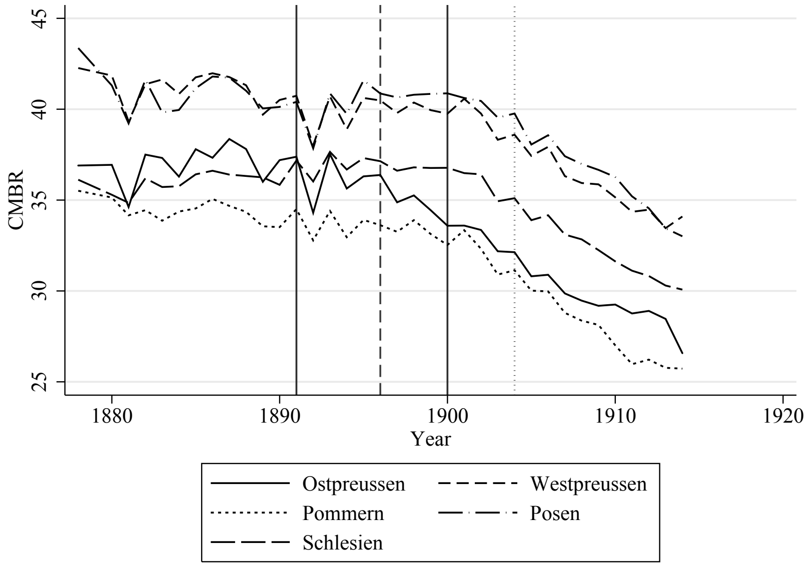


Fig. 5.5 contd.
Central provinces



Provinces with large Slav minorities



Source: Annual Yearbook of Statistics.

1880s. The CMBR only declines in the western and southern provinces during the mid-1880s, as shown in the upper left and the middle right panel, but this just continues a trend that started even earlier. The year 1900 then clearly marks a change in the trend.

Figure 5.5 also shows that trends are diverging between provinces, in particular during the 1890s. For example, the CMBR in was very similar for Schlesien and Ostpreußen prior to 1893, but after that the regions show a significant divergence in the CMBR. This may seem surprising, since both provinces were in the same region, in East Prussia. The same can be observed for Hannover and Oldenburg.

An indication of the cause for these differences is given in table 5.2, which lists the provinces sorted by the number of insured per 1000 in 1895. While in Oldenburg, only 15.7% of inhabitants were covered by social insurance, 19.4% were covered in Hannover. Prior to the mid-1890s, the CMBR in both provinces was almost the same. However, after the mid-1890s, the CMBR declined more strongly in Hannover. We can observe the same phenomenon for other provinces that shared a boundary and displayed the same CMBR before the mid-1890s, but differed significantly in the share insured after 1891. Among the Eastern provinces, the difference is most apparent for Pommern and Brandenburg. In Pommern, 21.2% were insured, while in Brandenburg 22.7% were insured. The same can be said for Schlesien (23.6%) and Ostpreußen (20.5%). In the Central provinces the difference is most apparent for Thüringen (22.2%) and Braunschweig (24.6%).

Observing diverging trends between provinces that were comparable in the dimension of the CMBR, but not in the dimension of insurance coverage renders support to the hypothesis that it was indeed social insurance that played a large role in peoples' lives after the mid-1890s. It also confirms our strategy of defining treatment according to the share of insured people in a province. The effect appears more apparent for provinces that are closer to the capital Berlin, which is in line with the regional distribution of the share of insured people in 1895.

In the southern states, we only observe a difference for Bayern (24% insured) and Württemberg (18.6% insured), but this difference had already emerged by the mid-1880s. The enforcement of pension insurance could have been less strict in the southern provinces, which did not have to report to the Imperial Insurance Agency (also refer to chapter 3). In addition, the number of observations for the South is small, as we aggregate all Bavarian jurisdictions into a single one (refer to section A.1 in appendix A). As the Kingdom of Bavaria consisted of very heterogenous parts, aggregation certainly masks some important regional developments.

5.2.3 Anticipation Effects

Could the early change in the southern provinces be related to anticipation effects? Taking another look at figure 5.5 we observe the CMBR *increasing* in almost all provinces slightly before 1891, when the pension system came into effect.

However, Vogel (1951) notes that there was high uncertainty among workers with regard to the effect of the pension system on their lives once the plans became known to them. Often, they would suspect that the whole idea was put forward by employers to pocket some more of the revenues. It is not surprising that workers thus resented the pension system, as they expected the worst. This type of uncertainty may have led to an *increase* in the CMBR, since uncertainty has a positive effect on fertility (Fraser 2001). Fertility could have been perceived as the more reliable means for insurance compared to pension insurance. The general volatility of the CMBR around 1891 can be interpreted as mirroring a period of high uncertainty.

We also observe a small increase in the CMBR before 1900 in some provinces, when the major amendments to the law on disability insurance came into effect. The CMBR decreased before 1900 in almost all Eastern provinces. The impact of such a type of anticipation effect on our analysis is, however, limited, as the anticipation effects are similar for all provinces. This implies that the treatment and control provinces were equally affected, but the divergence between the treated and the control provinces did *not* take place before the introduction of pension insurance. Therefore, we are confident that our identification strategy holds.

5.3 Multivariate Results

5.3.1 Difference-in-Differences Model

To underpin the descriptive analysis we present four different DD specifications for the 1891 policy change and four different DD specifications for the 1900 policy change. Tables 5.4–5.6 present these specifications for each of the three treatment definitions. All specifications correct for the panel structure by using the within transformation. This of course implies that we cannot use level covariates.[9] Columns (1)–(4) present the results for 1878–1899, i.e. for the 1891 policy change, and columns (5)–(8) present the results for 1891–1914, i.e. for the 1900 policy change. Column (1) and (5) present the simple DD results without adding covariates other than year dummies.

[9] We provide a sensitivity analysis using a first differences estimator that allows for the use of level covariates later.

Importantly, a comparison of tables 5.4–5.6 reveals that the treatment effect is broadly the same for the period 1900–1914, irrespective of the treatment definition. The DD coefficient is highly significant in specifications (4)–(8) in all tables. This implies that it is robust regarding the inclusion of covariates and regarding a reduced sample size. The magnitude of the coefficient differs somewhat. Taking column (8) as a benchmark, the coefficient indicates a reduction of 1.8–2.9 children per mill after 1900 if the share of insured people is more than one standard deviation above the mean. Put differently, the treatment effect for 1900–1914 relative to 1891–1899 is a decrease between 1.82 and 2.10 children per 1000. The average CMBR between 1891 and 1899 was 33.06. Therefore, a decrease of 1.82 children per mill corresponds to a decrease of 5.51% of the average CMBR, and a decrease of 2.10 children per mill corresponds to a decrease of 6.35% of the average CMBR.

Of course, there is the caveat to these estimates that they assign a magnitude to the fertility effect that result from an 11-17% increase in the share of insured people from the mean level. If we assume that the effect of pension insurance coverage is constant, we can calculate the effect of an increase from a zero level to the mean level (i.e. 21.5%–26.6%). The estimates suggest that an increase from zero coverage to 26.6% of the population covered would result in a reduction of 13.22% of the average birth rate. If, hypothetically, 100% of the population had been covered immediately, this is would have been associated with a 36.93–49.73% reduction in the average CMBR.

Figure 1.1 in chapter 1 shows that the strongest reduction in both the completed fertility rate (CFR) and the total fertility rate (TFR) occurred between 1900 and 1911. The CFR was down from 4.66 children per woman of the 1865 cohort to 3.90 children per woman of the 1875 cohort to 2.88 children per woman of the 1885 cohort. The women of the 1875 cohort were 14 in 1891 when the pension system was introduced; and the women of the 1885 cohort were 15 in 1900. The difference between the 1875 cohort – the first cohort potentially covered by pension insurance during all their fertile years – and the 1865 cohort is a reduced CFR by 16%. Our estimates suggest a decrease in the CMBR due to pension insurance to be between 7.68 and 12.50% if coverage is increased from a zero to the average level. This implies that pension insurance can explain between 48 and 78% of the decline in fertility. Before we underpin the robustness of these results, tables 5.4–5.6 deserve a closer look.

Table 5.4: Difference-in-difference results: projected insured 1882

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CMBR								
DD	.258	.769	.900	.953	.619	-.604	-1.225	-1.838
	(.337)	(.268)***	(.268)***	(.268)***	(.290)**	(.360)*	(.440)***	(.403)***
Stillbirths change yoy (%)		.023	.026	.027		.038	.027	.028
		(.010)**	(.010)**	(.010)***		(.014)***	(.016)*	(.014)**
Stillbirths change yoy (%) L1		.006	.007	.007		.033	.019	.016
		(.010)	(.010)	(.010)		(.014)**	(.015)	(.013)
Marriages p. 1000		-.027	-.011	.095		.004	.047	.038
		(.211)	(.209)	(.211)		(.074)	(.073)	(.066)
Marriages p. 1000 L1		.744	.725	.825		.130	.138	.109
		(.216)***	(.215)***	(.210)***		(.075)*	(.073)*	(.066)*
Index of agric. productivity		-.002	-.002	-.002		-.001	.002	-.002
		(.012)	(.012)	(.012)		(.035)	(.034)	(.030)
Index of agric. productivity L1		-.016	-.017	-.014		.020	.013	-.015
		(.012)	(.012)	(.012)		(.024)	(.023)	(.021)
Pop. density (Persons/sq. km)				-.007				-.012
				(.002)***				(.001)***
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Spatial lag	NO	YES	YES	YES	NO	YES	YES	YES
Time period	1878–1899	1878–1899	1878–1899	1878–1899	1891–1914	1891–1914	1891–1914	1891–1914
Pension system variables	NO	NO	NO	NO	NO	NO	NO	NO
Contribution variables	NO	NO	NO	NO	NO	NO	NO	NO
Obs.	524	403	395	395	599	506	423	423

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Information on contributions omitted in column (10) because of collinearity. Explanatory variables are also included as first lag, pension variables only as first lag. All columns except for columns (1) and (6) include a spatial lag, both contemporary and as a time lag. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Table 5.5: Difference-in-difference results: insured 1895

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CMBR								
DD	-.265	.082	.135	.467	-2.251	-2.260	-2.796	-2.100
	(.290)	(.212)	(.212)	(.218)**	(.231)***	(.259)***	(.277)***	(.300)***
Stillbirths change yoy (%)		.021	.023	.025		.039	.027	.027
		(.010)**	(.010)**	(.010)**		(.013)***	(.014)*	(.013)**
Stillbirths change yoy (%) L1		.004	.006	.006		.033	.018	.016
		(.010)	(.010)	(.010)		(.013)**	(.013)	(.013)
Marriages p. 1000		-.012	.010	.120		-.013	.013	.021
		(.213)	(.213)	(.215)		(.068)	(.066)	(.064)
Marriages p. 1000 L1		.750	.733	.809		.100	.097	.097
		(.219)***	(.219)***	(.213)***		(.070)	(.066)	(.064)
Index of agric. productivity		-.004	-.005	-.005		-.010	-.007	-.007
		(.012)	(.012)	(.012)		(.032)	(.030)	(.029)
Index of agric. productivity L1		-.006	-.007	-.003		.019	.014	.004
		(.012)	(.012)	(.012)		(.022)	(.021)	(.020)
Pop. density (Persons/sq. km)				-.009				-.006
				(.002)***				(.001)***
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Spatial lag	NO	YES	YES	YES	NO	YES	YES	YES
Time period	1878–1899	1878–1899	1878–1899	1878–1899	1891–1914	1891–1914	1891–1914	1891–1914
Pension system variables	NO	NO	NO	NO	NO	NO	NO	NO
Contribution variables	NO	NO	NO	NO	NO	NO	NO	NO
Obs.	524	403	395	395	599	506	423	423

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Information on contributions omitted in column (10) because of collinearity. Explanatory variables are also included as first lag, pension variables only as first lag. All columns except for columns (1) and (6) include a spatial lag, both contemporary and as a time lag. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Table 5.6: Difference-in-difference results: insured 1907

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CMBR								
DD	-.703	-.467	-.486	-.195	-2.809	-2.970	-2.796	-2.100
	(.308)**	(.232)**	(.231)**	(.237)	(.239)***	(.273)***	(.277)***	(.300)***
Stillbirths change yoy (%)		.018	.020	.022		.041	.027	.027
		(.010)*	(.010)**	(.010)**		(.013)***	(.014)*	(.013)**
Stillbirths change yoy (%) L1		.004	.005	.004		.035	.018	.016
		(.010)	(.010)	(.010)		(.012)***	(.013)	(.013)
Marriages p. 1000		-.056	-.039	.046		-.019	.013	.021
		(.213)	(.212)	(.215)		(.066)	(.066)	(.064)
Marriages p. 1000 L1		.779	.769	.835		.087	.097	.097
		(.217)***	(.217)***	(.214)***		(.067)	(.066)	(.064)
Index of agric. productivity		-.005	-.005	-.005		-.010	-.007	-.007
		(.012)	(.012)	(.012)		(.031)	(.030)	(.029)
Index of agric. productivity L1		-.005	-.005	-.002		.013	.014	.004
		(.012)	(.012)	(.012)		(.021)	(.021)	(.020)
Pop. density (Persons/sq. km)				-.007				-.006
				(.002)***				(.001)***
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
Spatial lag	NO	YES	YES	YES	NO	YES	YES	YES
Time period	1878–1899	1878–1899	1878–1899	1878–1899	1891–1914	1891–1914	1891–1914	1891–1914
Pension system variables	NO	NO	NO	NO	NO	NO	NO	NO
Contribution variables	NO	NO	NO	NO	NO	NO	NO	NO
Obs.	524	403	395	395	599	506	423	423

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Information on contributions omitted in column (10) because of collinearity. Explanatory variables are also included as first lag, pension variables only as first lag. All columns except for columns (1) and (6) include a spatial lag, both contemporary and as a time lag. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Results for 1878–1899

First of all, both the 1882 treatment and the 1895 treatment in tables 5.4 and 5.6 suggest that there was no negative effect if we compare the years 1891–1899 to the years 1878–1890. While the positive DD effect for this period (as displayed in columns (1)–(4) of table 5.5) is significant, it is only significant in column (4) in table 5.5.

In all tables, column (1) gives the 'pure' DD effect without adding covariates. Column (2) includes covariates that capture some of the determinants of the first demographic transition. By including information on the change in the stillbirth rate, we proxy child mortality.[10] We also add information on marriages and on productivity. To proxy the educational level, we add information on the share of illiterate recruits, because this is the only information on education available for all provinces of Imperial Germany.

It is also important to control for population density. However, information on illiterate recruits and population density is not available for all years. We therefore reproduce the estimates from column (2) in column (3), but restrict the sample to those observations for which the information on illiterate recruits and population density is available. We note that restricting the sample does not qualitatively change results. However, adding information on population density and illiterate recruits in column (4) affects the DD estimate. The positive DD estimate in table 5.4 only becomes significant when controlling for these variables in column (4).

Results for 1900–1914

We reproduce the DD estimates for the period 1900–1914 in columns (5)–(8) of tables 5.4–5.6. The DD effect for 1900–1914 is robust across treatment definitions and also when adding covariates. Consider first tables 5.5 and 5.6. The magnitude of the DD coefficient is always around -2 births per mill and highly significant, whether without adding covariates as in column (5), with a restricted sample as in column (6) or when adding covariates as in columns (7) and (8).

The DD coefficient is more sensitive to restricting the sample and to adding covariates when using the projected share of insured people as the treatment definition. Column (5) in table 5.4 in fact suggests a *positive* DD coefficient for the 1900–1914 period. It turns negative when adding covariates in column (6), and the magnitude doubles when only restricting the sample in column (7). The DD coefficient in the full specification in column (8) is however in line with the DD coefficient derived from the other definitions of treatment.

[10] In the medical literature, the stillbirth rate and child mortality are used to describe the same phenomenon, see also chapter 2.

5.3.2 Multivariate Model

Having completed the first of our three steps to investigate the impact of pension insurance on fertility, we now have an idea of the magnitude of the overall effect. The Regional Insurance Agencies collected a rich set of data on how the pension insurance system operated that help us to trace the effects we illustrated in chapter 4. We present two multivariate baseline models for the analyses of particular effects of the pension system on fertility below. These also help us to relate our results to existing research.

Our first baseline model is a change model that has frequently been used in the literature (e.g. Galloway et al. 1994; Galloway 2009; Goldstein and Klüsener 2010). This is equivalent to imposing fixed effects equation (5.2). Our second baseline model is the model in equation (5.2) in first differences. We include several variables in levels which are only available for certain years. If possible, we choose a point in time within the time frame of analysis.

For the time horizon 1878–1890, we include the following level variables as covariates in the first differences model: percentage active in farming in 1882, percentage active in trading in 1882, percentage active in mining in 1882, share Catholic in 1890, localities larger than 20.000 inhabitants in 1880, horses per 1000 inhabitants in 1883, the number of men entitled to vote in 1885, and the number of people per household in 1885.

For the time horizon 1891–1914, we include the following level variables as covariates in the first differences model: percentage active in farming in 1895, percentage active in trading in 1895, percentage active in mining in 1895, share Catholic in 1900, localities larger than 20.000 inhabitants in 1880, horses per 1000 inhabitants in 1907, the number of men entitled to vote in 1885, and the number of people per household in 1885. These level variables are in particular meant to capture determinants of the Fertility Decline other than the pension system, as discussed in chapter 2.

Table 5.7 shows different specifications of the model in equation (5.2), with fixed effects and in first differences, for different time horizons. The focus of table 5.7 is the comparison of our two baseline models, i.e. the change model with the change and level model, and the ability of the model to explain the traditional determinants of the Fertility Decline and the ability of the model to capture the spatial character of the data.

The first two columns show the FE model for 1878–1890 in column (1) and the FD model for 1878–1890 in column (2). The comparison of these two columns reveals that both models yield broadly the same results. Columns (3) and (4) show the column (1) and (2) models for a different time horizon. Columns (5) and (6) add pension system variables to the models and columns (7)–(10) examine two approaches to containing spatial correlation of errors.

Table 5.7: Multivariate model

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CMBR										
Stillbirths change yoy	.083 (.011)***	.042 (.017)**	.100 (.012)***	.035 (.008)***	.052 (.009)***	.025 (.008)***	.047 (.009)***	.023 (.007)***	.051 (.009)***	.023 (.007)***
Marriages pT	.235 (.236)	1.141 (.244)***	.032 (.064)	.011 (.043)	.042 (.036)	-.023 (.013)*	.026 (.035)	-.025 (.013)*	.035 (.036)	-.026 (.012)**
Index of agric. productivity	-.018 (.013)	-.006 (.013)	.005 (.031)	-.007 (.004)*	-.067 (.114)	-.043 (.071)	-.103 (.110)	-.038 (.070)	-.067 (.114)	-.033 (.068)
Savings bank books p. 100		.002 (.002)		.0002 (.0002)		.0004 (.0003)		.0005 (.0003)*		.0005 (.0003)*
Percent in farming 1882		-.008 (.014)								
Percent in trading 1882		-.052 (.042)								
Percent in mining 1882		.013 (.025)								
Percent in farming 1895				-.001 (.006)		-.015 (.012)		-.016 (.012)		-.013 (.013)
Percent in trading 1895				-.022 (.020)		-.032 (.032)		-.039 (.033)		-.027 (.032)
Percent in mining 1895				-.013 (.014)		-.051 (.022)**		-.052 (.021)**		-.048 (.023)**
Percent Catholic 1890		.001 (.002)								
Percent Catholic 1900				.003 (.001)**		.002 (.002)		.003 (.002)		.002 (.002)

Tab. 5.7 contd.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Localities > 20.000 1880		.0009 (.007)		-.014 (.011)		-.002 (.009)		-.004 (.009)		-.002 (.009)
Horses pT 1883		.006 (.002)***								
Horses pT 1907				-.0002 (.0008)		.002 (.001)*		.002 (.001)		.002 (.001)
Men entitled to vote pT 1885		.0008 (.001)		.002 (.001)		.0007 (.001)		.0009 (.001)		.0005 (.001)
Persons per household 1885		.207 (.183)		-.045 (.103)		.100 (.131)		.056 (.142)		.121 (.141)
Married women per married men (%) 1885		.042 (.041)								
Married women per married men (%) 1890				-.039 (.021)*		-.038 (.009)***		-.039 (.009)***		-.043 (.010)***
Spatial lag: average births							.280 (.171)	.290 (.175)*		
Spatial lag: migrants									.088 (.095)	.195 (.106)*
Obs.	242	217	506	483	284	262	284	262	284	262
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Time horizon	1878–1890	1878–1890	1891–1914	1891–1914	1901–1914	1901–1914	1901–1914	1901–1914	1901–1914	1901–1914
S.e. correction	FE	FD	FE	FD	FE	FD	FE	FD	FE	FD
Spatial lag	NO	NO	NO	NO	NO	NO	YES	YES	YES	YES
Obs.	242	217	506	483	284	262	284	262	284	262

Estimation with OLS. 1878–1890: columns (1) and (2). 1891–1914: columns (3)–(10). Explanatory variables are also included as first lag in all columns, pension variables only as first lag in columns (3)–(10). Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Turning to the economic effect captured by the level variables in the FD models first, except for the number of horses per 1000 in 1883, none of the level variables is significant in column (2). This however highlights a problem with restricting the time horizon to 1878–1890. The sample size may be too small to yield precise estimates. Indeed, looking at column (4), which shows the same model as in column (2), but for the time horizon between 1890–1914, we find a significant impact of more level variables: here the sample size is more than double the sample size in column (4).

The most interesting insight from column (4) is that the share of men entitled to vote has a positive coefficient. We proxy the legal entitlement to marry with this variable, since the age of legal entitlement to marry often coincided with the age of legal entitlement to vote. In addition, the impact of the share of Catholics is significant in this specification. Our analysis confirms the argument in Goldstein and Klüsener (2010), who claim that the share of Catholics should be included as a level variable rather than a change variable. The latter approach produced a negative and significant coefficient in Galloway et al. (1994). Here, the impact of the share of Catholics is rather small. According to the model, if the share of Catholics were 10 percentage points higher, the CMBR would be 0.3 births higher. This would be equal to a 1% increase in the CMBR.

The coefficient on the sex imbalances ratio in 1890 illustrates that spousal separation – mostly due to internal migration - had a persistently negative effect. If this ratio increases by one more separated couple for 100 couples, this depresses fertility by 0.03 - 0.04 births, i.e. it depresses the CMBR by 0.3-0.4 births. This is again equivalent to about a 1% effect. Note that this effect is highly robust across all FD specifications in table 5.7.

Except for specification (4), we find that industrialisation had a significant fertility-depressing effect. If the share of the population working in mining increases by 1 percentage point, this depresses the CMBR by 0.5 births. This is equivalent to a decrease of about 1.7%. As shown in column (2), the effect of the share of the population in mining is even stronger for the period 1878–1890.

Including the pension system variables in columns (6)–(10) does not change the economic effects on fertility of the other determinants of the Fertility Decline. This underpins our approach to consider the introduction of pension insurance as an important aspect of the Fertility Decline, but not as one challenging the existence of other factors. Note however that as soon as we include variables on the pension system – which reduces the sample size again – most estimates of the level variables fall short of any meaningful significance level except for the number of horses and the industrial sector variables.

5.3.3 Income and Substitution Effect

After the introduction of the pension system, workers compulsorily had to pay contributions which reduced their disposable income for other investments. This should, inter alia, reduce the investment in children. In addition to the income effect, the individual response to the introduction of pension insurance should also depend on a substitution effect. Simply put, the relative attractiveness of other means of old age provision should change as well. The effect of contributions on lifetime income depends on the internal rate of return of the pension system compared to the rate of return of other means of investment for old age (see chapter 4). If the only means for providing for old age were intergenerational transfers and the pension system, the existence of the latter should decrease the necessity of the former. This would be a pure income effect. If, however, people have the possibility of capital market saving, the effect is not as clear. Measuring the income effect of pension insurance and the substitution effect separately is difficult. We have information on contribution payments and we know the pension level, i.e. the value of pension insurance. The next two sections use this information to find out more about crowding out of fertility due to contribution payments, i.e. the income effect, and reinforced crowding out due to insurance, i.e. the substitution effect.

Consider the income effect first. We have information on net stock of pensions, i.e. on pensions that have to be currently paid net of those pensions that are discontinued as the pensioner has deceased or the entitlement was withdrawn.[11] This number reflects how many pensioners had to be financed with an existing volume of contributions and assets. If we control for contributions and assets, this number provides a proxy of the rate of return of the pension system.

The disability pension was the predominant type of pension. It was more important, and because more people received it, the rate of return was lower than for the old age pension. In fact, during the first years when the system was in place it was more lucrative to receive an old age pension, since the basic pension level was higher, whereas the disability pension increased more significantly after several years of contributing.

As expected, net disability pension stock had a significant negative effect on fertility in all multivariate specifications. Table 5.7 reproduces the estimates from columns (7)–(10) in table 5.7 for the variables that reflect existing pensions and applications. The effect of the net disability pensions stock is negative and highly significant across specifications. Importantly, the effect does not depend on old age pension entitlements or the number of un-

[11] Note that disability pensions were means-tested, so they could be withdrawn. Old age pensions could not be withdrawn.

approved disability pension applications. It is robust across specifications and invariant to whether only change or also level variables are included in the model. If the net disability pension stock rises by 1 disability pension per 1000 the CMBR falls by 0.13–0.20. Thus, if the net pension stock rose by 1%, the birth rate would fall by between 1.3 and 2.0 births.

Table 5.7: The income effect

	(1)	(2)	(3)	(4)
CMBR				
Net pension stock: old age (L1)	-.120 (.139)	-.097 (.136)	.002 (.036)	.019 (.036)
Net pension stock: disability (L1)	-.152 (.054)***	-.195 (.053)***	-.129 (.048)***	-.129 (.058)**
Net old age pension applications (L1)	-2.426 (2.092)	-.466 (2.134)	-1.183 (1.751)	-.417 (1.676)
Net disability pension applications (L1)	-.302 (.407)	-.198 (.403)	.309 (.274)	.344 (.278)
Approval rate: disability pensions (L1)	.007 (.011)	-.003 (.011)	.011 (.007)	.013 (.008)*
Approval rate: old age pensions (L1)	-.011 (.009)	-.002 (.009)	-.008 (.007)	-.011 (.007)
Time fixed effects	YES	YES	YES	YES
Standard error correction	FE	FE	FD	FD
Level variables	NO	NO	YES	YES
Pension system variables	YES	YES	YES	YES
Contribution variables	NO	YES	NO	YES
Obs.	261	261	239	239

Estimation with OLS. Explanatory variables are also included as first lag in all columns, pension variables only as first lag. Contribution variables only in columns (2) and (4). Level variables in specification (2) as in specification (10) in table 5.7. Significance level: $^{***}: p < 0.001$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

Second, to assess the importance of the substitution effect, we evaluate the importance of capital market saving. Contributions to a statutory pay as you go system can reduce investment uncertainty. This is particularly important when capital market returns and intergenerational transfers are unreliable. The period from 1873, when Imperial Germany joined the Gold Standard, to 1895 was characterised by moderate deflation. If individuals had access to the capital market, capital market investments should have been a dominant strategy. From 1895 however, the environment turned moderately inflationary. This also means that the long-term reliability of capital markets was not clear.

Mombert (1907) finds that in Prussia, a higher number of bank accounts in a region is associated with a lower fertility rate. This implies that there was access to capital market saving. It is unclear whether fertility or capital market saving would be more strongly affected by compulsory pension insurance.

To control for the access to capital markets which is crucial to measuring the partial effect on fertility, we control for the number of savings bank books in a province in 1900, taken from Mombert (1907). Figure 5.4 shows the relationship between the percentage of the population having a savings book in 1900 and the CMBR. The left panel shows the cross-sectional relationship between savings books and CMBR in 1900. The right panel plots savings books in 1900 and all province/year observations between 1878 and 1914.

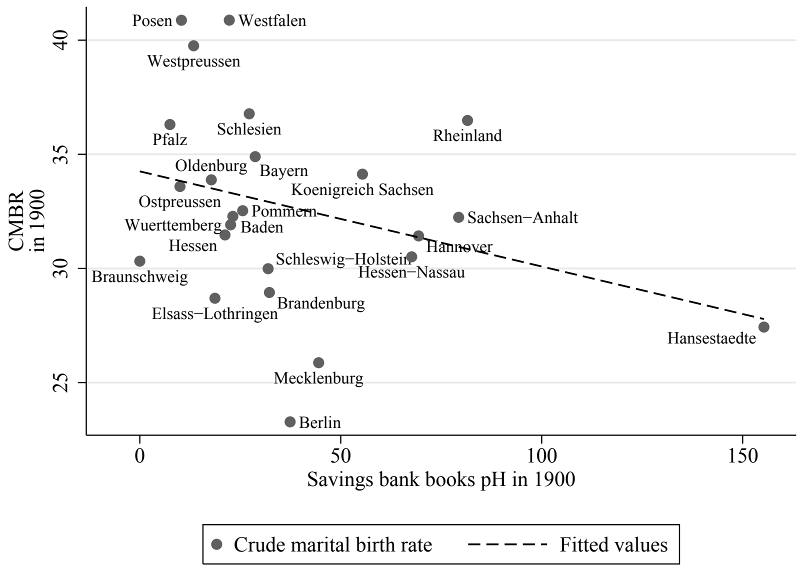
Mombert's data show that the CMBR is inversely related to capital market saving. How is the CMBR related to the internal rate of return of the pension system? This leaves the question of how to measure the internal rate of return of the pension system. It certainly cannot be measured by contribution rates, because these were the same across Imperial Germany for the first years. It canot be measured by the volume of contributions in each wage category either, because this reflects the labour market structure and the composition of the labour force.

Given the obvious negative relationship between savings books and CMBR in figure 5.4, finding a positive coefficient on savings books in the FD models in table 5.7 is surprising. The effect is minuscule, however. One more savings book per 1000 inhabitants would raise the CMBR by 0.005 births. This is around 0.2%. Interestingly, the effect only becomes significant in columns (8) and (10), in which we included a spatial lag. It is likely that the clustering of savings books in the provinces reflects spatial correlation rather than the negative relationship with the birth rate we could see when plotting just raw correlations in figure 5.4. Based on the above argument, we can add information on the net pension stock to the DD estimates to control for the income effect.

The above discussion shows that savings books seem an imperfect proxy for the crowding out caused by the provision of insurance. Instead, we can investigate a non-standard channel that helps to illustrate the effects related to insurance: the value of children.

The value of children as insurance against longevity depends, inter alia, on the survival of the children. The higher (infant) mortality, the less reliable are children as a form long-term insurance. In order to account for mortality, a couple may decide to have a larger family. If there is statutory pension insurance, there is less need to account for mortality. Mortality as a determinant of fertility should become less important. We use this observation to show that there was an effect specifically related to insurance.

Figure 5.4: CMBR and savings books



Source: Annual Yearbook of Statistics, Mombert (1907).

As we do not have information on child mortality, we use the change in the share of stillbirths as a proxy. We would expect that the introduction of the pension system should affected the coefficient on the stillbirth rate.[12]

Table 5.8 shows the coefficient on the change in the share of stillbirths and its first lag in a multivariate model. We have left out information on the pension system in columns (1) and (3) and added this information in columns (2) and (4). Columns (1) and (2) show FE models and columns (3) and (4) show FD models.

Compare first the FE estimates in columns (1) and (2) of table 5.8. The estimates are qualitatively the same and suggest that if the stillbirth rate increases by one percentage point, the CMBR increases by 0.17–0.20 births. If a higher share of children do not survive, it is necessary to have more children in order to have a certain number of children survive. Interestingly, the estimates for both the current value and the first lag only become significant

[12] Even though child mortality and stillbirths are always used in the same context in the medical literature (e.g. Bakketeig et al. 1993), we acknowledge that the share of stillbirths may also proxy the use of birth control. Abortion during all stages of a pregnancy was a common means to control family size until World War I (Woycke 1988). A certain fraction of stillbirths is thus likely to be ‘provoked’ stillbirths.

Table 5.8: The insurance effect

	(1)	(2)	(3)	(4)
CMBR				
Stillbirths change yoy (%)	.017 (.010)	.020 (.009)**	.013 (.004)***	.018 (.005)***
Stillbirths change yoy (%) L1	.018 (.011)	.017 (.010)*	.008 (.005)	.008 (.004)**
Marriages pT	-.0004 (.043)	.025 (.037)	-.022 (.018)	-.014 (.017)
Marriages pT L1	.044 (.038)	.039 (.035)	.033 (.019)*	.026 (.016)
Index of agric. productivity	-.006 (.123)	-.192 (.119)	-.025 (.050)	-.070 (.067)
Index of agric. productivity L1	.075 (.127)	-.060 (.119)	.050 (.059)	.046 (.063)
Spatial lag: migration	.308 (.118)***	.185 (.106)*	.333 (.101)***	.304 (.095)***
Spatial lag: migration L1	.132 (.122)	.068 (.110)	.005 (.056)	-.031 (.068)
Average old age pension L1		-.003 (.013)		-.004 (.011)
Average disability pension L1		.019 (.026)		.011 (.020)
Assets per cap. L1		-.266 (.056)***		.222 (.092)**
Percent in farming 1895			-.002 (.009)	-.006 (.013)
Percent in trading 1895			-.005 (.027)	-.015 (.033)
Percent in mining 1895			-.022 (.015)	-.056 (.023)**
Time fixed effects	YES	YES	YES	YES
Standard error correction	FE	FE	FD	FD
Level variables	NO	NO	YES	YES
Pension system variables	NO	YES	NO	YES
Contribution variables	NO	YES	NO	YES
Obs.	261	261	239	239

Estimation with OLS. Explanatory variables are also included as first lag in all columns, pension variables only as first lag. Contribution variables only in columns (2) and (4). Level variables in specification (2) as in specification (10) in table 5.7. Significance level: *** : $p < 0.001$; ** : $p < 0.05$; * : $p < 0.1$.

when adding the pension system variables. The estimate is similar – an increase of 0.13–0.18 births if the stillbirth rate increases by one percentage point – for the FD estimates in columns (3) and (4). Here too the first lag only turns significant if we add the pension system variables in column (4).

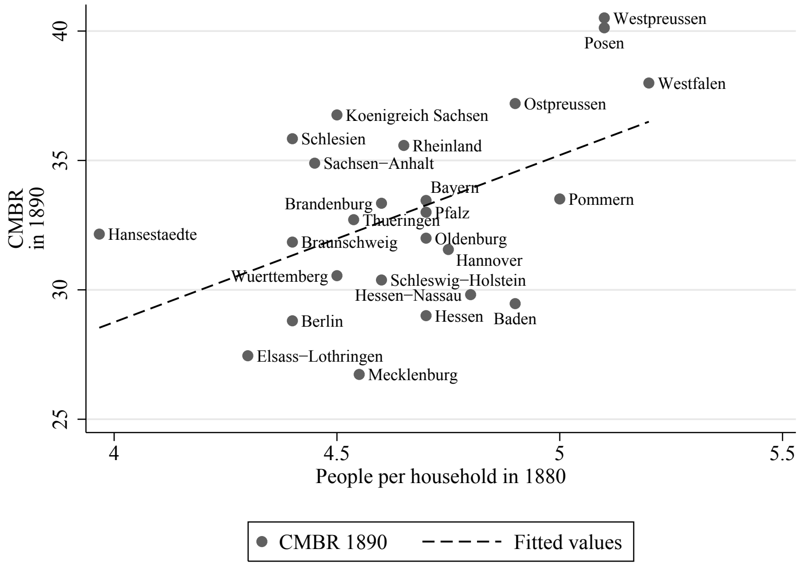
In sum, adding pension system information increases precision of the stillbirth rate coefficient, but not of the other variables such as e.g. marriages. The relationship is positive, thus if the stillbirth rate fell, or more generally speaking, if child mortality decreased, this would also reduce the CMBR. Therefore it is possible that with alternative insurance available, couples more carefully considered having another child if the probability that the children survived was higher.

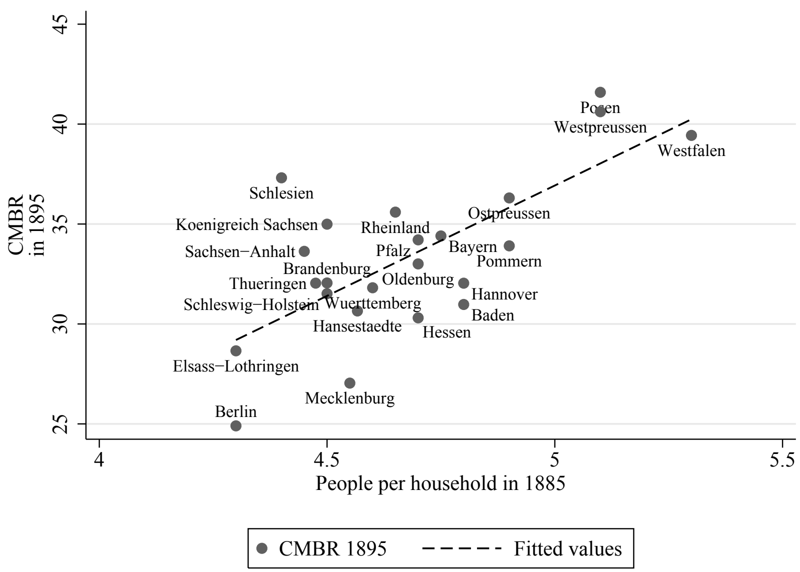
In the same line of argumentation, the existence of a public pension system should have reduced the reliance on intergenerational transfers. To reduce the dependence of the elderly on the mercy of their children was one of Bismarck's motives to support the creation of a public pension system. Evidence on the reliability of intergenerational transfers is mostly anecdotal. It is reasonable to assume that these were more important in agricultural areas where more than one generation lived on a farm. Of course, the number of individuals per household is endogenous to the number of births – a higher number of births leads to more people in the household and a higher number of couples in a household probably lead to a higher number of births. Therefore, we assess the correlation between the current CMBR and the number of people per household 10 years before in figure 5.5. The left panel shows the number of people per household in 1880 and the CMBR in 1890. The relationship is clearly positive.

As pension insurance decreased the importance of intergenerational transfers, the link between household size and the number of children should however have become weaker. We examine the relationship between the CMBR in 1895 – after the introduction of the pension system – and the number of people per household in 1885 in the right panel of figure 5.5. The lag is thus the same as in the left panel. There is a similar positive relationship between the lagged number of people per household and the CMBR in the right panel, but there is less dispersion. We also note Westpreußen, Posen, and Westfalen as outliers in both panels.

Table 5.9 reproduces the FD results from table 5.7, and presents specifications for different time horizons and excluding the above mentioned outliers. Column (1) gives the FD results for the time horizon 1878–1890. Column (2) excludes the outliers Posen, Westpreußen, and Westfalen. This shows that much of the positive relationship between the CMBR and household size 10 years earlier is confounded by Westpreußen, Posen, and Westfalen. Column (3) shows the same analysis, i.e. without any pension system variables, but for 1891–1914. We have a similar positive coefficient on household size as in column (1). Column (4) then adds the pension system variables. The association between household size and CMBR is still positive, albeit not significant.

Figure 5.5: CMBR and people per household





Source: Annual Yearbook of Statistics.

However, reducing the sample by the rural outliers, for which intergenerational transfers should have been more important, in column (4) turns the coefficient on household size *negative* and significant. Note that the coefficient on population density in buildings does not change its sign and stays of roughly the same magnitude, even though it is not significant in all specifications. This suggests that intergenerational transfers became less important because of the insurance effect of the pension system.

5.3.4 The Dowry Effect

The first demographic transition and the introduction of the pension system also give us an opportunity to analyse the impact of a tempo effect. The term tempo effect refers to the phenomenon that women postpone having children to later stages in life (e.g. Billari et al. 2002). However, if women only start to have children by their mid or end thirties, they cannot have more than one or two children for biological reasons: fecundity falls with age (Bongaarts and Feeney 1998; Bongaarts 1999). Evidence on the impact of the tempo effect is mixed (e.g. Lesthaeghe and Willems 1999), and it is not clear yet whether it is substantial, since the completed fertility of the cohorts who are said to be of postponing fertility has yet to be observed.

In the context of the first demographic transition, we proclaim that the introduction of the pension system had a postponing effect on marriages resulting in a postponement of fertility. We test the postponing effect on marriages with a DD approach and provide a supporting analysis that makes use of the pension system variables.

Our analysis rests on the fact that working women effectively accumulated a dowry in the pension system, which they could cash when they got married. The pension system therefore represented an alternative, but compulsory method of saving for a dowry. Therefore, the pension system effectively became a commitment device for saving for a dowry.

Women who worked in an occupation that qualified for pension insurance coverage were subject to compulsory insurance, just like men. Therefore, they faced an incentive to work for at least five years in that occupation before getting married in order to qualify for reimbursement. As a consequence, the number of marriages should have been lower for the first five years after the introduction of the pension system. After this temporary drop we would expect marriages to return to their previous level after 1896 and possibly even an elevated level, as the dowry made working class women, who would not have saved otherwise for a dowry, more attractive. Marriages indeed decreased from 1891 to about 1894 in most regions of Imperial Germany, followed by a surge in marriages until 1900.

Table 5.9: The value of intergenerational transfers

	(1)	(2)	(3)	(4)	(5)
CMBR					
Average old age pension (L1)				-.004 (.011)	-.004 (.011)
Average disability pension (L1)				.005 (.021)	-.016 (.019)
Approval rate: disability pensions (L1)				.012 (.008)	.006 (.007)
Approval rate: old age pensions (L1)				-.010 (.007)	-.003 (.006)
Total pension payments per cap. (L1)				.910 (.955)	.675 (.886)
Other costs per cap. (L1)				-.607 (.757)	-.645 (.716)
Share in agriculture	-.003 (.018)	.005 (.018)	-.001 (.010)	-.005 (.015)	.015 (.012)
Share in trade	-.022 (.076)	.019 (.085)	.012 (.031)	-.005 (.043)	.068 (.033)**
Share in mining	-.003 (.039)	.021 (.033)	-.012 (.016)	-.049 (.028)*	-.029 (.025)
Percent Catholic 1900	.0007 (.003)	.0006 (.003)	.001 (.002)	.001 (.002)	-.0008 (.002)
Localities > 20.000 1880	.006 (.012)	.005 (.012)	-.007 (.011)	.001 (.011)	.017 (.009)**
Horses pT 1907	.003 (.001)**	.004 (.002)**	.0009 (.001)	.0005 (.0009)	-.0003 (.0009)
Men entitled to vote pT 1885	.0007 (.001)	.002 (.002)	.0009 (.001)	-.0004 (.001)	-.0001 (.0009)
Savings bank books p. 100	.0003 (.001)	.0009 (.001)	.0003 (.0002)	.0006 (.0003)**	.0005 (.0002)**
Married women/married men (%) 1890	-.002 (.035)	-.030 (.046)	-.027 (.023)	-.044 (.020)**	-.027 (.023)
Persons per household	.060 (.873)	.290 (.945)	.043 (.181)	.180 (.214)	-.389 (.166)**
Persons per building	-.017 (.017)	-.027 (.020)	-.040 (.020)**	-.020 (.018)	-.032 (.027)
Time horizon	1878–1890	1878–1890	1891–1914	1891–1914	1891–1914
Pension variables	NO	NO	NO	YES	YES
Contribution variables	NO	NO	NO	YES	YES
Posen, Westpreußen, Westfalen included	YES	NO	YES	YES	NO
Obs.	217	190	239	239	211

Estimation with OLS. Explanatory variables are also included as first lag in all columns, pension variables only as first lag. Contribution variables only in columns (2) and (4). Level variables in specification (2) as in specification (10) in table 5.7. Significance level: *** : $p < 0.001$; ** : $p < 0.05$; * : $p < 0.1$.

In chapter 2 we used the share of women in working age as a proxy for the share of working women. This proxies the share well if we control for the industrial structure. However, Haerendel (2001) provides information on another proxy for the share of working women that also measures the extent to which they accumulated savings for their dowry: contributions in wage category I, as previously mentioned, the ‘women’s’ category.

To substantiate our hypothesis, we provide an analysis that relates the contribution in each wage category to the number of marriages. For this purpose, we calculate three measures. First, we calculate the share of contributions in each wage category relative to total contributions to the system, i.e.

$$m_1 = \frac{c_i}{\sum_{i=I}^{i=IV(V)} c_i} \cdot 100,$$

where c_i denotes total contributions in category i in *Mark*. Second, we calculate the share of revenues in category I relative to revenues in categories II–IV before 1900 and as of revenues in categories II–V after 1900, i.e.

$$m_2 = \frac{c_i}{\sum_{i=II}^{i=IV(V)} c_i},$$

where c_i denotes total contributions in category i in *Mark*. Put differently, the second measure presents revenues in category I in units of revenues in all other categories. For example, if $m_2 = 1.3$, the Regional Insurance Agency would collect 1.3 *Mark* of revenues in category I for 1 *Mark* of revenues in all other categories. If $m_2 = 0.8$ the Regional Insurance Agency would collect 80 *Pfennige* for each *Mark* of revenues in all other categories. As an implication, if $m_2 > 1$, category I was by far the most important category for revenues and the number of people contributing in category I must have been relatively high.

Interestingly, m_2 is only above one in Ostpreußen for some years. This means that either in Ostpreußen an exceptionally high number of women worked, or the number of women in Ostpreußen was exceptionally high, or in Ostpreußen, category I was not a women’s category, but wages were exceptionally low in general. Given the rural character of Ostpreußen and the analysis in appendix D that indicates a significant difference between the rural East Prussian provinces and all other provinces also with regard to the wage structure and how the pension system operated, we consider the third explanation the most likely one.

Third, we account for the fact that despite the on average relatively constant share of revenues in category I at the federal level, this share might have changed at the provincial level. As argued in chapter 4, the introduction of pension insurance could have triggered a response of female labour supply. Only by working, women would enjoy the benefits of the new insurance – even though these benefits were admittedly rather the benefits of accumulating a dowry than the benefits of receiving a pension later in life. If the pension system triggered a labour supply response, the initial value of contributions in category I is less likely to be affected than subsequent values. Contributions were first levied in 1891 when the law came into effect. Therefore, we calculate deviation of the relative share of category I revenues from its 1891 value:

$$m_3 = m_{2_t} - m_{2_{1891}},$$

for $t \geq 1892$.

If the pension system was indeed regarded as a dowry fund, it is likely that a woman marrying in t would cash her contributions from period $t-5$ if we assume that women would cash their contributions as soon as they could. Therefore, the value of past contributions should matter for marriages.

Figure 5.6 shows the correlation of revenues in category I and marriages for two points in time: 1888, i.e. before the introduction of the pension system and 1896, i.e. when the timing effect of the pension system should show.

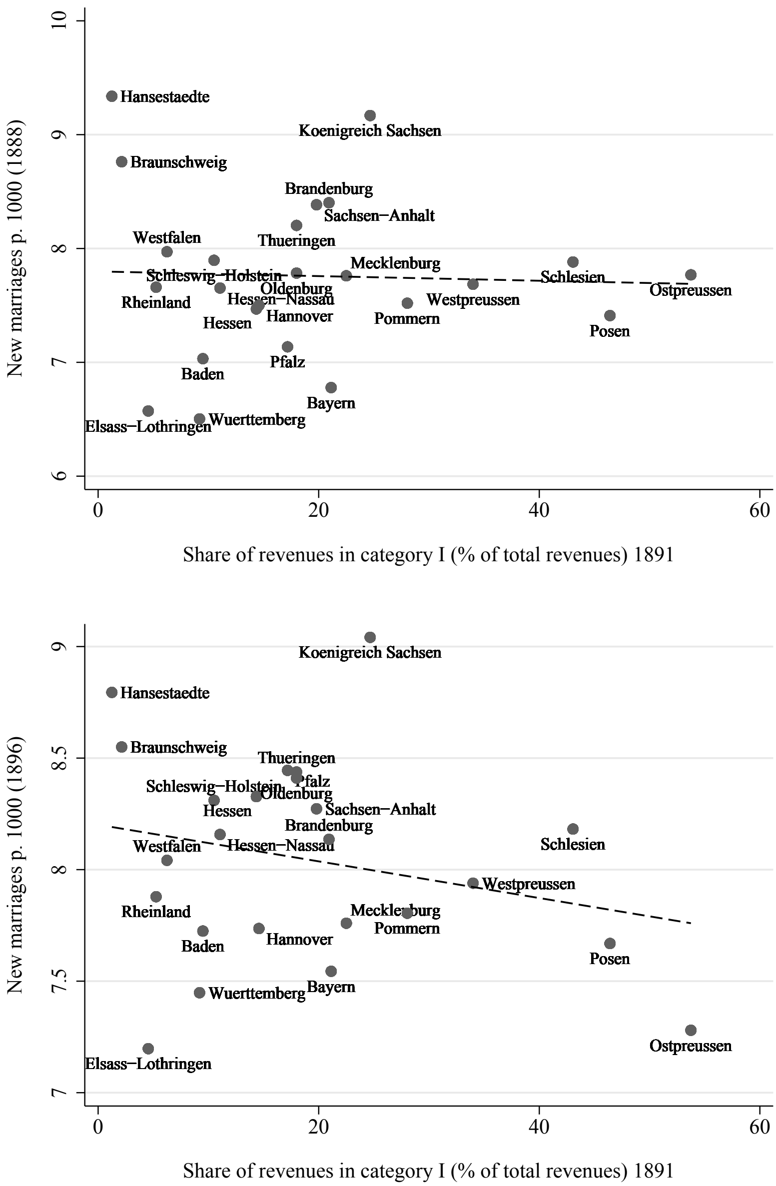
Comparing the upper with the lower panel in figure 5.6 highlights that the small inverse relationship between contributions in category I – which also reflect general trends in female labour force participation – for 1888 is much stronger in 1896. [13]

Testing the hypothesis whether the introduction of the pension system has first suppressed the number of marriages and then elevated the number of marriages is difficult. We cannot solely rely on time-series variation for identification, since we cannot control for important determinants of marriages, such as age structure and regional nuptiality laws for the whole time series. Identification using between-provinces variation and the introduction of the pension system requires a treatment and a control group. Therefore, we use the same identification strategy as we used for estimating the total effect of the pension system on fertility. We use the division of provinces into treatment and control group according to the share of insured people in a province. The dependent variable is marriages per 1000. Results are shown in table 5.10.

In column (1) we restrict the time horizon to years before 1896, when the first contributing women should have been able to cash their contributions in case of marriage. Thus, we would expect to find only the depressing effect

[13] Interestingly, the positive relationship between marriages and revenues in category IV is is not much different between 1888 compared to 1896. Category IV was the highest wage category, so it is safe to assume that only men contributed in this category. The share of category IV revenues is probably related to the share of men eligible for a marriage in a province.

Figure 5.6: Contributions and marriages



Source: Annual Yearbook of Statistics.
Berlin excluded as an outlier.

Table 5.10: The marriage effect

	(1)	(2)	(3)	(4)	(5)
Marriages p. 1000					
DD 1891	-.342 (.082)***	.136 (.140)			
DD 1896			-.094 (.070)	-.035 (.184)	
DD 1896 (2)					-.081 (.169)
Standard error correction	FE	FE	FE	FE	FE
Time fixed effects	YES	YES	YES	YES	YES
Time horizon	1886–1895	1878–1891	1891–1899	1891–1914	1891–1914
Obs.	250	225	350	600	600

Estimation with OLS.
Significance level: *** : $p < 0.001$; ** : $p < 0.05$; * : $p < 0.1$.

on marriages as compared to the years before the introduction of the pension system. Indeed, the DD coefficient is negative and highly significant and indicates a reduction in marriages of 0.32 marriages per 1000. This is equivalent to a reduction of 4.22% relative to the 1891 level of 8.05 marriages per 1000. If we assume constant marginal effects, this corresponds to a reduction of 33% of the 1891 level if 100% of the population were insured.

Column (2) defines the time horizon as 1878–1891. Therefore, the DD indicator variable compares the year 1891 to the years preceding the pension system. This coefficient is positive, such that the negative coefficient we observe in column (1) must indeed be related to the years 1892–1895.

In column (3), we restrict the time horizon to 1891–1899. The treatment period is 1896–1899. Here, we would expect marriages to increase again. Even though the DD coefficient has a negative sign, it is insignificant and of a much smaller magnitude than the DD coefficient in column (1). Extending the time horizon to 1914 in column (4) presents an even smaller and insignificant DD coefficient. This substantiates our claim that the depressing effect on marriages took place in the early half of the 1880s. Column (5) presents the same estimate as in column (4), but defines treatment not as years 1896–1899 as in column (4), but as years 1896-1914. The coefficient is still significantly smaller than in column (1) and insignificant.

To furnish more evidence on the relation between contributions and marriages, table 5.11 provides correlations not only for current values of the measures discussed above, but also for lagged values. That is to say, we use m_1 and its lagged values for each wage category in addition to m_2 and m_3.

Columns (1) and (2) of table 5.11 present the results for the years 1894–

1899. This is the time period when we would expect a positive impact of contributions in category I on marriages. Columns (3) and (4) present results for 1903–1914, when we would expect to see either a persistent, but smaller effect on marriages or a return to no particular effect. We find a large and positive effect for the first lag of category I revenues, which is, however, only significant in the FD approach. It suggests that if contributions in category I in $t-1$ rise by 1 *Mark* per inhabitant, new marriages rise by 18 per 1000. Put differently, if revenues in category I in $t-1$ rise by 1000 *Mark* per 1000 inhabitants, this is correlated with 18 new marriages per 1000 inhabitants. This is consistent with our expectations.

For the FE approach in column (2) we find a negative effect of the second lag of contributions in category III. Columns (3) and (4) of table 5.11 present the results for the years 1903–1914. None of the contribution variables significantly affects marriages after 1900. We only find a significant positive effect of contributions in the new category V after 1900. The previous category IV was split into category IV and V since more and more workers would fall into category V. Therefore, it is possible that the positive category V effect is related to rising wages.

To establish evidence of a pension-system driven marriage effect on the birth rate, we regress the birth rate on marriages and a set of covariates before and after the introduction of the pension system and compare magnitude and precision of the coefficient on marriages.

Table 5.12 shows both the coefficient on marriages and the coefficient on the first lag of marriages for different time frames. For the sake of comparability, we only show the FE estimates. We would expect the CMBR to be more sensitive to the number of marriages after the pension system was introduced, i.e. between 1891 and 1896.

Column (1) establishes a benchmark against which we can evaluate the coefficients for later periods. This shows the effect of marriages on the CMBR for the period 1878–1890, i.e. for a period without a statutory pension system. We observe a negative coefficient for the current value variable and a positive coefficient for the first lag. The interpretation is straightforward. While a marriage in $t-1$ very likely results in a birth in t, a marriage in t should negatively affect births in t, since a couple that only marries in t is on average less likely to have a child in t, unless the marriage is motivated by a pregnancy.

This effect changes completely for the years 1891–1896. The coefficient on the first lag is higher and highly significant. If the pension system causes the number of marriages, and through this fertility, to rise then omitting pension system variables would cause a positive bias in the marriage-fertility relation. We can test whether this is the case.

Table 5.11: Pension system contributions and marriages

	(1)	(2)	(3)	(4)
Concl. marriages p. 1000				
Contrib. I (Mark/Inh.)	-9.649 (16.403)	-9.649 (13.658)	3.359 (3.467)	2.400 (2.702)
– L1	18.330 (9.183)**	18.330 (13.413)	-.702 (.870)	-.627 (2.731)
– L2	10.221 (14.226)	10.221 (13.228)	-.294 (1.005)	1.400 (2.284)
– L3	3.951 (9.112)	3.951 (9.134)	-2.548 (2.818)	-3.085 (1.927)
Contrib. II (Mark/Inh.)	1.495 (2.200)	1.495 (2.895)	-.050 (.323)	.386 (1.325)
– L1	-4.673 (5.974)	-4.673 (6.592)	.521 (.648)	1.169 (1.803)
– L2	8.289 (10.562)	8.289 (8.298)	-1.829 (1.938)	-1.687 (1.821)
– L3	2.900 (4.204)	2.900 (4.760)	.183 (.612)	-.100 (1.151)
Contrib. III (Mark/Inh.)	2.343 (7.610)	2.343 (6.193)	.940 (.897)	1.228 (1.329)
– L1	-4.743 (8.750)	-4.743 (6.907)	.095 (.411)	.062 (1.751)
– L2	-10.415 (6.763)	-10.415 (5.348)*	-.207 (.598)	.640 (1.668)
– L3	3.616 (3.453)	3.616 (3.684)	-1.361 (1.368)	-1.286 (1.092)
Contrib. IV (Mark/Inh.)	3.755 (2.634)	3.755 (2.287)	-.699 (1.040)	-1.759 (1.540)
– L1	-5.761 (5.667)	-5.761 (4.217)	-.012 (.426)	-.087 (1.942)
– L2	1.775 (4.298)	1.775 (4.303)	-.037 (.370)	-.662 (1.774)
– L3	-.763 (1.999)	-.763 (3.351)	.597 (.505)	.652 (1.000)
Contrib. V (Mark/Inh.)			.727 (.370)**	.772 (1.120)
– L1			-.054 (.340)	-.300 (1.550)
– L2			-.737 (.594)	-.696 (2.114)
– L3			-.277 (.486)	-.739 (1.517)
Contrib. I / (Contrib. II-IV(V))	-14.946 (14.918)	-14.946 (12.373)	-3.688 (3.211)	-1.813 (1.897)
Contrib. I / (Contrib. II-IV(V)), change yoy	.036 (.030)	.036 (.026)	.003 (.002)	-.0008 (.006)

Table 5.11 contd.

Total revenues from contrib.	.00008 (.0002)	.00008 (.0002)	.00005 (.00005)	.00003 (.00005)
Years	1894–1899		1903–1914	
Time fixed effects	YES	YES	YES	YES
Standard errors	FD	FE	FD	FE
Obs.	25	50	250	275

Estimation with OLS, correction for unobserved heterogeneity either by cluster option or fixed effects. Coefficients for revenues in category II (lag 0-3) and population are not displayed. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Column (3) reproduces the estimates from column (2), but with a sample reduced to those observations for which pension system variables are available. The magnitude of the coefficients changes only slightly, and the first lag is still significantly positive. If we add pension system variables in column (4) we are back to a negative coefficient in the current value, and to a positive coefficient in the first lag. This suggests that omitting pension system variables may indeed cause a positive bias in the marriage-fertility relationship. As an implication, this suggests that the effect of the pension system on fertility through marriages is positive.

We substantiate this in columns (5)–(7), by showing the same effect for 1897–1900. If we do not add pension system variables in column (5), the coefficient in the first lag is of the same magnitude as in column (3), but it is reduced substantially if we include pension system variables in column (6).

The analysis therefore shows that there is a positive effect of pension insurance on fertility through marriages. If we leave out pension system controls, there is a positive bias in the coefficient on marriages. If we include pension system variables, the coefficient on marriages is insignificant during the period for which we expected a suppression of marriages because of the waiting period to cash the dowry. If we include pension system variables for periods after 1896, the positive coefficient on marriages is significant. This renders further support to our claim that after an initial period of suppression of marriages, the share of marriages would rise and possibly have a stronger influence on births.

Of course, we have to keep in mind that these estimations are approximations. The relative distribution of contributions reflects male and female labour supply, wage and industrial structure and also potential changes to these variables over time. While this makes it hard to isolate effects, it makes this information a powerful tool for controlling the effects of these variables on fertility.

Table 5.12: The indirect effect on fertility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CMBR							
Marriages p. 1000	-.247 (.247)	.464 (.287)	.532 (.499)	-.035 (.672)	-.011 (.054)	-.075 (.054)	.026 (.035)
Marriages pT (L1)	.033 (.257)	1.692 (.264)***	1.050 (.460)**	.573 (.490)	1.003 (.328)***	.621 (.344)*	.068 (.033)**
Time fixed effects	YES	YES	YES	YES	YES	YES	YES
Time horizon	1878–1890	1891–1896	1891–1896	1891–1896	1897–1900	1897–1900	1901–1901–1914
Pension variables	NO	NO	NO	YES	NO	YES	YES
Contribution variables	NO	NO	NO	NO	NO		
Obs.	248	144	70	70	94	94	309

Estimation with OLS, correction for unobserved heterogeneity either by fixed effects. Limited set of non-pension covariates includes change of stillbirth rate and first lag and spatial variable and first lag. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

5.3.5 *Considerations on the Fiscal Externality*

The fiscal externality effect is perhaps the most interesting effect of statutory pensions on fertility from a public finance point of view. However, this is most difficult to test with the data, since it refers to the aggregate result of an individual optimisation problem. As the externality only appears in the aggregate and after a behavioural adjustment at the individual level, it is unlikely to show immediately. The resulting lag is difficult to identify. Also, the fiscal externality appears in a pay as you go type of pension system (see also chapter 4), but Bismarck's pension system was a funded system until 1900. Consequentially, we would expect the pension system to depress fertility more strongly after 1900 than after 1891, as after 1900 the fiscal externality kicked in additionally.

To approximate the fiscal externality after 1900, we pursue the following strategy. We reproduce the DD estimates from tables 5.4–5.6, but now add all pension system covariates which we have shown to capture other channels by which the existence of a pension system affects fertility. Given that these covariates capture the variation in fertility due to other effects, the remaining DD estimate should provide an indication of the fiscal externality. Table 5.13 shows six specifications, two for each definition of treatment. The first specification always restricts the sample to those observations for which information on the pension system variables is available and the second specification adds these pension system variables to the model.

Table 5.13: Full DD model

	(1)	(2)	(3)	(4)	(5)	(6)
CMBR						
DD	-.505 (.422)	-.562 (.327)*	-1.997 (.341)***	-.536 (.325)*	-2.555 (.350)***	-.929 (.400)**
Standard error correction	FE	FE	FE	FE	FE	FE
Time fixed effects	YES	YES	YES	YES	YES	YES
Treatment definition	1882	1882	1895	1895	1907	1907
Pension variables	NO	YES	NO	YES	NO	YES
Covariates	YES	YES	YES	YES	YES	YES
Obs.	373	373	373	373	373	373

Estimation with OLS for 1900 policy change. Explanatory variables are also included as first lag in all columns, pension variables only as first lag. Contribution variables only in columns (2) and (4). Level variables in specification (2) as in specification (10) in table 5.7. Significance level: $^{***}: p < 0.01$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

Columns (1) and (2) show the two different specifications for the projected share of insured people based on the 1882 occupational census. Adding pension system variables does not change the DD coefficient, but it becomes significant, albeit only at the 10% level. Interestingly, for the two other definitions of treatment, the DD coefficient is still highly significant when adding pension system variables in columns (4) and (6), but it is more than halved in magnitude.

We interpret this 'residual' DD coefficient as the fiscal externality effect. Based on this, the maximum fiscal externality effect is a reduction of 0.929 births if the share of insured people increases by 17.21%. This is equivalent to a reduction of 2.84% of the 1900 average crude marital birth rate. If we assume constant effects, an increase in the share of insured people from zero to the mean level would trigger a decline in fertility of 7.61%.

As the results in table 5.13 are derived using a fixed effects model, the level covariates are not included. But these are essential, as we would not like the DD coefficient to e.g. reflect the industrial structure. This complicates the analysis, since running a DD model with first differences, i.e. (5.3) on first differences $\Delta CMBR$, gives a difference-in-difference-in-differences (DDD) model, in which the coefficient γ_{DDD} shows the difference in the *absolute change* of the CMBR.

As such changes can be interpreted as pace effects, they are not useful if we would like to compare the DD estimates to the fixed effects models. As a simple solution to this problem, we run a pooled cross section OLS model with DD terms, and control for group-correlated errors with the Liang and Zeger (1986) correction.

Table 5.14: Full specification: OLS model

	(1)	(2)
CMBR		
DD	-2.970 (1.449)**	-1.983 (.925)**
Stillbirths change yoy (%)	.005 (.016)	.028 (.013)**
Marriages p. 1000	-.141 (.111)	.052 (.075)
Index of agric. productivity	-.525 (.349)	-.867 (.230)***
Percent in farming 1895	-.372 (.135)***	-.169 (.110)
Percent in trading 1895	-1.313 (.441)***	-.235 (.396)
Percent in mining 1895	-.292 (.339)	.324 (.275)
Percent Catholic 1900	.111 (.034)***	.072 (.012)***
Localities > 20.000 1880	-.189 (.120)	-.065 (.052)
Horses pT 1907	.033 (.020)*	.032 (.012)***
Men entitled to vote pT 1885	.052 (.023)**	.041 (.010)***
Savings bank books p. 100	.003 (.003)	.002 (.002)
Persons per household 1885	6.574 (2.010)***	4.352 (.552)***
Married women/married men (%) 1890	.682 (.408)*	.022 (.192)
Time fixed effects	YES	YES
Treatment definition	1895	1895
Obs.	373	373

Estimation with OLS. Explanatory variables are also included as first lag in all columns, pension variables only as first lag. Level variables as in specification (10) in table 5.7. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Table 5.14 compares the full specification with level variables without pension variables in column (1) to a specification with pension variables in column (2). The DD coefficient using simple OLS with insufficient standard error correction is somewhat larger; it indicates a reduction of 2.97 births if the share of insured people rises by 11%. However, adding pension system variables also reduces this coefficient by about a third. While the significant negative effect of a large share of the population in trading becomes insignificant when adding pension system variables, the index of agricultural productivity is only significant in specification (2). It appears that after controlling for the influence of particular effects of the pension system, the index of agricultural productivity sufficiently captures the industrialisation effect.

Generally, there is a strong effect of industrialisation driving the decline in fertility. It is often claimed that it was not pension insurance that caused people to have smaller families, but that it was rather the fact that pension insurance mainly covered workers and workers were most exposed to the forces of industrialisation. It may, however, also be the other way round. Perhaps, instead, too much importance was assigned to the industrialisation effect, which was partly driven by the introduction of pension insurance.

5.4 Sensitivity Analyses

5.4.1 Measuring Pension Insurance Coverage?

The analysis in table 5.4 reveals that the DD coefficient appears sensitive to adding demographic information. Our descriptive analysis did not show a substantial correlation of the share of insured people and the age or industrial structure of a province.[14] It is unlikely that these are captured in the time-invariant fixed effects, since these variables are likely to change over time. It could be possible that our treatment variable does not measure pension insurance coverage, but that it is a measure of the share of workers who were more strongly affected by industrialisation.

To provide a thorough sensitivity analysis, we first check for alternative definitions of treatment. That is to say, we define treatment as a share of the population in a particular sector that is more than one standard deviation above the average. We look at farming in 1871, farming in 1882, mining in 1882, and trade in 1882. Here, we provide the results according to alternative treatment definitions for the 1900 policy change.

Column (1) defines treatment as an above average share of the population in farming in 1871. This has a significant *positive* effect. Column (2) defines treatment according to the share in farming in 1882. The DD coefficient is positive, but not significant. Using the share in mining in 1882 in column (3) and the share in trade in 1882 in column (4) renders a significant negative DD coefficient. Compared to our analysis using the share of insured people, the coefficient in column (4) is particularly large. However, the results do not contradict our analysis using the share of insured people.

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[14] We provide an in-depth analysis of the regional variation in pension variables and what determines regional variation in appendix D.

It would be more surprising if we did not find a significant DD coefficient when using the share in mining or in trade. In the end, occupations out of all sectors qualified for pension insurance (see table A.12 in appendix A). Then, the secondary and tertiary sector underwent a significant development and this development reflects the processes of industrialisation. Thus, it is likely, that for the population in a specific sector the effects of pension insurance and industrialisation added up. As we show in chapter 2, the traditional determinants of the Fertility Decline also played a significant role in the First Demographic Transition.

The positive coefficient on the share in farming is in line with this explanation. The onset of the Fertility Decline is dated to years after 1900 for the more rural areas, for example the East Prussian areas (e.g. Knodel 1878). The direct value of children was higher in rural families, since they could work on the family farm. Put differently, the value of children did not decrease as rapidly in rural families due to pension insurance, as they contributed to household income early on and relative to this value, the value attached to old age provision was lower. Possibly, the DD coefficient in table 5.15 would even be larger if it were not for the pension insurance effect.

Above all, table 5.15 highlights the importance to control for sectoral information, because the treatment is related to the sector. We do not want the DD coefficient to capture any industrialisation effect, and therefore it is important to add the information. We have already illustrated in table 5.14 in section 5.3.5 that adding sectoral information does not affect the DD estimate.

5.4.2 Social Insurance or Pension Insurance?

One of our first and main concerns must be the fact that several elements of social insurance were introduced within a relatively short time frame during the 1880s. In fact, finding a significant effect for 1900 could measure an accumulated social security effect and not a pension insurance effect. In addition, perhaps we would find a significant effect in 1891 for social insurance only if we separated the effect from pension insurance.

Table 5.16 addresses these concerns. Column (1) sets the DD indicator variable to switch to 1 for the years after 1882 (i.e. including 1883), and restricts the period of analysis to 1878–1890. This allows us to compare years with social insurance to years without any form of statutory social insurance. In fact, for the period 1883–1890 compared to 1878–1882 we find a significant negative effect of social insurance: a reduction of 0.61 in the CMBR. Taken together with the analysis for years 1891–1899 compared to before, it seems that social insurance coverage had a negative effect on fertility, while the effect of pension insurance coverage seems to have emerged with a lag.

Table 5.15: Difference-in-difference results – alternative treatment definitions

	(1)	(2)	(3)	(4)
CMBR				
Treatment effect	.899 (.306)***	.493 (.417)	-2.559 (.391)***	-4.195 (.543)***
Treatment	% farming 1871	% farming 1882	% mining 1882	% trade 1882
Controls	YES	YES	YES	YES
Spatial lag	YES	YES	YES	YES
Obs.	506	506	506	506

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Explanatory variables as in .... Treatment set to post 1900. Time horizon 1891–1914. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Table 5.16: Difference-in-difference results: sensitivity

	(1)	(2)	(3)	(4)	(5)
CMBR					
DD	-.614 (.188)***	.161 (.201)	-1.492 (.312)***	-.741 (.206)***	-.440 (.168)***
Stillbirths change yoy (%)	.028 (.010)***	.025 (.010)**	.048 (.017)***	.024 (.009)***	.035 (.009)***
Stillbirths change yoy (%) L1	.011 (.010)	.006 (.010)	.041 (.015)***	.024 (.009)***	.034 (.009)***
Marriages p. 1000	.021 (.223)	.212 (.209)	.205 (.115)*	-.003 (.040)	-.003 (.040)
Marriages p. 1000 L1	.276 (.238)	.760 (.214)***	.284 (.117)**	.047 (.040)	.040 (.040)
Index of agric. productivity	-.006 (.012)	-.005 (.011)	-.006 (.026)	-.058 (.111)	-.112 (.107)
Index of agric. productivity L1	-.005 (.047)	-.004 (.011)	.009 (.018)	-.111 (.113)	-.040 (.112)
Time fixed effects	YES	YES	YES	YES	YES
Time horizon	1878–1890	1883–1899	1891–1902	1900–1914	1903–1914
Spatial lag	YES	YES	YES	YES	YES
Obs.	242	357	230	345	276

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Information on contributions omitted in column (10) because of collinearity. Explanatory variables are also included as first lag, pension variables only as first lag. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Considering the analysis in chapter 4, it is possible that we observe some confirmation of the Social Security Hypothesis. It is possible that social security contributions reduced disposable income, and thereby fertility.

Column (2) helps to compare the pension insurance effect to all other social insurance. The DD indicator variable switches to 1 after 1890, such that it is only 1 for pension insurance years. However, we restrict the time frame to 1883–1899, such that we compare pension insurance years only to years during which some other form of statutory social insurance was in place. Here, we do not find a significant pension insurance effect. This underpins our analysis above. The main effect occurred in 1900, when the system switched from funded to pay as you go.

5.4.3 Child Labour Legislation

We could also argue that the 1891 effect is masked by tightened child labour laws as described in Boentert (2007). Tightened child labour laws reduced the amount of income a child could contribute to household income. Therefore, the direct value of children was reduced. So we would expect to observe a negative effect, if we were only looking for the effect of tightened child labour laws. However, we find a positive effect which is unlikely to be driven by tightened child labour laws.

But perhaps the positive effect would be much larger and significant if it were not for tightened child labour laws? Child labour laws were changed again in 1903. Therefore, it is helpful to only look at years during which child labour laws were not changed, i.e. 1891–1902. In 1900 pension insurance switched from a funded to a pay as you go system (also refer to chapter 3). We can test whether we find a significant effect for 1900 if we restrict the time horizon to 1891–1902. The results of this exercise are shown in column (3) in table 5.16. We still find the same significant pension insurance effect as in tables 5.4–5.6, albeit of a somewhat smaller magnitude.

To substantiate our findings, we can carry out the reverse exercise, too. We can directly check for a 1903 effect in the data, but restrict the analysis to 1900–1914, since there was no exogenous pension system change taking place during these years. The results of this exercise are shown in column (4). We find a significant negative coefficient on the DD indicator, but it is only about two thirds of the coefficient in column (3). Thus we can establish a clear pension system effect for 1900, but we also find a significant 1903 effect compared to 1900–1902. This could however be an effect related to the child labour laws or to responses to the Imperial Insurance Agency's review of the code of practice of the Regional Insurance Agencies that took place between 1902 and 1904, or to a lagged effect of the 1900 policy change. In column (5) we illustrate a classic placebo treatment and set the DD indicator to 1 only for 1907–1914 in column (5) and restrict the years to 1903–1914. We find a significant coefficient for the placebo treatment, which indicates a reduction of 0.5 births. However, we find this effect for each year after 1903.

To investigate whether we may have measured a time trend, we reproduce the estimates from column (8) in table 5.5 with a full set of placebo treatments. That is to say, we include a set of variables that switch to one for years after 1900, years after 1901, years after 1902, up to year 1914. Then we interact these placebo treatments with our treatment variable. The coefficients on the resulting interaction terms are shown in table 5.17. They assist in filtering for which year we really find a significant effect.

Column (1) takes a look at years 1891–1914. Only the interaction term for 1900 is significant and of the magnitude we already know from tables 5.4–5.6. All other interaction terms are insignificant. Column (2) restricts the years to 1900–1914. It becomes obvious that there was no significant treatment effect after 1900. To complement the analysis above, column (3) restricts the time horizon to 1903-1914, i.e. to the time frame *after* child labour laws were tightened again. Again, we find no significant interaction effect. This underpins the robustness of our results for the pension insurance effect.

We provide an analysis of placebo treatments for the full specification with pension variables in table 5.19. Specifications (1)–(4) show different definitions of treatment. Column (1) defines treatment as post 1903, column (2) defines treatment as post 1905, column (3) defines treatment as post 1907, and column (4) defines treatment as post 1910. The DD effect diminishes constantly between specification (1) and specification (4), but is insignificant in all specifications. This underpins that we indeed capture an effect that is related to 1900.

5.4.4 The Importance of Time Series Information

Results presented so far are based on the use of the within transformation for standard error correction. This is a standard estimator to correct for the panel structure of the data. This means that it also takes into account that cross-section variation is in fact only based on 25 observations. Nevertheless, this simple estimator does not account for serial correlation, which may be substantial. Aggregating the data before and after the treatment reduces the sample to 50 observations. This eliminates the serial correlation problem. Table 5.18 shows such an aggregation exercise for the 1882 projected insured treatment definition and for the 1895 share of insured people treatment definition.

It is interesting to see that the results based on the 1882 projected share of insured people treatment definition are not robust to aggregation. This con-

Table 5.17: Difference-in-difference results: placebo treatments

	(1)	(2)	(3)
CMBR			
DD 00	-1.403 (.649)**		
DD 01	-.253 (.835)	.305 (.474)	
DD 02	-.003 (.802)	-.039 (.444)	
DD 03	-.339 (.802)	-.309 (.443)	
DD 04	.023 (.803)	-.055 (.444)	-.037 (.388)
DD 05	-.265 (.803)	-.226 (.444)	-.203 (.389)
DD 06	-.126 (.800)	-.095 (.442)	-.155 (.387)
DD 07	-.123 (.799)	-.208 (.441)	-.128 (.386)
DD 08	.199 (.800)	.134 (.442)	.168 (.387)
DD 09	-.049 (.802)	.032 (.444)	-.034 (.388)
DD 10	-.147 (.803)	-.186 (.445)	-.174 (.390)
DD 11	-.185 (.806)	-.127 (.449)	-.156 (.393)
DD 12	.007 (.808)	-.087 (.451)	-.052 (.395)
DD 13	.016 (.806)	.037 (.448)	.081 (.393)
DD 14	-.182 (.803)	-.148 (.445)	-.220 (.389)
Time fixed effects	YES	YES	YES
Time horizon	1891– 1914	1900– 1914	1903– 1914
Spatial lag	YES	YES	YES
Obs.	506	345	276

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Explanatory variables as in specification (8) in tables 5.4–5.6. Significance level: $^{***}: p < 0.01$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

firms our analysis with covariates that already highlighted that the treatment effect is sensitive to the sample definition and to the covariates added. How-

Table 5.18: Difference-in-difference results: aggregation

	(1)	(2)	(3)	(4)	(5)
CMBR					
	Treatment: projected share insured 1882				
Treatment effect	-.252	.263	.172	.988	.630
	(.723)	(.554)	(.341)	(1.134)	(1.006)
	Treatment: share insured 1895				
Treatment effect	1.152	-.260	.026	-2.872	-2.235
	(.507)**	(.654)	(.647)	(1.399)**	(1.001)**
Treatment	Post 1891	Post 1891	Post 1896	Post 1900	Post 1900
Time horizon	1878–1914	1878–1899	1878–1914	1878–1914	1891–1914
Obs.	50	50	50	50	50

Estimation with OLS. Significance level: $^{***}: p < 0.001$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

Table 5.19: Full DD specification: sensitivity

	(1)	(2)	(3)	(4)
CMBR				
DD	-.372	-.294	-.026	.268
	(.264)	(.240)	(.234)	(.261)
Time fixed effects	YES	YES	YES	YES
Spatial lag	YES	YES	YES	YES
Obs.	395	395	395	395

Estimation with OLS, correction for unobserved heterogeneity with within transformation. Information on contributions omitted because of collinearity. Explanatory variables are also included as first lag, pension variables only as first lag. Significance level: $^{***}: p < 0.01$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

ever, the results using the 1895 share of insured people definition are robust to aggregation. The results in column (5) correspond to the results in column (8) in table 5.5.

5.4.5 Spatial Correlation

To ensure that we do not mistake the results of our model with spatial correlation, we follow Goldstein and Klüsener in using the mean of the birth rate in the neighbouring provinces as an explanatory variable. Unless otherwise indicated, we use it in all models. Table 5.7 illustrates the differences to a model without a spatial lag in columns (7) and (8). The coefficient on the spatial lag is significant in the FD model, but not in the FE model. The coefficient is however only marginally significant at the 10% significance level in the FD model. We therefore illustrate a second approach to capture spatial correlation. We first determine the province of origin of the majority of foreign-born workers in a province. In this context, foreign-born refers to workers born in a province different from their province of reference, i.e. it describes *internal* migration. Then we use the birth rate in that province as a spatial lag. The resulting estimates are shown in columns (9) and (10) of table 5.7. Here, the spatial lag is again significant at the 10% significance level only for the FD model. This suggests that the spatial component might be related to a level variable that we cannot control for in the FE model and that is not sufficiently captured by the fixed effects.

In order to render further support to our models, we also run the change and level FD models for the relative (i.e. percentage) change instead of the absolute change. Results are qualitatively the same. We conclude that our change and level model is more suited to capture both the economic and spatial effects of the decline in fertility.

5.4.6 Pace Effects

The remaining open question is why we observe a significant effect only before 1889 and after 1900. The system was introduced already in 1891, so do we observe a lagged effect of the 1891 introduction, or do we observe an effect of the 1900 change? We can test whether the change in the *growth rate* of the CMBR was different in 1891 than in 1900. Here, using interaction terms in a first differences model is useful. As discussed above, applying a DD procedure in a first differences model effectively yields a DDD estimate. Before, we evaluated whether the difference in birth rates was higher in the provinces with a high share of insured people after the introduction of the pension system. Now we investigate whether the difference in the *decline* of birth rates was higher in the provinces with a high share of insured people after the introduction of the pension system. Table 5.20 illustrates the DDD results.

The results in column (1) are hardly surprising. They present the DDD results without covariates for the 1891 policy change. It implies that birth rates also *changed* more strongly in the treated provinces after 1891. So in addition to the lower level of the CMBR after 1891 in the treated provinces the CMBR dropped more strongly in the treated provinces. However, column (2) adds the change in stillbirths year on year, marriages per 1000, the index of agricultural productivity and the respective first lags as covariates to the sample. The DDD coefficient changes the sign and becomes insignificant. This is caused by adding information on marriages. There is possibly some

Table 5.20: Pace effects of the pension system on fertility

	(1)	(2)	(3)	(4)	(5)
CMBR					
DDD	-.213 (.108)**	.026 (.073)	.443 (.263)*	.465 (.248)*	.506 (.323)
Stillbirths change yoy		.046 (.012)***		.029 (.005)***	.024 (.005)***
Marriages pT		.745 (.203)***		-.021 (.019)	-.019 (.021)
Index of agric. prod.		-.006 (.004)		.001 (.045)	-.010 (.046)
Time fixed effects	YES	YES	YES	YES	YES
Time horizon	1878–1899	1878–1899	1891–1914	1891–1914	1891–1914
Economic controls	NO	YES	NO	YES	YES
Pension system var.	NO	NO	NO	NO	YES
Contribution variables	NO	NO	NO	NO	NO
Obs.	378	378	352	352	352

Estimation with OLS, correction for unobserved heterogeneity by first differencing. Significance level: $^{***}: p < 0.01$; $^{**}: p < 0.05$; $^{*}: p < 0.1$.

unobserved effect related to both the policy change and marriages, or it could be an indication that the effect of the pension system on fertility *through* marriages we discussed in section 5.3.4 could also have affected the pace of the adjustment. The coefficient on marriages is significant at the 1% significance level for both the current value and the first lag and both coefficients are at 0.75 and 0.59 higher than for the level model. So there appears to be a pace effect for marriages, too.

Interestingly, such an effect of adding covariates does not show for the 1900 policy change. The DDD coefficient in columns (3) and (4) is roughly the same, but here the surprise is its magnitude. The coefficient is positive and significant, which means that treated provinces experienced a lower level of fertility, but they adjusted more slowly – or the untreated provinces adjusted more quickly after 1900.

The effect is persistent if we add information on the pension system in column (5), but it is marginally not significant. The implications are interesting. If we see a significantly lower level of fertility in the treated provinces after 1900, but a faster decline in the non-treated provinces after 1900, this might indeed point to the 1900 effect rather being a lagged effect of the initial introduction of the pension system than an effect of the 1900 change.

It suggests that as the pension system was introduced, there was no immediate drop in births. However, births fell more rapidly in those provinces that were more profoundly exposed to pension insurance. This resulted in a significantly lower level of births in the treated provinces after 1900. As the share of the population insured was expanded in 1911,[15] the initially 'untreated' provinces would display the same development – a fast decline resulting in a lower level with a lag – later than the initially 'treated' provinces.

5.5 The Pension System and the Demographic Transition

This chapter presents an empirical approach to find out more about the pension fertility nexus. The introduction of pension insurance in Imperial Germany provides a unique setting for testing the implications of introducing pension insurance in a society without previous involvement of the state. When the state provides insurance, it assumes tasks that previously remained within the family. Therefore, incentives for individual decision-making are changed significantly.

We highlight in chapter 1 that this might in fact be one major reason for why we still observe a pronounced decline in fertility in developed economies. The debate normally considers a society to experience a First Demographic Transition when the level of economic development changes rapidly, like in nineteenth century Imperial Germany. The Second Demographic Transition supposedly takes place when a society has reached a high level of economic development, but experiences cultural change or advances in contraception. Chapters 1 and 2 however show that these arguments were put forward to explain *both* the First and the Second Fertility Decline, and that the division into First and Second Fertility Decline may be artificial. Both were possibly driven by the same phenomenon.

We show that the introduction of pension insurance qualifies as a major driving force for this effect. The introduction of pension insurance first increased the pace of adjustment in the provinces that were more exposed to it, which resulted in a reduced level of births. Our analysis indicates that the same development may have taken place later in the 'untreated' provinces, i.e. those with a lower initial exposure to pension insurance.

It is possible that all provinces in Imperial Germany adjusted at some point, since pension insurance was de facto introduced in all provinces. Given that pension insurance was extended constantly over the twentieth century (with exception of the two World Wars of course), its impact should have

[15] In 1911, also white collar workers were included to be covered by compulsory statutory pension insurance.

rather increased than decreased. This could be a reason for fertility declining so persistently.

Of course, our analysis does not claim that pension insurance was the only determinant affecting fertility. We find the primary determinants of fertility, i.e. marriage, migration and mortality, to be significant in our analysis. In some specifications we find a significant, but small effect of Catholicism. In addition, female labour force participation, education, and the industrial structure as a proxy of industrialisation were significant determinants of fertility in most specifications.

In addition we provide evidence on a significant crowding out of fertility caused by the introduction of the pension system. Evidence based on the internal rate of return of the pension system, and on the value of intra-family transfers is persistently highly significant. Our proxies for the labour market effects were only significant in few specifications. However, we did find a timing effect on marriages and a significant negative overall effect after 1900, even when controlling for all other determinants. We suggest that this 'residual' pension system effect is related to the fiscal externality the pension system causes. We also find pace effects for 1891. However, we have to keep in mind that we find the 1900 effect if we compare the time period after 1900 to the time period 1891–1899. Therefore, the effect could be related to the 1900 policy change. This change turned the pension system into a pay as you go system.

Even though the effect of the pension system was a largely indirect one, it was and it is substantial. However, in comparison to other determinants, the effect of pension insurance on the incentives to have children is an often neglected issue in the debate on the ongoing second Fertility Decline. Still, it is essential to consider in order to address the decline in fertility. Chapter 6 draws conclusions for modern family policy and the design of public pension systems.

Chapter 6

Shaping the Future

The most important revolution of our times is the changed role of women in society.

Die größte Revolution unseres Jahrhunderts ist die veränderte Stellung der Frau.

Theodor Heuss, German President, 1955

Christian and Melanie Kauder with their children Milena and Luca in front of the Bär home in Frankonia (2011). Georg Bär in the picture on page 1 was Milena's and Luca's great-great-grandfather. When the picture of the Kauder family was taken, more than 100 years of declining fertility had passed since Georg Bär was photographed with his siblings at the same spot. While a number of 3 siblings was unusually small for Georg's generation, 2 siblings are already above the average for Milena and Luca's generation.
Source: Family archive.

6.1 A Century of Declining Fertility

"The most important revolution of our times is the changed role of women in society." To Theodor Heuss, the first president of the Federal Republic of Germany, who was born in 1884, the changes Germany had experienced since the onset of the industrial revolution were indeed overwhelming. Since the 1848 revolution, women have inter alia campaigned for education, for universal suffrage, and they have increasingly participated in the labour force.

Since 1955 when Heuss remarked on the status of women in society, the trend has continued at an increased pace. From the current perspective, society was still utterly conservative in Germany in the 1950s. Until 1958, a husband could give notice to the employer on behalf of for his working wife without her consent.[1] A woman was not allowed to open a bank account without her husband's approval. Only since 1977, have women been allowed to work without their husband's consent.[2] These changes reflect changing attitudes towards women. Women of the German baby boomer generation were born in 1955 or later, therefore most of them were able to work without an explicit consent of their husbands. Couples started to enjoy the new prosperity of a double income without kids. Apart from the fact that the state had effectively decoupled the decision of having children from the provision for old age, having children instead of working now in fact had *negative* effects on old age income. Having children implied dropping out of the labour force, therefore no pension claims could be accumulated.

In this respect, nothing has changed since the 1890s. From 1891–1914, women who decided to have a child and stay at home to raise the child instead of working would not only lose their wage income, but also the pension claims they could have earned with continued work. Today pension claims are still predominantly accumulated by working. As women started to work more hours for larger incomes in the course of the twentieth century, the loss in foregone pension claims also became larger. In 1986, the German Constitutional Court finally acknowledged that raising a child should be recognised for the calculation of pension claims. However, the Constitutional Court would only recognise one year equivalent of average pension claims. This was extended to three years in 1992. The justification for this law given by the government is telling:

[1] *GleichberG*, BGBl I 1957, p. 609.
[2] *Erstes Eherechtsreformgesetz*, BGBl I 1977, p. 1421.

It is a decisive contribution to the social recognition of family work with regard to standard jobs that the years spent on bringing up children are taken into account for pension entitlements. Family work thus is considerably upgraded.

Die Anrechnung von Kindererziehungszeiten in der Rentenversicherung ist ein entscheidender Beitrag zu einer Gleichbewertung der Tätigkeit in der Familie und der außerhäuslichen Erwerbstätigkeit. Die Tätigkeit in der Familie erfährt hierdurch eine deutliche Aufwertung.

Source: Hänlein (1989), p. 31.

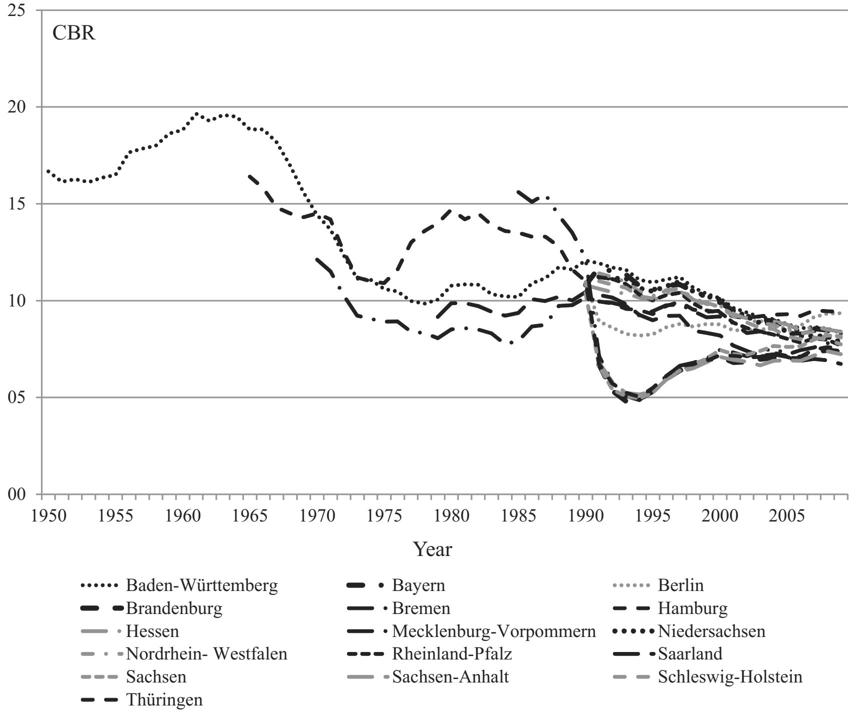
In fact, the conservative government aimed to make child rearing at home more worthwhile by reducing the opportunity cost of doing so. Not because of the problems a low birth rate implied for the pension system, of course. Women should assume their traditional role as a housewife and mother. This sounds familiar. The grandmothers of the baby boomers faced the same critique when they started to flock to the factories.

The effort to lure women back to the kitchen did not pay off, however, neither then nor in the 1980s. The 1980s effort came too late and was implemented too half-heartedly to re-introduce the link between children and old age provision. When facing either the option of having a child and staying at home or the option of working, continued income and a higher level of pension claims,[3] women decided in favour of the latter. As a result, birth rates kept on falling as illustrated in figure 6.1. Figure 6.1 shows the crude birth rate (CBR) for the German states where available since 1950. The baby boom can be clearly inferred for Baden-Württemberg, which is the only state for which we have figures on the CBR for the 1950s. The CBR rises to 19.1 in 1961 and then falls steadily. In 2009, the last year of observation, the CBR was between 9.4 in Hamburg and 6.7 in Saarland.

Was this cultural change after all? Crude birth rates fell strongly during the 1970s when the contraceptive pill became widely available (e.g. Goldin and Katz 2002), also in Baden-Württemberg, Bremen, and Thüringen as shown in figure 6.1. But in Thüringen, the CBR rose again after approximately 1975, whereas it stayed at a lower level in Baden-Württemberg and Bremen. This is only seemingly a puzzle: Thüringen is an East German state that was formerly part of the communist German Democratic Republic (GDR), which pursued decidedly pronatalist policies (e.g. Büttner and Lutz 1990; Kreyenfeld 2004; Sinn 2005). After German reunification in 1990 birth rates fell strongly in the East German states Thüringen, Brandenburg, and Sachsen. Their adjustment towards the West German level between 2000 and 2009 shows that this was not a decline in response to the reunification shock, but

[3] Note that even though the time of rearing a child was recognised as earning some pension claims, the level was of course lower than the level that could have been earned with paid work (Hänlein 1989). In particular, this applies to women in well-paid jobs, because pension claims are related to net income.

Figure 6.1: Crude birth rate in the German states



Source: Statistisches Landesamt Baden-Württemberg (2010); Statistisches Landesamt Bayern (2011); Statistik Berlin Brandenburg (2011); Statistisches Amt für Hamburg und Schleswig-Holstein (2011a,b); Hessisches Statistisches Landesamt (2011); Landesbetrieb für Statistik und Kommunikationstechnologie Niedersachsen (2010); Landesbetrieb Information und Technik Nordrhein-Westfalen (2011); Statistisches Landesamt Rheinland-Pfalz (2011); Statistisches Landesamt Sachsen (2011); Statistisches Landesamt Sachsen-Anhalt (2011); Landesamt für Statistik Thüringen (2011). Data from 1990 onwards: Statistisches Bundesamt (2011d).

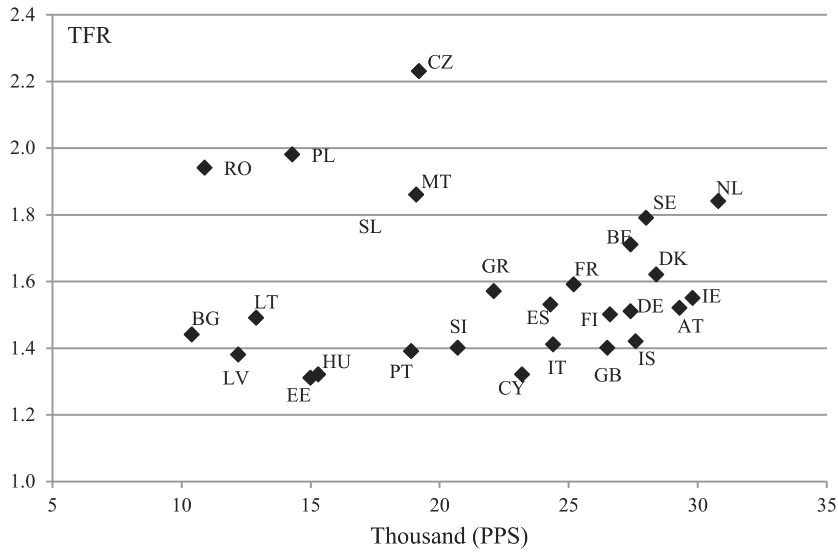
an initial undershooting as part of an adjustment process towards the West German level (e.g. Conrad et al. 1996; Kreyenfeld 2003). Today, all German states display a similar trend.

East Germans adopted the West German fertility pattern relatively quickly – within 20 years. Is it thus possible that the higher standard of living in West Germany proved Brentano and his contemporaries right who claimed that growing prosperity came along with a strong substitution effect?

In Europe it is not the least prosperous regions that display the highest fertility. We use GDP figures in terms of purchasing power standards (PPS) to proxy the stage of economic development in figure 6.2. It shows the correlation between GDP, measured in PPS, and the total fertility rate (TFR).

There is no clear inverse relationship between the stage of development and the TFR. However, this is what we would expect if we believed that economic development is the main driver of the fertility rate. On the contrary, if we only consider countries right of 20,000 PPS, there is a clear *positive* relationship between GDP and the TFR. Therefore economic development is neither a convincing explanation for the development of fertility rates in East Germany after German reunification nor is it a convincing explanation for fertility differentials in Europe. In addition, fertility rates in Europe converge as strongly as they do in the German states (see figure 1.2 in chapter 1).

Figure 6.2: TFR and GDP in PPS in 2009 in selected European countries



Source: Eurostat (2011a). TFR for Italy is the 2008 value.

Consequently the phenomenon to concentrate on is not the baby boom, which certainly reflected some catching up after the war. It is not the contraceptive-pill related drop in birth rates in the 1970s, either. Figure 1.1 in chapter 1 shows that we observe such a drop in total fertility rates, but not in completed fertility rates. The contraceptive pill has mainly changed family planning, but not necessarily family size. Thus, the availability of the contraceptive pill is not an explanation for the adjustment of East German birth rates after reunification to a lowest-low level of fertility.

The fertility decline is under way since more than a century. Within a bit more than a century, crude birth rates dropped by 75% relative to their level in 1878. Figure 6.3 puts the recent developments into this perspective. We have to focus on a much earlier period to find out more about the root causes of declining fertility.

The baby boom in the 50s and 60s that we see for Baden-Württemberg looks rather small compared to the fertility level in the 1880s. While the CBR was around 20 during the baby boom, it was above 40 in 1878. By the end of the nineteenth century, the trend had already changed. In this context, the development until today just appears to be a continuation of that trend. Put in this perspective, the first and the second fertility decline do not look like two different effects but like two phases of the same phenomenon.

Theodor Heuss was right, women's emancipation, their increased labour force participation and the implicit consequences had been very apparent by 1955 and would change much more in the decades to follow, but a general trend had been set much earlier.

6.2 The Changed Role of the State

The changed role of women came along with a changed role of the state. During the 1880s and the 1890s the first comprehensive social security system was introduced in Imperial Germany. While the importance of this development for the existence of the modern welfare state in Europe is widely acknowledged, the role of the welfare state in shaping individual behaviour is less recognised.

The state increasingly assumed the role of the family. First, accident insurance was institutionalised. A responsibility previously assumed by employers was now passed on to the state. In particular, there were clear rules for the provision for the future of workers and their dependants in the case of work-related misfortunes of any kind. Moreover, the state also introduced comprehensive health insurance with sick pay and comprehensive old age and disability insurance. The worker and his family were no longer left to the mercy of the wider family. Instead, the state took over the duties of the family and thus became as important in peoples' lives as their family. Even though it is often neglected, this changed individual behaviour irrevocably.

As we have shown, social security in general and statutory pension insurance in particular have strong indirect effects on fertility. It is evident that investment in public insurance crowds out investment in private insurance, either in the form of capital market investments or in the form of a reduced number of children. However, it is not clear how strong such an effect would be. If statutory insurance is guaranteed by the state and neither depends on the merit of the next generation nor on capital market risks, it is a much better option and consequently leads to a strong crowding out. Simply put, the need to have children to insure oneself against poverty in old age is considerably reduced or even eliminated.

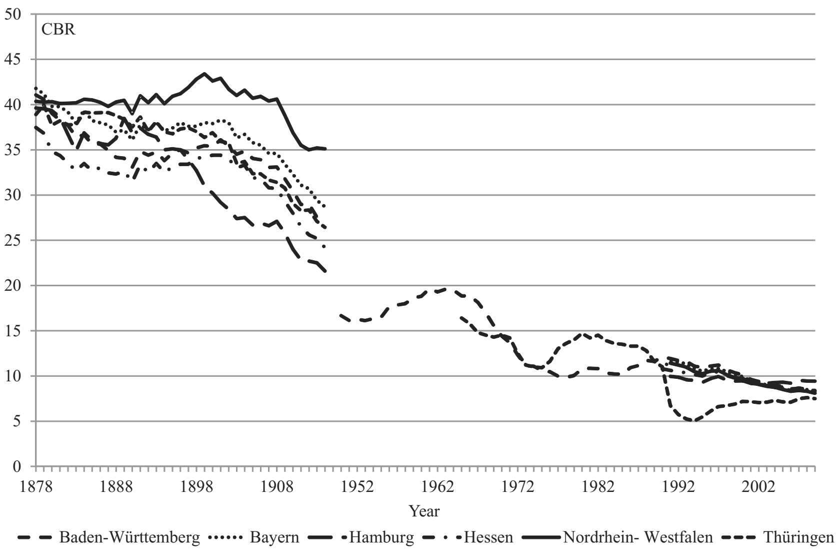
A pay as you go pension system gives the crowding out effect an additional twist. In both a fully funded system and a pay as you go system, the motivation to have children is also decoupled from the motivation to provide for old age. In addition to this effect, it is not own contributions that have to make up for own pensions, but the contributions of the next generation in a pay as you go system. Effectively, it is the children of other people who pay for the pension. In particular if it makes sense for the individual to reduce the number of children, because the state guarantees the pension, it collectively erodes the state's ability to guarantee the pension. Therefore, a pay as you go system renders itself infeasible in the very long run. The externality effect additionally reinforces the crowding out described above.

Precisely because the fertility decline is a long-term development and because the decoupling of the old age provision motive from having children takes some generations, it is worthwhile to take a closer look at the time when the trend changed. The introduction of pension insurance was the last of the 1880s-1890s welfare reforms. Only the most needy groups of the population were covered by pension insurance; the extension of the system was planned for later. We therefore use variation in coverage across the jurisdictions of Imperial Germany to identify the effect of the pension system on fertility during the first twenty years of its existence.

Twenty years are about the effect of one generation. This has also proven to be about the time frame for institutional changes to permeate. For example, the adaptation of East German birth rates to the lower West German level has taken about twenty years to adjust. Correspondingly, if we compare the years after the introduction of pension insurance before World War I (1891–1914) to the years before the introduction of the pension system (1878–1890), we find that birth rates only declined significantly after 1900. This was the time when the system was changed from a funded system to a pay as you go system and the pension system had existed for approximately ten years already.

After 1900, an increase in the share of insured people of around 11% would reduce the crude marital birth rate by around 6%. This does not seem a significant reduction, but only at first sight. Figure 6.3 shows that the crude birth rate fell by around 37% in some provinces between 1900 and 1914. However, assuming a rise in the share of insured people from 0% to average, i.e. to between 21% and 26% of the population, the resulting decline in the birth rate is around 13% based on the most conservative estimates. It means that pension insurance may have contributed up to a third to the decline in birth rates. The upper bound estimate for the opportunity cost effects of the

Figure 6.3: Crude birth rate in selected German states



Sources: Kaiserliches Statistisches Amt (1880–1914). Statistisches Landesamt Baden-Württemberg (2010); Statistisches Landesamt Bayern (2010); Statistik Berlin Brandenburg (2011); Statistisches Amt für Hamburg und Schleswig-Holstein (2011a,b); Hessisches Statistisches Landesamt (2011); Landesbetrieb für Statistik und Kommunikationstechnologie Niedersachsen (2010); Landesbetrieb Information und Technik Nordrhein-Westfalen (2011); Statistisches Landesamt Rheinland-Pfalz (2011); Statistisches Landesamt Sachsen (2011); Statistisches Landesamt Sachsen-Anhalt (2011); Landesamt für Statistik Thüringen (2011). Data from 1990 onwards: Destatis (2011c).

pension system, including the fiscal externality, is a contribution of about 36% to this effect or 4.7 percentage points.

This is substantial given that there were other factors at play too. Accelerated economic development in Germany started in the nineteenth century. Along with industrialisation came the need for a larger workforce. Women increasingly participated in the labour force and started to campaign for equal rights. It is not surprising and certainly not a coincidence that this was the time when social insurance was introduced, even though policy makers had been elaborating on the idea twenty years earlier.

Progress with regard to prosperity, the status of women in society, and social insurance reinforced each other. Cultural change has enabled women to participate in the workforce, but women's participation in society and politics has also led to changed attitudes. Cultural change brought about a new type of welfare state that also allowed women's participation in the labour force, since it was not necessary to have children in order to have support when a person grows old. Growing prosperity reinforced the importance of the pension system, in which pensions and income are linked. Industrialisation and growing prosperity are the encompassing theme for fertility change. It is important to acknowledge that the introduction of pension insurance cannot be viewed separately from this context. However, the introduction of pension insurance at a specific point helps us to identify its effect. We have restricted the analysis to Imperial Germany and the period before 1914, because the two World Wars did not only shake the pension system, but also the structure of society in Germany. During the Third Reich, women's emancipation was brought to a halt, and pronatalist policies pushed up the fertility rate. But after the baby boom after World War II the trend of declining birth rates continued. How much leeway is left?

The completed fertility rate (CFR) fell from 5 children per woman to 1.5 children per woman between cohorts born in 1865 and cohorts born in 1965. This is a reduction of 70%. The pension system led to a decline in birth rates of around 13% in 14 years. If this were a continuous trend, the pension system would have led to a reduction in birth rates of around 92%. This clearly overestimates the development. Figure 6.3 suggests that the fall has slowed down since the 1970s.

This analysis has shown that people react to economic incentives, and that the incentives built in the pension system can explain a large part of the fertility decline. If the pension system has caused the problems it faces today, the most straightforward solution would be redesigning the pension system such that the adverse incentives are removed. Simply put, if the pension system decouples the old age provision motive from the decision to have children, why not reintroduce the link?

6.3 Implications for the Design of Pension Systems

6.3.1 Children and Pensions

A law to recognise a year of childcare at home to count as one year of average contributions towards pension claims was the first policy that reintroduced the link between children and pensions in Germany in 1986.[4] It is ironic that this policy change was intended to recognise the value of work in the home and reflected conservative attitudes of the then ruling conservative party. It was neither introduced to increase the sustainability of the pension

[4] This was extended to 3 years for children born in or after 1992, along with extended maternity leave rules. Also, before 1996, claims earned by staying at home to raise a child could be offset by earnings-related claims and were capped. (Cigno and Werding 2007).

system nor to increase fertility. Moreover, politicians were reluctant to introduce this rule also for women born before World War II. Norbert Blüm, Germany's then labour minister, who claimed that there was no pension problem, said "Why should I pay for the rubble women?".[5] Reintroducing the link between children and pensions was certainly not a top priority on the political agenda.

Child-related pension benefits are in place in some countries (such as in the German example often more by accident than by intention), but the extent to which childcare is recognised differs across countries. Most frameworks rest on the assumption that a woman loses pension claims when she stays out of the labour market to raise a child (e.g. Anderson and Meyer 2006). In the UK, the number of years needed to qualify for a Full Basic Pension can be almost halved if the pensioner had assumed specific domestic responsibilities (Cigno and Werding 2007), whereas in France, pension entitlements are automatically augmented by two years if a mother or father has taken care of a child for at least nine years before the child's sixteenth birthday (Cigno and Werding 2007). Similarly, in Italy, women can also receive an increase in pension claims for the time they are required to stay out of the labour force before and after giving birth and if they voluntarily stay at home longer (Cigno and Werding 2007). In Sweden, too, the pension framework is designed to make up for times of parental leave.

Cigno and Werding (2007) provide simulations on how much household income drops, given the different child-related components in pensions if a woman leaves the labour force to rear a child. This highlights the main point: rules are designed to make up for the opportunity cost of having children. But chapter 5 illustrates that the opportunity cost effect related to female labour force participation is not the most important effect when it comes to children and pensions. The missing link between providing for old age and having children has not yet been explicitly targeted.

Even when Cigno and Werding (2007) claim that "today women – as well as men – can qualify for a modest pension by just rearing two children"[6] taking into account changes to German legislation in 2002, having children instead of working to provide for old age has not been an option for German women. On the contrary, birth rates continued falling in the 1980s and neither the 1992 nor the 2002 change to the legislation made a difference. Why did reintroducing a link between children and pensions not work? If Cigno and Werding are right, child-related benefits are now substantial, but

[5] Rubble women (*Trümmerfrauen*) refers to those women that were left after World War II and had to do hard work in rebuilding the country because many men were still in captivity. Spiegel (1986), p. 31.

[6] Cigno and Werding (2007), p. 61.

they have not changed population dynamics. However, there are more effects at play here. The same laws that granted child-related pension benefits to women who stayed at home also granted them benefits in lieu of labour income which was meant to encourage women to stay at home to raise the child. This was a strong incentive for women to stay at home for the time granted by the state (Ondrich et al. 1996, Gottschall and Bird 2003, Berger and Waldfogel 2004). As a consequence, labour market reentry became more difficult, as women stayed out of the labour force between 12 and 36 months. This has led employers to be reluctant to hire women in childbearing age altogether (Scheubel 2009). But apparently the majority of women preferred the attachment to the labour market to being a housewife. They preferred to earn their pension benefits by working, even if this meant that they could not have children.

Cultural change, as mentioned by Theodor Heuss, intensified the decoupling effect of statutory pension insurance. Women increasingly preferred to work. Clearly, just making up for the opportunity cost of children is not enough to change a behaviour which origins are rooted in the nineteenth century.

It would be easy to introduce a stronger link between pensions and children in current systems. Sinn (2001, 2005) suggests a three pillar pension system consisting of the traditional pay as you go pillar for current pensioners, and a child-related pillar and a funded pillar for future pensioners. As a key element, the baby boomers who do not have any children should be endorsed to privately save for old age. If the pension system would be reformed accordingly, it would effectively be contingent on the number of children. The maximum pension should only be paid to individuals with three children; people without any children should not receive a pay as you go pension. Sinn argues that this is not unjust. People who do not have children do not face child-related expenses, such as direct costs or foregone wage income. Compared to people with children they have additional means which they can invest for their old age pension.

One major advantage of this suggestion is that existing pay as you go pension schemes would not have to be changed. Instead, they would be supplemented by a funded component. After all, the pay as you go scheme still acts as an enforcement device for unreliable children (Sinn 2004b), but people would become individually responsible for their old age provision again – just like originally intended by Bismarck. Another advantage of child-related pensions is that they do not interfere with the individual decision to have children, but removes previously distorting incentives. Therefore, the state interferes less with private decision-making (Sinn 2005).

6.3.2 Alternative Family Policies

The obvious alternative is a secondary compensating intervention instead of eliminating the primary distortion. If the pension system influences people to have less children, they can be induced to have more children by other measures. Such measures range from lump-sum child benefits (e.g. Peters 1995; van Groezen et al. 2003; Fenge and Meier 2005), often means-tested, to child or family tax benefits (Meier and Wrede 2008).

Many countries have family policy instruments in place. The taxation of families as opposed to singles or couples (e.g. Mirrlees 1971). In Germany, there is a tax allowance for married couples that is not conditional on having children. In contrast, France has a family tax splitting system, which reduces the tax burden contingent on the number of children. As a consequence, France has one of the highest total fertility rates in Europe: 1.9 in 2009 (Eurostat 2011e). Egger and Radulescu (2010) show that changing the tax regime from family tax splitting to tax splitting for couples indeed reduces births by about one fifth.

Child care policies and tax policies go hand in hand. The joint taxation of couples often implies a higher marginal tax rate on women, since their wages are lower (Apps and Rees 2004). If there are insufficient childcare facilities available, this means that it is the women who stay at home to care for their children – and it is the women who have to face the cost of extremely difficult labour market re-entry. Individual taxation in combination with childcare facilities can provide the necessary incentives (Apps and Rees 2004). This is the Scandinavian approach to family policy (e.g. Sundström and Stafford 1992). Should countries with pay as you go public pension schemes follow the Scandinavian model?

With respect to the German case, any type of family policy quickly runs the danger of being called pronatalist and thus of evoking unpleasant remembrances of the country's past. While this argument certainly does not qualify as a serious objection when it comes to effectively pronatalist policies, the main concern remains. Pronatalist policies are a secondary intervention that creates additional distortions. From an efficiency point of view, this is clearly the second best solution. In addition to the fact that pronatalist policies cannot solve the baby boomers' dilemma, the effect of pronatalist policies would come in too late to alleviate the burden of the baby boomers' pensions (e.g. Berkel et al. 2002; Börsch-Supan 2004).

6.3.3 It is too late ... not just in Germany

For the baby boomers, fertility incentives come too late. They are in their mid to end forties. Even if it were immediately communicated that they would only receive a full pension if they had three children, their remaining fertile time span is too short to bear enough children.

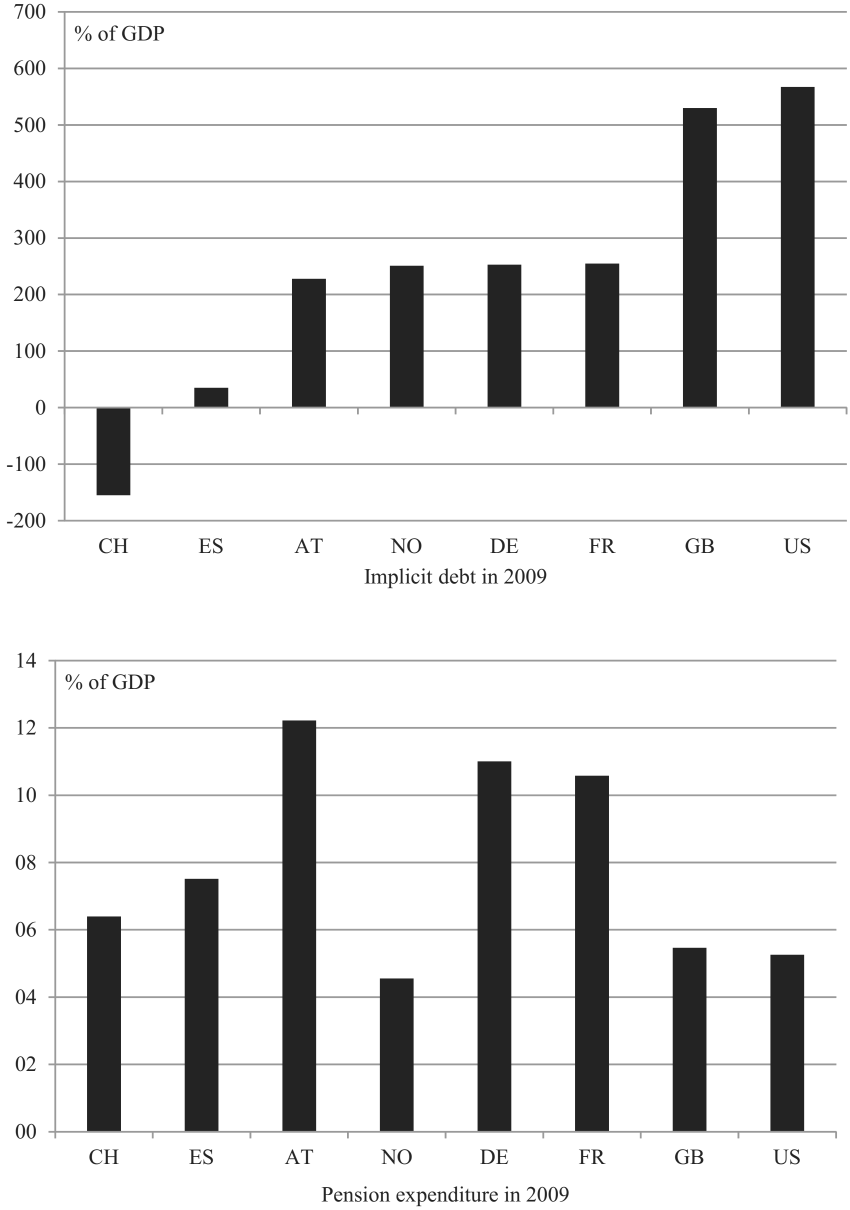
Figure 6.5 shows the old age dependency ratio for Europe, i.e. the ratio of the population aged 65 and over to the population aged 15 to 64 years. This gives a flavour of the burden that the working age population has to shoulder in terms of pension contributions. It is clear that Germany and Italy stand out: the old age dependency ratio was already above 30 in 2010. Ireland and Finland are at the lower end. Note however that Finland is the only European country without a pay as you go system, thus population ageing would not be much of a problem there in terms of the implicit tax in pension contributions. Even though Germany and Italy stand out as the countries with the oldest and most rapidly ageing population, the general trend is overwhelmingly homogenous. It is not just Germany that is ageing. All European countries have an ageing problem. Of course, this is a result of increasing life expectancy. However, declining fertility plays a role in all those countries too.

Eurostat's population projections illustrate the severity of the ageing problem. The ageing problem differs between countries. Figure 6.6 shows the projected percentage change relative to 2010 up to the year 2060. Comparing Germany to its neighbours, only the population in Poland is projected to shrink more.

The baby boomers will retire between 2020 and 2030. This is when the projected burden on a single generation is the largest in Germany. The OECD projects the old age dependency ratio to reach almost 50% by 2050 in OECD countries (OECD 2011), while the OECD projects this ratio to be even above 50% for the EU 27 average (OECD 2011). In Germany, it is projected to rise above 50% by 2030 (Statistisches Bundesamt 2009). Put differently, two people in working age will have to support one pensioner. The baby boomers are large cohorts, while the cohorts of their children are substantially smaller. The most urgent question to address is how the baby boomers' children can shoulder this immense burden.

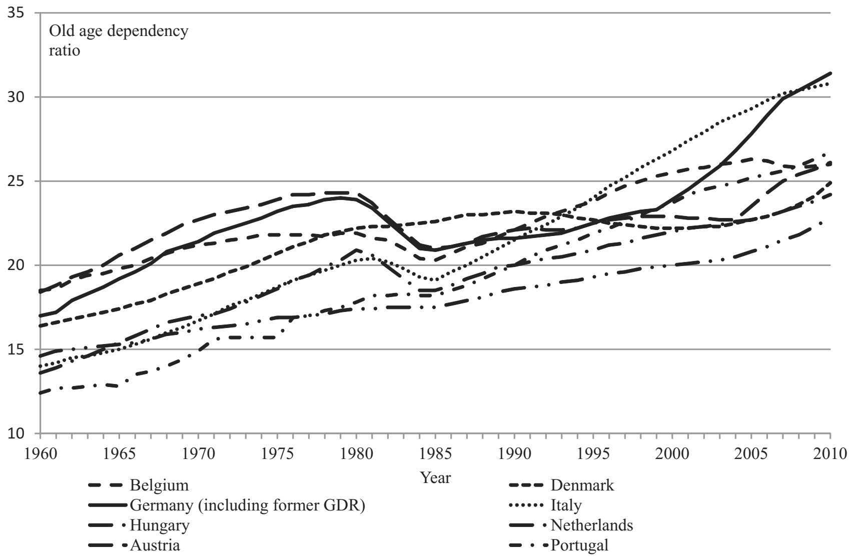
Figure 6.4 illustrates the problem. The top panel shows the level of implicit debt in selected OECD countries. The implicit debt is calculated as the present value of all existing pension entitlements. This is exactly the figure, which the reserves in an entitlement coverage system would have to cover. In Germany, this figure was 253% of GDP in 2009. Even though it is apparent that implicit debt is much higher in both the UK and the US in terms of GDP, the calculations for the numbers in figure 6.4 also include health expenditures for the poor. This mainly drives the high numbers for the US. In contrast, the German figures almost exclusively represent the implicit liabilities resulting from the pay as you go pension system (Bräuniger et al. 2009).

Figure 6.4: Implicit debt and pension expenditures



Source: Bräuniger et al. (2009) and Eurostat (2011c).

Figure 6.5: Old age dependency ratio in selected European countries



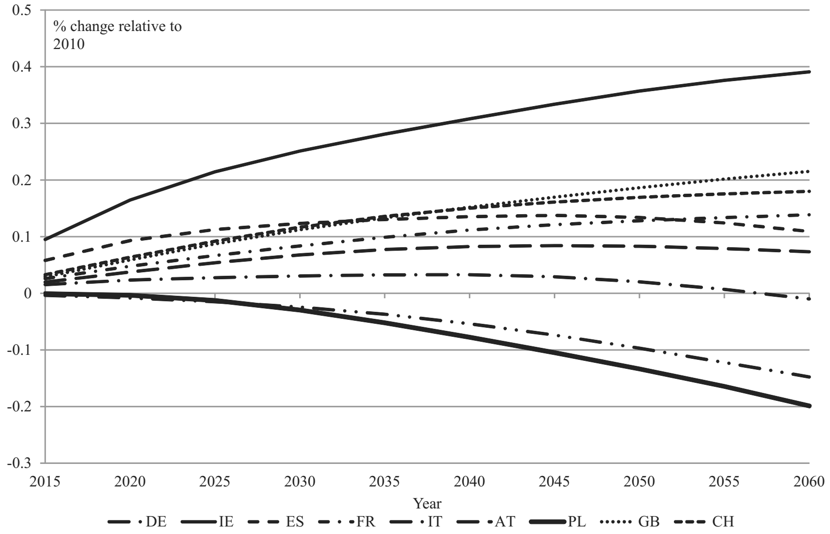
Source: Eurostat (2011b).

Pension expenditures, as shown in the bottom panel of figure 6.4, were approximately 12% of GDP in Germany and approximately 14% of GDP in Italy, the two most rapidly ageing European countries. These figures are among the highest in OECD countries.

As the baby boomers' children cannot shoulder the burden simply by paying contributions, the pension level consequently has to fall. If the old age dependency ratio almost doubles, pensions would have to fall by 50%. With a current replacement rate of about 58.4% of net average earnings in Germany (OECD 2011), we would have to face a pension level close to the minimum subsistence level, which is about 33% of average earnings (Statistisches Bundesamt 2005).

It appears that the baby boomer generation stepped in the trap of the public pay as you go pension system, believed in guaranteed pensions, adjusted their lifestyle and now must inevitably face a situation with a projected pension level close to the subsistence level. However, this is not necessarily the case, as neither the baby boomers' children nor the state is able to pay the baby boomers' pensions. They have to take care of their own pension. They may be too old to have children, but they are not too old to save. The child pension system suggested for example by Sinn (2005) foresees a funded pillar. As the state can 'guarantee' pensions, but not necessarily their level, people must be encouraged to save.

Figure 6.6: Population projection for selected European countries



Source: Eurostat (2011d).

There is hope. Bräuniger et al. (2009) mention that the value of implicit debt strongly depends on the design of the pension system. The pension system in Germany underwent many changes only between 2004 and 2009. Since then, the value of implicit debt has varied between 105% of GDP and 260% of GDP, showing that adjusting the pension system to population ageing can really make a difference. Hence there is more leeway for reconsidering key features of pay as you go pension systems, such as the statutory retirement age.

6.3.4 Increasing the Sustainability of Existing Pension Schemes

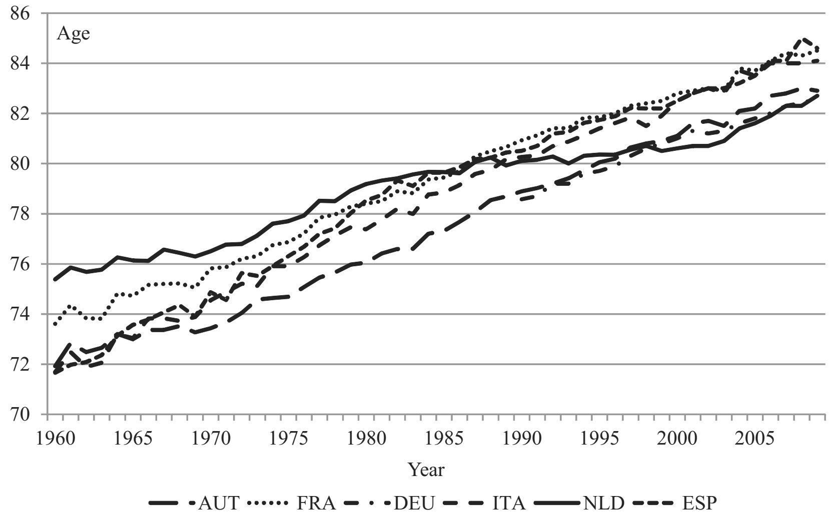
It is simply not possible that the baby boomers' children bear the whole burden that population ageing imposes on society. The burden can however be shared, and shifted, because it depends on only a few parameters that determine which generation has to bear how much of the burden.

First, the burden depends on the size of the cohort of pensioners. This, in turn, depends on life expectancy of the respective cohort and on the age at which the cohort actually retires. The effective retirement age depends on the statutory retirement age and on early retirement incentives within the pension system. We have touched upon the latter issue in chapter 4.

Second, the burden depends on the size of the labour force at each point in time. This, in turn, depends on population growth and on the labour force participation rate. The labour force participation rate of men is high in Germany, but there is scope within the labour force participation rate of women.

Third, the burden depends on the pension level in relation to wages. Increased productivity of the labour force as a whole generates more income and thus also more tax revenues or a higher volume of social security contributions.

Figure 6.7: Female life expectancy at birth for selected European countries



Source: World Bank (2011b).

The first issue is easiest to tackle. The size of the cohort of pensioners is fixed. As figure 6.7 however shows, life expectancy at birth has been rising steadily over the past fifty years. Formerly communist countries, like the Czech Republic or Poland, have joined the trend around 1990, albeit at a still lower level. Accordingly, each cohort receives pensions for a longer time span. As a consequence, the pension level can be indexed to life expectancy to take account of this fact (e.g. Berkel and Börsch-Supan).

In addition, the effective retirement age in Germany was 63.3 years in 2010 (Deutsche Rentenversicherung 2011). This is below the statutory retirement age of between 65 and 67 depending on the year of birth due to extensive incentives to retire earlier than at the statutory retirement age (Hernæs et al. 2000). There are two solutions to this problem. One of them is the elimination of early retirement incentives (Börsch-Supan 2004).

Bismarck's pension system was a forerunner in this respect. At that time, it was more of a concern that people might claim pensions before they needed a pension as income support. If people reached the age of 70, they just had to prove that they had paid contributions. It was clear that if they had made it up to the age of 70, when life expectancy was about 30 years (see also table 6.1), they deserved their income support. If people wanted to claim a pension earlier than at the age of 70, they had to prove that they needed the pension by proving that they qualified as disabled. The claim had to be approved by a Regional Insurance Agency official. Disability was defined contingent on the ability to earn a certain wage. Therefore, disability pensions were effectively means-tested. If a claimant was successful, they received a full pension. In the late twentieth century, the situation had become different. It was relatively easy to qualify for early retirement at a reduced pension level. However, it was not reduced calculatorially fair (Börsch-Supan 2004). As a consequence too many people chose the path of early retirement to enjoy some more leisure with an acceptable income. Introducing a stronger reduction in the pension level for early retirement would remove these incentives.

Table 6.1: Life expectancy in Imperial Germany

	Life expectancy at birth	Average annual increase per 1000
1871/80	37	
1881/90	38.7	4.5
1891/00	42.3	8.8
1901/10	46.6	9.8
1910/11	49.1	10.3
1924/26	57.4	10.9
1932/34	61.3	8.3

Source: Marschalck (1984), p. 164.

The second option to make the pension system more sustainable is raising the retirement age. After all, the quasi-statutory retirement age had been the age of 70 during the nineteenth century (see also chapter 3). It was lowered to 65 at the beginning of the twentieth century, but this was at a time when average life expectancy at birth was around 47 years (see also table 6.1). Nowadays average life expectancy is far *beyond* the statutory retirement age.

Recently, the statutory retirement age was increased by two years to age 67, but there are suggestions that even go beyond the age of 69 (e.g. Sachverständigenrat 2011). The majority of the population firmly oppose raising the statutory retirement age (Scheubel et al. 2013), but not only in Germany this is mainly due to a lack of information (Boeri et al. 2002).

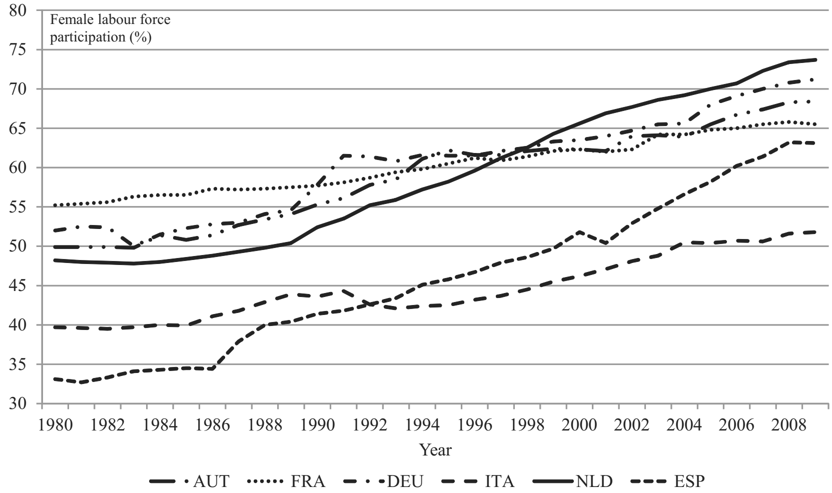
The second parameter to decrease the burden of contributions is more difficult to address. While population growth cannot be affected for the period 2010–2030, increased immigration is often mentioned as a solution to the problem. This solution would however require permanent immigration of young people with at least average incomes. If immigrants are either a burden for the welfare state because they do not contribute sufficient tax revenue or display the same age structure as the population in the country they move to, this does not change the relationship between working age population and pensioners. Moreover, any immigrant who pays pension contributions also acquires pension claims. If the immigrant returns to their home country, they maintain the right to a pension. As the pension is financed by the next generation in the country of temporary migration, the immigrant's children do not contribute to their parents' pension (Sinn 2005), which would effectively worsen the old age dependency ratio.

A second solution to raise the volume of contributions is to increase labour force participation. While the male labour force participation rate in Germany was 82.3% in 2010, the female labour force participation rate was relatively low compared to other European countries up to the end of 1990s. As shown in figure 6.8, 70.8% in 2010 it is still more than 10 percentage points lower than the male labour force participation rate.

It is obvious that the countries with the lowest female labour force participation rate are the Catholic countries Italy and Poland. The countries with the highest female labour force participation rate are the Scandinavian countries. Not conincidentally, these countries have the most active family policies. As pronatalist policies nowadays aim to reconcile labour force participation and having a family, they often lead to a higher labour force participation rate of women. Policies that make it easier to both have children and work thus strike a double dividend. They alleviate the burden of paying the pensions and the burden for future generations, since they raise the birth rate.

A third option to decrease the burden of the baby boomers' pensions is to enhance economic growth. If economic growth cannot be driven by population growth, it can be driven by productivity growth. Investing in the human capital of those generations that have to pay the pensions of the baby boomers can boost their productivity and therefore also their capacity to finance the pensions (e.g. Sinn 2005). While this is not an alternative to encouraging private investment in an additional funded pillar of the pension system, it may also come too late. Investments in children's education would have to be implemented immediately. The children of school age today will be 26 when the baby boomers retire. It is unlikely that education policies are implemented immediately when commonly set targets for growth, as in Europe's 2020 strategy, are notoriously missed. Nevertheless, following the Europe 2020 strategy can be an option to enhance growth prospects in order to shoulder the burden of ageing populations more easily.

Figure 6.8: Female labour force participation rate (of female population aged 15–64)



Source: World Bank (2011a).

In the end, the scope for such changes is, alas, limited. The 2007–2009 financial crisis has brought sovereign states to the limit of their financial capacity. Many European states are heavily indebted. There is hardly room for manoeuvre in pension politics. Despite this, it has to be tried and done to avoid a catastrophe in terms of old age poverty. If governments do not take action, we will be back in the situation Bismarck wanted to avoid. Poor pensioners dependent on the merit of their children is not an appealing scenario. Establishing an additional funded pillar to supplement existing pay as you go schemes is unavoidable. As then the initial distortion would persist, i.e. the state would still remain heavily involved in private decision making, removing this distortion – for example in the context of a child pension system – is of utmost importance in order to really achieve a turnaround in terms of fertility.

In the end, Konrad Adenauer was wrong and Theodor Heuss was only partly right. The changed role of women in society has shaped the past century and will also shape the future. The changed role of women has, however, come along with a changed role of the state. Families assume less responsibilities and the state assumes more responsibilities. Dealing with population ageing and the fertility decline requires an understanding of this connection. In the end, one of the most important changes of our times was the introduction of social security.

Appendix A

Data

A.1 The Data Set

The main data set used for the analyses in this book is combined from two sources. The first source is the Annual Yearbook of Statistics for Imperial Germany (*Statistisches Jahrbuch für das Deutsche Reich*), which was published by the Imperial Statistical Office (Kaiserliches Statistisches Amt 1880–1914). The first Annual Yearbook of Statistics was published in 1871, but only after 1880 it was officially called the Annual Yearbook of Statistics for Imperial Germany (before: Statistics of Imperial Germany).

Table A.1: Statistical offices in Germany

Founding year	*Province*
1805	Preußen
1808	Bayern
1820	Württemberg
1850	Sachsen und Bremen
1851	Mecklenburg-Schwerin
1852	Baden
1854	Braunschweig
1855	Oldenburg
1861	Hessen
1864	Thüringen
1866	Anhalt und Hamburg
1871	Lübeck

Source: Sniegs (1998).

The Annual Yearbook of Statistics is an invaluable source of long time series information on key indicators for the states and provinces of Imperial Germany. While the regional statistical offices collected and published information at lower jurisdictional levels, the information in the Annual Yearbook of Statistics is either aggregated at the federal level or at the state or province level.

In Germany statistics were collected on a broad basis quite early on. Not surprisingly, the first statistical office was founded in the Kingdom of Prussia in 1805, soon followed by a statistical office in the Kingdom of Bavaria in 1808 (Marschalck 1984; Sniegs 1998). Table A.1 shows the founding years of the regional statistical offices in states that were later a part of Imperial Germany.[1]

The work of the regional statistical offices was supplemented by the collection of statistics by the German Customs Union from 1834 onwards. Reliable statistics on the size of the population were necessary to distribute customs revenues. In 1871, emperor Wilhelm I proclaimed the intention to found an Imperial Statistical Office. The Imperial Statistical Office started its work in 1872 and was subordinate to the Ministry of the Interior. It assumed the tasks previously with the Office of the German Customs Union. This meant that the collection and reporting of statistics was harmonised across Imperial Germany. Collecting reliable statistics was both intended to observe broader developments in Germany, but also as a reliable basis for policy making (Sniegs 1998).

Imperial Germany consisted of the West German and South German duchies and princedoms and the Prussian provinces. These are shown in figure A.1.

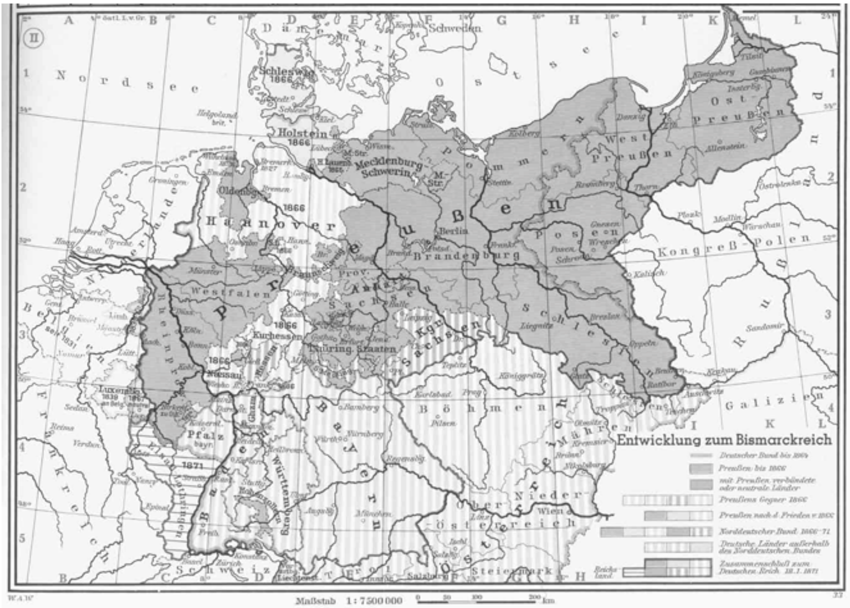
The 41 jurisdictions, for which information is published in the Annual Yearbooks of Statistics, are shown in table A.2. Even when considering the fact that information from the Annual Yearbook of Statistics is available for every year, i.e. 37 years (1878–1914) before World War I, the number of 41 cross-sectional observations is small. In particular, it is much smaller than the 71 cross-sectional observations in Knodel's seminal analysis of Imperial Germany (Knodel 1974) and recent studies using Prussian data, e.g. Goldstein and Klüsener (2010) or Becker et al. (2010) (approximately 452 cross-sectional observations). However, we use the jurisdictional level as presented in table A.2 as the level of analysis for our study, as data on the pension system is only available at that specific level.

The administration of the pension system was decentralised (see chapter 3 for details). The regional authorities, the so-called Regional Insurance Agencies collected an abundance of data on the pension system. They continuously collected information on 40 variables to monitor the functioning of the pension system (Sniegs 1998). The division of the territory of Imperial Germany into administrative areas for the pension system was based on the division into states and provinces. We match data from the Annual Yearbook of Statistics with information from the Regional Insurance Agencies.

The information collected by the Regional Insurance Agencies is not easy to access. Not all business reports from all years are still available, and sometimes information is still archived at the regional statistical offices (Kaschke

[1] Facts in this section are collected mainly from Sniegs (1998) and the German National Statistical Office (2011).

Figure A.1: The territory of Imperial Germany 1871



Source: Stier et al. (1968)

and Sniegs 2001). The information was also published in the annual business reports of each Regional Insurance Agency. In addition, most Regional Insurance Agencies had to report to the Imperial Insurance Agency, so a large fraction of this information was also published in the annual business report of the Imperial Insurance Agency.

While information collected by the Regional Insurance Agencies was sometimes published in the Annual Yearbook of Statistics, it was not published regularly. In addition, the Imperial Insurance Agency only collected information that was necessary to monitor the financial situation of the pension insurance system (Sniegs 1998). To assess more information, it is thus necessary to consider information from the business reports of the Regional Insurance Agencies. Therefore, we rely on the collection of data from the business reports of the Regional Insurance Agencies by Kaschke and Sniegs (2001) and Sniegs (1998). Sniegs (1998) also gives a detailed discussion on how these numbers were collected.

Some Regional Insurance Agencies were in charge of the administration of more than one province, while for some provinces there was more than one Regional Insurance Agency. The annual business reports of the Regional Insurance Agencies provide information for 31 units of observation.

Table A.2: Provinces in Imperial Germany

Königreich Preußen	Ostpreußen Ostpreußen
	Westpreußen/Danzig
	Berlin
	Brandenburg
	Pommern
	Posen
	Schlesien
	Sachsen
	Anhalt
	Schleswig-Holstein
	Hannover
	Schaumburg-Lippe
	Lippe
	Westfalen
	Hessen-Nassau
	Waldeck
	Rheinland
	Hohenzollern
Königreich Bayern	3 Reg.Bezirke Franken
	Bayern rechts des Rheins
	Bayern links des Rheins
Other kingdoms, grand duchies, duchies, princedoms, and cities	Königreich Sachsen
	Württemberg
	Baden
	Hessen
	Mecklenburg-Strelitz
	Mecklenburg-Schwerin
	Oldenburg
	Braunschweig
	Sachsen-Altenburg
	Sachsen-Koburg-Gotha
	Sachsen-Weimar
	Sachsen-Meiningen
	Schwarzburg-Sondershausen
	Schwarzburg-Rudolstadt
	Reuss älterer Linie
	Reuss jüngerer Linie
	Hamburg
	Lübeck
	Bremen
	Elsass-Lothringen

Source: Kaiserliches Statistisches Amt (1888–1914).

To harmonise the two data sets, we have to aggregate information for some provinces and for some Regional Insurance Agencies. This results in a final number of 25 cross-sectional observations.

Column (2) in table A.3 lists the provinces for which the Imperial Statistical Office reported regional data in column (2). Column (3) lists the jurisdictions of the Regional Insurance Agencies. Column (1) indicates how we matched the province data and the Regional Insurance Agency data.
The division into administrative areas plays a large role when it comes to province-specific, but time-invariant heterogeneity. Knodel (1974) for example also analyses fertility at the state level, but uses different administrative levels for different regions of Imperial Germany, claiming that this adjustment is appropriate because of the vastly differing size of the population at e.g. the province level. However, our analysis concentrates on the effect of the pension system, and region-specific effects such as the interpretation of the law by regional authorities should correspond to the administrative boundaries of the Regional Insurance Agencies.

For the change and level model (see chapter 5), we augment the data set with numbers on savings books from Mombert (1907). Data for Elsaß-Lothringen, Lippe and Berlin are adjusted according to Knodel (1974) because of alleged misreporting of those numbers. Mombert provides data on lower-level jurisdictions for some areas. Therefore, we aggregate some figures. The resulting matching is based on a list of lower-level jurisdictions for all provinces provided by Rademacher (2011). Table A.4 shows this matching.

Table A.4 illustrates that Mombert (1907) sometimes only collected data for the capital of a province and sometimes there is more than one observation for a province. If there is just one observation, even if only for a smaller city in a province, we use this observation for the respective province. If there are more observations, we use the average.

Table A.3: Matching of Provinzen *and regional insurance agencies*

Variable	*Province*	*Regional insurance agency*
Königreich Preußen		
Ostpreußen	Ostpreußen	Ostpreußen
Westpreußen	Westpreußen/Danzig	Westpreußen
Berlin	Berlin	Berlin
Brandenburg	Brandenburg	Brandenburg
Pommern	Pommern	Pommern
Posen	Posen	Posen
Schlesien	Schlesien	Schlesien
Sachsen-Anhalt	Sachsen	Sachsen-Anhalt
	Anhalt	
Schleswig-Holstein	Schleswig-Holstein	Schleswig-Holstein
Hannover	Hannover	Hannover
	Schaumburg-Lippe	
	Lippe	
Westfalen	Westfalen	Westfalen
Hessen-Nassau	Hessen-Nassau	Hessen-Nassau
	Waldeck	
Rheinprovinz	Rheinland	Rheinprovinz
	Hohenzollern	
Königreich Bayern		
Bayern	3 Reg.Bezirke Franken	Mittelfranken
		Oberfranken
		Unterfranken
	Bayern rechts des Rheins	Niederbayern
		Oberbayern
		Oberpfalz
		Schwaben
Pfalz	Bayern links des Rheins	Pfalz
Sachsen	Königreich Sachsen	Königreich Sachsen
Württemberg	Württemberg	Württemberg
Baden	Baden	Baden
Hessen	Hessen	Hessen
Mecklenburg	Mecklenburg-Strelitz	Mecklenburg
	Mecklenburg-Schwerin	
Oldenburg	Oldenburg	Oldenburg
Braunschweig	Braunschweig	Braunschweig

Table A.4: Matching of regional boundaries as in Mombert (1907)

Jurisdiction in Mombert (1907)	*Matched jurisdiction as in the Annual Yearbook of Statistics*
Mittelfranken	3 Reg.Bezirke Franken
Oberfranken	3 Reg.Bezirke Franken
Unterfranken	3 Reg.Bezirke Franken
Anhalt	Anhalt
Freiburg	Baden
Karlsruhe	Baden
Konstanz	Baden
Mannheim	Baden
Pfalz	Bayern l. Rh. (Rbz. Pfalz)
Berlin	Berlin
Frankfurt	Brandenburg
Potsdam	Brandenburg
Bremen	Bremen
Lothringen	Elsaß-Lothringen
Oberelsaß	Elsaß-Lothringen
Unterelsaß	Elsaß-Lothringen
Oberhessen	Großherzogtum Hessen
Rheinhessen	Großherzogtum Hessen
Starkenburg	Großherzogtum Hessen
Hamburg	Hamburg
Aurich	Hannover
Hannover	Hannover
Hildesheim	Hannover
Lüneburg	Hannover
Osnabrück	Hannover
Stade	Hannover
Wiesbaden	Hessen-Nassau
Kassel	Hessen-Nassau
Sigmaringen	Hohenzollern
Bautzen	Königreich Sachsen
Chemnitz	Königreich Sachsen
Dresden	Königreich Sachsen
Leipzig	Königreich Sachsen
Zwickau	Königreich Sachsen
Lippe	Lippe
Lübeck	Lübeck
Mecklenburg-Schwerin	Mecklenburg-Schwerin
Mecklenburg-Strelitz	Mecklenburg-Strelitz
Oldenburg	Oldenburg
Gumbinnen	Ostpreußen
Königsberg	Ostpreußen
Köslin	Pommern
Stettin	Pommern
Stralsund	Pommern
Bromberg	Posen
Posen	Posen

Jurisdiction in Mombert (1907)	*Matched jurisdiction as in the Annual Yearbook of Statistics*
Reuß ä. L.	Reuß älterer Linie
Reuß j. L.	Reuß jüngerer Linie
Aachen	Rheinland
Cöln	Rheinland
Düsseldorf	Rheinland
Koblenz	Rheinland
Trier	Rheinland
Erfurt	Sachsen
Magdeburg	Sachsen
Merseburg	Sachsen
Sachsen-Altenburg	Sachsen-Altenburg
Sachsen-Coburg Gotha	Sachsen-Koburg-Gotha
Sachsen-Meiningen	Sachsen-Meiningen
Sachsen-Weimar	Sachsen-Weimar
Schaumburg-Lippe	Schaumburg-Lippe
Breslau	Schlesien
Liegnitz	Schlesien
Oppeln	Schlesien
Schleswig	Schleswig-Holstein
Schwarzburg-Rudolstadt	Schwarzburg-Rudolstadt
Schwarzburg-Sondershausen	Schwarzburg-Sondershaus.
Niederbayern	Übr. Bayern r. Rh.
Oberbayern	Übr. Bayern r. Rh.
Oberpfalz	Übr. Bayern r. Rh.
Schwaben	Übr. Bayern r. Rh.
Waldeck	Waldeck
Arnsberg	Westfalen
Minden	Westfalen
Münster	Westfalen
Danzig	Westpreussen
Marienwerder	Westpreußen
Württemberg	Württemberg

Sources: Mombert (1907) and Annual Yearbooks of Statistics.

Variable	*Province*	*Regional insurance agency*
Thüringen	Sachsen-Altenburg Sachsen-Koburg-Gotha Sachsen-Weimar Sachsen-Meiningen Schwarzburg-Sondershausen Schwarzburg-Rudolstadt Reuss älterer Linie Reuss jüngerer Linie	Thüringen
Hansestädte	Hamburg Lübeck	Hansestädte
Elsass-Lothringen	Elsass-Lothringen Bremen	Elsass-Lothringen
25	*41*	*31*

A.1.1 Variables

This section presents a detailed account of the variables in our combined data set, of the respective data set they originate from and of the availability for certain years. Most variables were either only reported for census years, such as the figures on the number of married men and married women, or such as the figures on the age structure. Information on the harvest is not available for Berlin for the years 1878–1882 for wheat, oat, and hey. Data on the harvest are not available for any of the jurisdictions for 1898, because the Imperial Statistical Office changed its reporting practice in that year. Prior to 1898 the numbers for each year were reported with a two-year lag, i.e. numbers for 1880 were published in the Annual Yearbook of Statistics of 1882. In 1898 this lag was changed to one year, such that the 1899 yearbook contained numbers for 1897, but the 1900 yearbook contained the numbers for 1899.

A.1.2 Summary Statistics

Table A.6 presents the summary statistics for all variables used in the analyses averaged over all years. If information is missing for some years, we reduce the sample accordingly, but check for sample selection effects before doing so.

Some variables are crucial for achieving between-province comparability. For example, the provinces differed both in area and population size. If not indicated otherwise, we therefore adjust all variables to population size. However, the population size is not reported during all years, in particular it is not reported for later years. We therefore use an extrapolation approach for the years 1900–1910, which we describe below.

Similarly, information on the area used for growing crops is not reported every year, because the area of each province did not change much after 1871. We therefore use the area of the previous year if information on the area is missing.

Differences between certain years in how the age structure of the population was reported also make some adjustment with regard to the computation of the size of the working age population necessary.

Table A.3: Data availability 1871–1890

Variable	1871	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890
Annual Yearbook of Statistics															
Births	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Share of ill. births			x		x	x	x	x	x	x	x	x	x	x	x
Stillbirths			x	x	x	x	x	x	x	x	x	x	x	x	x
Population			x	x	x	x	x	x	x	x	x	x	x	x	x
Area			x		x					x					x
Marriages			x	x	x	x	x	x	x	x	x	x	x	x	x
Prod. in agric.					x	x	x	x	x	x	x	x	x	x	x
Harvest: rye	x			x	x	x	x	x	x	x	x	x	x	x	x
Harvest: barley	x			x	x	x	x	x	x	x	x	x	x	x	x
Harvest: oat	x			x	x	x	x	x	x	x	x	x	x	x	x
Harvest: wheat	x			x	x	x	x	x	x	x	x	x	x	x	x
Harvest: potatoes	x			x	x	x	x	x	x	x	x	x	x	x	x
Harvest: hey				x	x	x	x	x	x	x	x	x	x	x	x
Area: rye	x				x	x	x	x	x	x	x	x	x	x	x
Area: barley	x				x	x	x	x	x	x	x	x	x	x	x
Area: oat	x				x	x	x	x	x	x	x	x	x	x	x
Area: wheat	x				x	x	x	x	x	x	x	x	x	x	x
Area: potatoes	x				x	x	x	x	x	x	x	x	x	x	x
Area: hey					x	x	x	x	x	x	x	x	x	x	x
Illiterate recruits			x	x	x	x	x	x	x	x	x	x	x	x	x
Occupation	x						x								
Catholic pop.	x				x					x					x
Protestant pop.	x				x					x					x
People per build.	x				x					x					

Variable	1871	1877	1878	1879	1880	1881	1882	1883	1884	1885	1886	1887	1888	1889	1890
People per HH	x				x					x					
Loc. > 20.000		x			x										
Loc. 5.000-20.000			x		x										
Horses								x							
Men entitled to vote	x				x					x					
Married men / married women	x				x					x					x
Age structure of pop.	x									x					x
Pop. born in diff. province										x					
Mombert (1907)															
Savings books															

Table A.4: Data availability 1891–1901

Variable	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Annual Yearbook of Statistics											
Births	x	x	x	x	x	x	x	x	x	x	x
Share of illegitimate births	x	x	x	x	x	x	x	x	x	x	x
Stillbirths	x	x	x	x	x	x	x	x	x	x	x
Population	x	x	x	x	x				x	x	
Area				x							
Marriages	x	x	x	x	x	x	x	x	x	x	x
Productivity in agriculture (index)	x	x	x	x	x	x	x		x	x	x
Harvest: rye	x	x	x	x	x	x	x	x	x	x	x
Harvest: barley	x	x	x	x	x	x	x	x	x	x	x
Harvest: oat	x	x	x	x	x	x	x	x	x	x	x
Harvest: wheat	x	x	x	x	x	x	x	x	x	x	x
Harvest: potatoes	x	x	x	x	x	x	x	x	x	x	x
Harvest: hey	x	x	x	x	x	x	x	x	x	x	x
Area: rye	x	x	x	x	x	x	x		x	x	x
Area: barley	x	x	x	x	x	x	x		x	x	x
Area: oat	x	x	x	x	x	x	x		x	x	x
Area: wheat	x	x	x	x	x	x	x		x	x	x
Area: potatoes	x	x	x	x	x	x	x		x	x	x
Area: hey	x	x	x	x	x	x	x		x	x	x
Illiterate recruits	x	x	x	x	x	x	x	x	x	x	x
Occupation					x						
Catholic population						x				x	
Protestant population						x				x	
People per building											

Variable	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
People per household											
Localities > 20.000											
Localities 5.000-20.000											
Horses		x					x			x	
Men entitled to vote											
Married men / married women											
Age structure of population											
Population born in different province											
Mombert (1907)											
Savings books										x	
Annual business reports of Regional Insurance Agencies (Kaschke and Sniegs 2001)											
Revenues: other	x	x	x	x	x	x	x	x	x	x	x
Revenues: category I	x	x	x		x	x	x	x	x	x	x
Revenues: category II	x	x	x		x	x	x	x	x	x	x
Revenues: category III	x	x	x		x	x	x	x	x	x	x
Revenues: category IV	x	x	x		x	x	x	x	x	x	x
Revenues: category V										x	x
Expenditures: other	x	x	x	x	x	x	x	x	x	x	x
Expenditures: administration	x	x	x	x	x	x	x	x	x	x	x
Expenditures: pensions	x	x	x	x	x	x	x	x	x	x	x
Expenditures: reserves	x	x	x	x	x	x					
Number insured					x						
New pensions		x	x	x	x	x	x	x			
Existing pension entitlements (old age)	x	x	x	x	x	x	x	x	x	x	x
Ceased pension entitlements (old age)	x	x	x	x	x	x	x	x	x	x	x
Existing pension entitlements (disability)											
Ceased pension entitlements (disability)											
Value of new pension entitlements		x	x	x	x	x	x	x			

Variable	1891	1892	1893	1894	1895	1896	1897	1898	1899	1900	1901
Capital value of existing pension entitlements		x	x	x	x	x	x				
Applications: disability pension		x	x	x	x	x	x	x	x	x	x
Approved disability applications		x	x	x	x	x	x	x	x	x	x
Approved old age pension applications	x	x	x	x	x	x	x	x	x	x	x
Applications: old age pensions	x	x	x	x	x	x	x	x	x	x	x
Average old age pension	x	x	x	x	x	x	x	x	x	x	x
Average disability pension		x	x	x	x	x	x	x	x	x	x
RIA: Assets		x					x			x	

Table A.5: Data availability 1902–1914

Variable	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Annual Yearbook of Statistics													
Births	×	×	×	×	×	×	×	×	×	×	×	×	×
Share of illegitimate births	×	×	×	×	×	×	×	×	×	×	×	×	×
Stillbirths	×	×	×	×	×	×	×	×	×	×	×	×	×
Population				×				×	×				
Area													
Marriages	×	×	×	×	×	×	×	×	×	×	×	×	×
Productivity in agriculture (index)	×	×	×	×	×	×	×	×	×	×	×	×	×
Harvest: rye	×	×	×	×	×	×	×	×	×	×	×	×	×
Harvest: barley	×	×	×	×	×	×	×	×	×	×	×	×	×
Harvest: oat	×	×	×	×	×	×	×	×	×	×	×	×	×
Harvest: wheat	×	×	×	×	×	×	×	×	×	×	×	×	×
Harvest: potatoes	×	×	×	×	×	×	×	×	×	×	×	×	×
Harvest: hey	×	×	×	×	×	×	×	×	×	×	×	×	×
Area: rye	×	×	×	×	×	×	×	×	×	×	×	×	×
Area: barley	×	×	×	×	×	×	×	×	×	×	×	×	×
Area: oat	×	×	×	×	×	×	×	×	×	×	×	×	×
Area: wheat	×	×	×	×	×	×	×	×	×	×	×	×	×
Area: potatoes	×	×	×	×	×	×	×	×	×	×	×	×	×
Area: hey	×	×	×	×	×	×	×	×	×	×	×	×	×
Illiterate recruits	×	×	×	×	×	×	×	×	×	×			
Occupation						×							
Catholic population				×					×				
Protestant population				×					×				
People per building													

Variable	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
People per household				x									
Localities > 20.000				x									
Localities 5.000-20.000				x									
Horses			x			x					x	x	x
Men entitled to vote													
Married men / married women													
Age structure of population													
Population born in different province													
Mombert (1907)													
Savings books													
Annual business reports of Regional Insurance Agencies (Kaschke and Sniegs 2001)													
Revenues: other	x	x	x	x	x	x	x	x	x	x	x	x	
Revenues: category I	x	x	x	x	x	x	x	x	x	x	x	x	x
Revenues: category II	x	x	x	x	x	x	x	x	x	x	x	x	x
Revenues: category III	x	x	x	x	x	x	x	x	x	x	x	x	x
Revenues: category IV	x	x	x	x	x	x	x	x	x	x	x	x	x
Revenues: category V	x	x	x	x	x	x	x	x	x	x	x	x	x
Expenditures: other	x	x	x	x	x	x	x	x	x	x	x	x	x
Expenditures: administration	x	x	x	x	x	x	x	x	x	x	x	x	x
Expenditures: pensions	x	x	x	x	x	x	x	x	x	x	x	x	x
Expenditures: reserves													
Number insured						x							
New pensions													
Existing pension entitlements (old age)	x	x	x	x	x	x	x	x	x	x	x	x	
Ceased pension entitlements (old age)	x	x	x	x	x	x	x	x	x	x	x	x	
Existing pension entitlements (disability)													
Ceased pension entitlements (disability)													
Value of new pension entitlements													

Variable	1902	1903	1904	1905	1906	1907	1908	1909	1910	1911	1912	1913	1914
Capital value of existing pension entitlements													
Applications: disability pension	x	x	x	x	x	x	x	x	x	x	x	x	
Approved disability applications	x	x	x	x	x	x	x	x	x	x	x	x	
Approved old age pension applications	x	x	x	x	x	x	x	x	x	x	x	x	
Applications: old age pensions	x	x	x	x	x	x	x	x	x	x	x	x	
Average old age pension	x	x	x	x	x	x	x	x	x	x	x	x	
Average disability pension	x	x	x	x	x	x	x	x	x	x	x	x	
RIA: Assets			x			x					x	x	x

Growing area: Information on the growing area for basic crops is available for every year from 1880 to 1914 except for 1898. We therefore use the growing are in 1880 also for 1878 and 1879 and set the 1898 value for the growing area to the 1897 value.

Area: Information on the area of each province is available for 1871, 1880, 1885, 1890 and 1894. Borders hardly changed. For the years between 1871 and 1880 we use the 1871 value, for the years between 1880 and 1885 we use the 1880 value, for the years between 1885 and 1890 we use the 1885 value, for the years between 1890 and 1894 we use the 1890 value and for the years after 1894 we use the 1894 value.

Population: Information on the population structure is reported annually in the Annual Yearbook of Statistics until 1895. From 1895 this information is only reported for certain years (1895, 1899, 1900, 1905, 1909, and 1910). To emulate the Statistical Office's methods (Verhandlungen des Reichstages 1888/89), we use a static method to estimate the population for the years in between. Define g as the population growth rate, p_t as the population in year t, and n as the number of years between two observations. Then the average population growth rate $\bar{g}$ in each five year interval can be calculated as

$$\bar{g} = \left(\frac{p_{t+5}}{p_t}\right)^{\frac{1}{n}} - 1$$

and the population for the years in between can be calculated as

$$p_{t+1} = p_t(1+\bar{g}).$$

For the years 1911-1914 we use the population growth rate between 1909 and 1910.

Age structure: Information on the age structure is available for certain age groups. However, the reporting differs between the reporting years. In 1871 and 1885 the age categories were: under 5, 5–10, 10–15, 15–20, 20–25, 25–30, 30–40, 40–50, 50–60, 60–70, 70–80, and older than 80. In 1890, the age categories were: under 10, 10–20, 20–30, 30–40, 40–50, 50–60, 60–70, and older than 70.
To make numbers comparable, we have to use the coarser 1890 scale. However, we need information on the share of the population aged 15–60 to define the share of the population in working age.[2] To compute the share of the population younger than 15 for 1890, we divide the number in age group '10–20' by 2 and add the resulting number to the number in age group 'below 10'. The old age dependency ratio is computed as the population aged 15–60 relative to the population older than 60. The share in working age is computed as the population aged 15–60 relative to the total population.

[2] We set the upper bound to 60 when computing the old age dependency ratio, because people were only considered disabled because of old age when older than 70. However, as Kaschke and Sniegs (2001) note, there was a significant share of old age pensioners younger than 70. Therefore, we set the age for being considered as 'old' to 60.

Table A.6: Summary statistics

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Births (p 1000)	925	35.0	4.9	18.8	47.1
Share of illeg. births	900	8.9	3.5	1.3	58.2
Stillbirths (p 1000)	899	1.2	0.3	0.7	2.0
Population	925	2173054.0	1429001.0	327112.0	7194643.0
Area	925	21570.1	15424.4	59.0	69936.7
Marriages (p 1000)	925	7.9	1.0	0.8	22.1
Harvest: rye (tons)	895	326038.9	361687.7	0.0	5868078.0
Harvest: barley (tons)	895	107153.6	113914.8	0.0	631138.0
Harvest: oat (tons)	895	255687.4	294825.0	0.0	5279340.0
Harvest: wheat (tons)	895	137207.2	185538.2	0.0	2830921.0
Harvest: potatoes (tons)	895	1335689.0	1162768.0	0.0	5903625.0
Harvest: hey (tons)	871	914059.4	1422574.0	0.0	18900000.0
Area: rye (sq km)	875	242750.1	230839.4	0.0	3603843.0
Area: barley (sq km)	875	66762.1	68984.8	0.0	349468.0
Area: oat (sq km)	875	164374.9	126915.9	0.0	1956392.0
Area: wheat (sq km)	875	76274.5	67034.3	0.0	305512.0
Area: potatoes (sq km)	875	123620.4	93016.7	0.0	344388.0
Area: hey (sq km)	850	240214.2	253498.4	0.0	3074670.0
Illiterate recruits (p 1000)	784	0.0	0.1	0.0	0.4
Share in farming	99	33.8	16.8	0.2	65.4
Share in mining	99	19.0	8.8	6.2	45.5
Share in trade	99	5.7	3.4	2.0	23.9
Catholic population (%)	175	28.7	26.4	0.2	81.0
Protestant population (%)	175	68.6	26.4	17.7	99.2
People per building	75	9.8	8.5	5.8	57.1
People per household	100	4.6	0.4	2.4	5.3
Horses (p 1000)	218	80.7	50.4	16.6	245.2
Localities > 20.000	125	7.9	8.7	0.0	47.0
Localities 5.000-20.000	125	32.4	30.7	0.0	141.0
Men entitled to vote (p 1000)	75	219.7	18.8	104.8	246.4
Share married	100	33.4	2.2	24.4	36.9
Share in working age	75	58.1	3.4	53.7	71.0
Savings books (p 1000)	25	50.0	70.0	0.0	345.9
Revenues: other (Mark pc)	575	0.6	0.6	0.0	3.9
Revenues: cat. I (Mark pc)	550	278.5	225.4	-18.8	923.4
Revenues: cat. II (Mark pc)	550	721.8	260.0	117.6	1845.7
Revenues: cat. III (Mark pc)	550	642.4	358.0	76.2	2398.9
Revenues: cat. IV (Mark pc)	550	452.4	425.8	26.4	3585.7
Revenues: cat. V (Mark pc)	350	461.4	520.5	23.6	3681.8

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
Expenditures: administration (Mark pc)	575	0.1148	0.0657	0.0167	0.5191
Expenditures: pensions (Mark pc)	575	0.9998	0.5765	0.0816	3.2159
Expenditures: other (Mark pc)	600	0.035	0.034	-0.244	0.347
RIA: Assets (Mark pc)	575	15.2	9.6	0.9	51.8
Existing pension entitlement (old age) (pc)	566	0.0027	0.0015	0.0006	0.0077
Ceased pension entitlements (old age) (pc)	557	0.0003	0.0002	0.0000	0.0032
Existing pension entitlements (disab.) (pc)	540	0.0082	0.0055	0.0001	0.0236
Ceased pension entitlements (disab.) (pc)	531	0.0011	0.0015	0.0000	0.0125
Applications: old age pensions (pc)	573	0.0005	0.0008	0.0000	0.0088
Applications: disabibility pensions (pc)	547	0.0022	0.0010	0.0000	0.0055
Approved disability pension applications (pc)	550	0.0016	0.0007	0.0000	0.0040
Approved old age pension applications (pc)	575	0.0004	0.0006	0.0001	0.0061
Average disability pension (Mark)	550	149.8	23.1	112.8	214.4
Average old age pension (Mark)	574	151.3	19.3	109.7	199.2
Number insured (p 1000)	75	225.1	40.1	142.5	423.2

A.2 The Occupational Censuses

In Imperial Germany, the first census was conducted in 1871, the first year of Imperial Germany's official existence. The years 1871, 1882, 1895 and 1907 were census years during which information on the population's occupation was collected. General censuses as opposed to occupational censuses were conducted regularly, at least every five years. Unfortunately, the information collected in the general census was not always consistent with previous years, in particular the information on occupation. We focus on the 1882 census, because the statistics from this year were used for projections on pension insurance coverage prior to its introduction.

The 1882 occupational census was prepared and conducted in connection with the population census of 1885 and mandated by Imperial law.[1] The categories in the 1882 occupational census were more detailed than in 1871. The government recognised the need for a reliable statistical basis on which decisions on the introduction of social insurance could be taken (Sniegs 1998). The censuses were administered by the Imperial Statistical Office and by its regional branches.

The question that formed the basis for the classification of jobs was on the "occupation or line of business; main employment; additional occupation; employment status of the population older than 14" (*"Beruf oder Erwerbszweig; Hauptbeschäftigung; mit Erwerb verbundene Nebenbeschäftigungen; Arbeits- und Dienstverhältnis der über 14 Jahre alten Personen"*)[2].

All censuses report the number of people in mining and industrial production, trade and transport, farming and fishery, hired labour and services, civil services, and those without profession. Table A.7 reproduces this classification.

The classification of jobs of the Imperial Statistical Office is more detailed at the national level than at the regional level. Its five main categories are divided into 23 groups of in total 145 occupations in addition to 8 categories for the self-employed and for inmates (Kaiserliches Statistisches Amt 1884). The number of women in each occupation is only available at the national level. Table A.7 therefore also indicates whether specific information was available at the national and/or the provincial level in 1882 .

Even though the censuses collected information on dependants, information on dependants that worked in a family business, for example as common in agriculture, remains ambiguous. The 1871 census reports the sum of dependants, whereas the 1882 census presents the numbers for the working and their dependants separately. Only in the 1907 census, numbers on dependants are available separately (Ritter and Tenfelde 1992).

A person was counted as a dependant if they were a member of the household and did not have any source of own income or were at most marginally employed. This means that housewives and children were registered as dependants if they did not have a large income on their own account. Another implication of this treatment of dependants is that every person in Imperial Germany was registered, at least in theory, such that the number of people registered in the occupational census should be equal to the population (Kaiserliches Statistisches Amt 1884). To check the reliability of the population census figures, we can compare population figures and aggregate numbers for the working population and dependants according to the occupa-

[1] RGBl 1882/5.
[2] Kaiserliches Statistisches Amt 1884, p.2

Table A.7: Classification of occupations according to the Imperial Statistical Office

	Category	*Subcategory*	*Availability in 1882*	
			National	*Provicial*
A	Farming, forestry, livestock breeding, fishery	Self-employed, including public officials and other managers Administration Workers and subworkers	Employed men and women, total number of dependants, number of servants, in detail for 6 occupations	Total number employed, total number of dependants
B	Industrial production, mining	Self-employed, including public officials and other managers	Number of employed by sex, number of dependants, number of servants, in detail for 110 occupations	Employed and number of dependants by self-employed on own account or on behalf of others
		Administration Workers and subworkers		Total number employed + dependants
C	Trade and transport, food and beverage industry	Self-employed, including public officials and other managers Administration Workers and subworkers	Employed men and women, total number of dependants, number of servants, in detail for 20 occupations	Total number employed, total number of dependants
D	Hired labour and service, includes servants		Employed men and women, total number of dependants, number of servants, by domestic services and hired labour	Total number employed, total number of dependants, total number of servants separately
E	I. Military and military administration		Employed men, total number of dependants, number of servants, by 2 ranks	Not available separately

	Category	Subcategory	Availability in 1882	
			National	*Provicial*
	II. Civil service (including municipal services), clerical services and so-called independent professions		Employed men and women, total number of dependants, number of servants, by 6 categories	Total number employed, total number of dependants
F	I. Self-employed without profession or without recorded profession		Employed men, total number of dependants, number of servants, by 2 categories	Total number employed and number of dependants
	II. in vocational preparation or advanced vocational training, inmates without gainful employment		Employed men, total number of dependants, number of servants, by 2 categories	

Source: Kaiserliches Statistisches Amt (1880–1914).

tional census. The reliability of these numbers is important, since we adjust all variables in our analyses to population size and the variable which we use for identification is based on figures from the 1882 occupational census.

Table A.8 reproduces the total number counted in each occupational census and the total number of the population as reported by the Imperial Statistical Office. Except for the 1907 census, which only reports the numbers for the working population and not for dependants, numbers are approximately the same.

Table A.9 shows how the census numbers deviated from official population statistics in absolute and relative terms. This deviation is relatively constant between -2% and 3% of the population in 1895, and there is only one large outlier in 1882: the deviation is 23% in Thürigen. This is probably related to a reporting error, since the average deviation is the same as reported in Kaiserliches Statistisches Amt (1884) according to which small differences were caused by a difference in the definition of population.

For the population censuses, officials counted the number of people present in a district and the people living in this district, even if not present on the day of the census. For the occupational census, people were counted in the district where they worked on the day of the census. The occupation census took place in summer, while the population census took place in winter.

Moreover, in Kaiserliches Statistisches Amt (1884) population growth is mentioned as another reason for the deviation of the 1882 occupational census from the 1880 population census, but given the different methodology, a simple measurement error is a more plausible explanation. Another explanation considered in Kaiserliches Statistisches Amt (1884) was emigration. As the occupational census indicated a slightly larger female population, it was concluded that the deviation must have been due to the emigration of men.

Table A.8: Population according to occupation census and population census

	1871		*1882*		*1895*		*1907*	
	Census	Population	Census	Population	Census	Population	Census	Population
Ostpreußen	1,822,934	1,885,771	1,928,247	1,938,676	1,981,627	2,006,689	824,786	2,047,201
Westpreußen	1,314,611	1,374,247	1,374,281	1,384,456	1,469,119	1,494,360	641,675	1,672,113
Berlin	826,341	1,070,478	1,156,945	1,217,759	1,615,517	1,677,304	888,655	2,055,365
Brandenburg	2,036,888	2,254,862	2,278,027	2,272,592	2,793,727	2,821,695	1,590,211	3,802,120
Pommern	1,431,633	1,499,543	1,517,712	1,519,256	1,575,052	1,574,147	687,837	1,700,328
Posen	1,583,843	1,649,772	1,665,617	1,685,325	1,774,046	1,828,658	779,081	2,042,554
Schlesien	3,707,167	3,943,199	3,998,782	4,011,069	4,355,477	4,415,309	2,100,679	5,082,482
Sachsen-Anhalt	2,306,611	2,449,676	2,579,471	2,581,338	2,996,646	2,991,847	1,397,044	3,363,067
Schleswig-Holstein	1,045,419	1,109,561	1,124,127	1,122,004	1,298,024	1,286,416	618,555	1,560,894
Hannover	2,100,089	2,232,690	2,257,797	2,287,384	2,571,258	2,598,098	1,314,446	3,043,549
Westfalen	1,775,175	2,015,871	2,068,872	2,069,524	2,666,319	2,701,420	1,433,129	3,863,663
Hessen-Nassau	1,456,594	1,581,607	1,601,255	1,621,311	1,797,869	1,814,568	922,246	2,204,593
Rheinland	3,644,905	4,045,622	4,174,877	4,200,376	5,113,861	5,171,754	2,668,734	6,839,456
Bayern	4,236,991	1,806,944	4,596,669	1,854,836	5,022,934	5,052,553	2,853,063	5,787,759
Pfalz	615,035	2,703,333	672,092	2,813,046	756,242	765,991	404,640	910,362
Königreich Sachsen	2,556,244	2,912,477	3,014,822	3,033,103	3,753,262	3,787,688	1,910,398	4,653,224
Württemberg	1,818,539	1,933,042	1,957,469	1,974,655	2,070,662	2,081,151	1,100,430	2,367,955
Baden	1,461,562	1,545,613	1,558,598	1,571,917	1,719,238	1,725,464	1,007,498	2,075,245
Mecklenburg	557,897	659,326	674,160	673,777	709,836	698,976	287,245	737,308
Thüringen	1,067,441	1,128,423	920,119	1,187,897	1,331,427	1,336,495	630,052	1,543,790
Oldenburg	316,640	327,112	337,427	340,592	369,014	373,739	176,367	460,128
Braunschweig	311,764	340,519	349,761	356,715	435,731	434,213	204,481	490,154
Hansestädte	513,534	643,425	691,123	723,611	938,170	961,360	855,868	1,334,311
Elsaß-Lothringen		1,525,159	1,539,580	1,555,835	1,623,079	1,640,986	896,402	1,842,912
Imperial Germany	38,507,856	42,638,272	44,037,830	43,997,054	50,738,136	51,240,881	26,193,522	61,490,992

Source: Annual Yearbook of Statistics and population censuses.

Table A.9: Deviation between occupational census and population census

	1871		*1882*		*1895*	
	Total	Percent	Total	Percent	Total	Percent
Ostpreussen	62,837	.03	10,429	.01	25,062	.01
Westpreussen	59,636	.04	10,175	.01	25,241	.02
Berlin	244,137	.23	60,814	.05	61,787	.04
Brandenburg	217,974	.1	-5,435	0	27968	.01
Pommern	67,910	.05	1,544	0	-905	0
Posen	65,929	.04	19,708	.01	54612	.03
Schlesien	236,032	.06	12,287	0	59832	.01
Sachsen-Anhalt	143,065	.06	1,867	0	-4,799	0
Schleswig-Holstein	64,142	.06	-2,123	0	-11,608	-.01
Hannover	132,601	.06	29,587	.01	26840	.01
Westfalen	240,696	.12	652	0	35101	.01
Hessen-Nassau	125,013	.08	20,056	.01	16,699	.01
Rheinland	400,717	.1	25,499	.01	57,893	.01
Bayern	273,286	.06	74,558	.02	29,619	.01
Pfalz	49,118	.07	3,541	.01	9749	.01
Koenigreich Sachsen	356,233	.12	18,281	.01	34,426	.01
Wuerttemberg	114,503	.06	17,186	.01	10,489	.01
Baden	84,051	.05	13,319	.01	6,226	0
Mecklenburg	101,429	.15	-383	0	-10,860	-.02
Thueringen	60,982	.05	267,778	.23	5,068	0
Oldenburg	10,472	.03	3,165	.01	4,725	.01
Braunschweig	28,755	.08	6,954	.02	-1,518	0
Hansestaedte	129,891	.2	32,488	.04	23190	.02
Elsass-Lothringen	.	.	16,255	.01	17,907	.01
Deutsches Reich	4,130,416	.1	638,202	0.02	502,745	.01

Sources: Annual Yearbook of Statistics and population censuses.

A.3 Estimating the Projected Number of Insured

For the identification of an effect of social insurance on fertility we use a variable that measures the the number of people covered by insurance in a province. However, the numbers of insured people reported after the introduction of the pension system are potentially endogenous. Therefore, we use an approximation of insurance coverage on the basis of numbers that were collected before the introduction of the pension system. We make this approach consistent with the approximation of the Imperial Statistical Office to estimate the number of potentially insured people as background information for the parliamentary discussions on the draft law on pension insurance (Verhandlungen des Reichstages 1888/89).

Our approximation differs from the calculations in Verhandlungen des Reichstages (1888/89), because these calculations were based on federal data from the 1882 census, which was more detailed than the regional data which we use in terms of the occupational classification.

A.3.1 Official Estimates

The draft law that was discussed between 1887 and 1889 (see also chapter 3) indicated which occupations should qualify for statutory pension insurance. Based on this and on the information on the number of people working in each occupation as collected in 1882, the Imperial Statistical Office estimated the number of insured people. The number for 1889 was derived with a relatively simple extrapolation exercise using the average population growth rate between 1880 and 1885. Table A.10 presents the definition of occupations which would qualify for statutory pension insurance according to Verhandlungen des Reichstages (1888/89). The estimates based on this definition and on the 1882 occupational census are reproduced in table A.11. According to these estimates on the basis of the occupational census for 1882, 10,795,735 people would have been covered by pension insurance had pension insurance already been in place in 1882. This number excludes dependants, because it was not clear when the law on pension insurance was discussed in parliament whether dependants would be covered by insurance, and if so to which extent. The number of approximately 11 million insured people was therefore considered as a lower bound (Verhandlungen des Reichstages 1888/89).

Therefore, the official projections were also adjusted for dependants and certain types of hired labour. It was assumed that a third of dependants in farming would be covered by pension insurance and that 50% of hired labour would be covered, such that the final estimate was 11,018,000.

Table A.10: Persons to be covered by the pension system

von der Berufsabtheilung A (Land- und Forstwirthschaft, auch Thierzucht und Fischerei) alle Personen mit Auschluß der Selbstständigen (a), ihrer Angehörigen (c1) und einer auf $\frac{5}{6}$ bemessenen Zahl der Forstbeamten;	People of the professions in category A (farming, forestry, livestock breeding, and fishery), excluding the self-employed (a), their dependants (c1) and a fraction of $\frac{5}{6}$ of public officials in forestry;
von der Berufsabtheilung B (Industrie einschließlich Bergbau und Bauwesen) alle b- und c-Personen (die verhältnismäßig wenig zahlreichen Beamten der Reichs-, Staats- und Kommunalbetriebe lassen sich nicht ohne Weiteres ermitteln und sind daher nicht mit einbezogen);	all (b) and (c) people of the professions category B (industrial production and mining), the relatively few public officials of imperial, federal and municipal entities cannot be ascretained easily and are therefore excluded;
von der Berufsabtheilung C (Handel und Verkehr einschließlich Gast- und Schankwirthschaft) alle b- und c-Personen mit Auschluß der Eisenbahn-, Post- und Telegraphenbeamten, jedoch mit Einschluß der Personen under C15a (See- und Küstenschiffahrt);	all (b) and (c) people of the professions category C (trade and transport, food and beverage industry), excluding public officials in railways and communications, but including people in category C15a (nautical services);
von den Berufsabtheilungen D (häusliche Dienstleistung und Lohnarbeit wechselnder Art) und G (In der Haushaltung ihrer Herrschaft lebende Dienende für häusliche [nicht gewerbliche] Dienste) alle Personen; endlich	in professional category D (hired labour and service) and G (servants living in their mastery's estate) all people;
von der Berufsabtheilung E (Staats-, Gemeinds-, Kirchen- u. Dienst, auch sogenannte freie Berufsarten) die Personen unter E3c, E4b, E5b und c.	all people in categories E3c, E4b, E5b, and E5c of professions category E (civil service, including municipal services, clerical services, and so-called independent professions)

Reproduced as in Verhandlungen des Reichstages (1888/89), p. 111

Table A.11: Persons potentially covered by pension insurance

	Number of persons in occupations covered by pension insurance, at the age of ...								
Occ. cat.	< 15	15 – 20	20 – 30	30 – 40	40 – 50	50 – 60	60 – 70	70–	Total
					Men				
A	117583	495919	626479	460615	415641	316042	200815	52822	2685916
B	109995	828192	1173410	746749	447652	226086	97502	18235	3647821
C	13399	122794	205434	137728	85040	41105	15868	2967	624335
D	1478	12349	41973	58759	45560	30885	18129	4613	213746
E	56	573	3932	4077	3726	2732	1974	810	17880
G	2436	10737	17929	5682	2509	1589	1106	522	42510
Total	244947	1470564	2069157	1413610	1000128	618439	335394	79969	7232208
					Women				
A	55051	377179	389019	157194	157193	136619	83079	20403	1375737
B	28634	203160	189695	60090	35940	19296	8479	2204	547498
C	2652	39088	60571	19561	12077	7920	4213	1205	147287
D	3470	18536	29293	28421	36494	36539	24514	6569	183836
E	144	2496	8584	6381	4567	2839	1384	360	26755
G	61248	475589	534679	97093	50121	35857	21455	6372	1282141
Total	151199	1116048	1211841	863740	296392	239070	143134	37113	3563527

A.3.2 Estimates based on Regional Data

We cannot exactly reproduce the numbers in Verhandlungen des Reichstages (1888/89), because the job classification is more at the federal level than at the regional level in the occupational census. On the basis of the definition of whether a profession qualifies for insurance coverage presented in table A.10 we develop a classification for the categories available at the provincial level. This classification is presented in table A.7.

The calculations in Verhandlungen des Reichstages (1888/1889) assume a total number of 10,032,371 people in Imperial Germany to be covered by insurance in 1882. This number is useful to check whether our classification for the provincial level yields a similar number. To do this we compare different approaches for estimating the number of people covered by statutory pension insurance in table A.12.

The 1882 column compares the figures according to the classification of jobs in (Verhandlungen des Reichstages 1888/89) to the reginally more detailed 1882 census numbers. It presents the approximate number of the share of people insured in 1882. The 1889 column extrapolates the figures from 1882 using the growth rate of the population over 16 between 1880 and 1885.[3] This growth rate is shown in the last column.

The first of the 1895 columns presents the number of insured if we apply the classification as in (Verhandlungen des Reichstages 1888/89) to the 1895 census numbers. The second of the 1895 columns extrapolates the numbers in the first 1895 column, also using the growth rate of the population over 16 between 1880 and 1885. The third 1895 column presents the number of people insured according to the 1895 census.

The first 1907 column also applies the classification in (Verhandlungen des Reichstages 1888/89) to the 1907 census numbers. The second 1907 column presents the number of people insured in 1907 according to the 1907 census. The total estimate of people (to be) insured based on our classification is roughly 12 million people for 1882 (the first column in table A.12).

The approach of extrapolating the numbers according to the 1880-1885 population growth rate grossly overestimates the number of people insured. The crude 1882 classification (column 1882) is closest to the number reported as insured in 1895 (column 1895, (3)). Therefore, we use the following three measures to approximate the extent of pension system coverage in a province. First, we use the classification according to the 1882 census, but without extrapolation (column 1882). Second, we use the number reported as insured in the 1895 census (column 1895, (3)). Third, we use the number reported as insured in the 1907 census (column 1907, (2)).

[3] We use the growth rate between 1880 and 1885, because this growth rate is also used in official documents.

Table A.12: Number of people covered by the pension system

Province	*1882*	*1889*	*1895*			*1907*		*Pop. growth: 16 and older*
			(1)	(2)	(3)	(1)	(2)	
Ostpreußen	533,321	12,434	531,877	496	411,000	683,062	436,000	-0.42
Westpreußen	365,332	407,314	446,749	447,119	300,000	529,062	307,000	0.02
Berlin	346,277	1,098,253	1,315,268	2,953,725	453,000	551,174	650,000	0.18
Brandenburg	646,771	851,013	1,408,100	1,076,702	642,000	1,226,914	946,000	0.04
Pommern	391,597	362,326	576,033	338,985	335,000	566,257	376,000	-0.01
Posen	451,032	521,628	512,017	590,871	362,000	665,279	352,000	0.02
Schlesien	1,159,158	1,530,689	2,187,662	1,942,594	1,041,000	1,768,901	1,224,000	0.04
Sachsen-Anhalt	713,012	1,024,145	1,683,190	1,396,882	633,000	1,141,275	716,000	0.05
Schleswig-Holstein	279,816	326,377	620,111	372,405	291,000	453,266	376,000	0.02
Hannover	573,082	659,878	1,184,671	744,666	505,000	1,091,249	665,000	0.02
Westfalen	527,492	844,355	1,703,393	1,263,709	469,000	1,207,759	665,000	0.07
Hessen-Nassau	392,049	483,271	927,335	578,180	355,000	720,908	449,000	0.03
Rheinland	1,052,118	1,612,096	3,279,153	2,324,031	994,000	2,139,160	1,358,000	0.06
Bayern	1,513,801	1,756,823	1,984,766	1,995,952	1,211,000	2,377,310	1,133,000	0.02
Pfalz	201,686	239,090	401,697	276,624	155,000	340,841	165,000	0.02
Königreich Sachsen	858,880	1,411,418	2,730,347	2,160,534	943,000	1,500,893	1,244,000	0.07
Württemberg	451,005	488,182	896,374	522,479	387,000	938,175	469,000	0.01
Baden	399,539	468,143	777,673	536,249	363,000	825,654	440,000	0.02
Mecklenburg	192,148	150,358	261,949	121,852	179,000	232,570	195,000	-0.03
Thüringen	219,639	270,616	777,672	323,629	296,000	530,863	346,000	0.03
Oldenburg	82,583	84,883	160,630	86,905	59,000	145,179	76,000	0
Braunschweig	111,545	173,006	252,756	252,025	107,000	162,619	130,000	0.06
Hansestädte	180,930	373,289	736,745	694,459	244,000	597,149	376,000	0.11
Elsass-Lothringen	470,172	457,259	771,506	446,473	326,000	689,475	355,000	0

Province	*1882*	*1889*	*1895*			*1907*		*Pop. growth: 16 and older*
			(1)	(2)	(3)	(1)	(2)	
Imperial Germany	12,112,985	15,606,846	26,127,674	21447546	11,061,000	21,084,994	13,449,000	0.019

1882: Numbers of workers potentially covered according to census. *1889:* Numbers based on 1882 census and growth rate of population over 16 between 1880 and 1885. *1895, (1):* Numbers of workers potentially covered according to census 1895. *1895, (2):* Numbers based on 1882 census and growth rate of population over 16 between 1880 and 1885. *1895, (3):* Number of people insured. *1907, (1):* Numbers of workers potentially covered according to census 1907. *1907, (2):* Number of people insured.

Appendix B

Econometric Considerations

B.1 Difference-in-differences as an Identification Strategy

In the classic difference-in-differences-model, outcomes are observed for two groups for two time periods. One of the groups is exposed to a treatment in the second period but not in the first period. The second group is not exposed to the treatment during any of the periods. This is necessary for *identification*.

The regional structure of the data makes it necessary to control for unobserved heterogeneity. This is necessary for the unbiased *estimation* of error terms, which would otherwise lead to the wrong conclusions about the significance of parameter estimates. This section shows that first differences estimation – one possibility to correct for province-specific time-invariant effects – is equivalent to the difference-in-differences strategy in the two by two case, i.e. with two time periods and one treatment and one control group.

As an implication, the discussion on additional complications in the difference-in-differences model in section B.2 also applies to models in first differences, even though difference-in-differences is not an identification strategy in these models. The discussion in section B.2 refers to potential sources for biased standard errors, even when measures are taken to eliminate province-specific time-invariant effects. In particular, if the treatment is measured at level different from the level of observation, the problem of group-correlated errors arises in addition to the issues discussed in this section. As we use province-level data in the analyses, we refer to the lowest level of observation as provinces. However, the discussion in this section also applies if the lowest level of observation is the individual level.

B.1.1 Difference-in-differences Estimation

The canonical two-by-two difference-in-differences approach, as first laid out concisely in Ashenfelter and Card (1985), assumes that a fraction of the population is exposed to a form of treatment between a pre-treatment period ($t = 0$) and a post-treatment period ($t = 1$), during which the population is observed. This is frequently indicated by a treatment indicator $D_{i,t}$, which switches to 1 if province i in the treatment group is exposed to the treatment.

The outcome of interest is $y_{i,g,t}$ for province i in group g at time t. In our example, $y_{i,g,t}$ is the CMBR in province i in group g at time t. In the simple two by two case, $t = 2$ and $g = 2$, such that the dummy variable D_g is equal to 1 if an observation belongs to the treatment group. In our setting, if $g = 1$, a province is considered treated, if $g = 0$, a province is considered to be in the control group. The dummy variable D_t is equal to one if the time period is the time period after the treatment has taken place.

The difference-in-differences estimator $\hat{\gamma}_{g,t}$ from

$$y_{i,t,g} = \gamma_g D_g + \gamma_t D_t + x_{\mathbf{i,g,t}}\beta_x + D_{g,t}\gamma_{g,t} + \varepsilon_{i,g,t} \tag{B.1}$$

is equal to a comparison of means

$$\hat{\gamma}_{g,t} = \left(\bar{y}_{g=1,t=1} - \bar{y}_{g=1,t=0}\right) - \left(\bar{y}_{g=0,t=1} - \bar{y}_{g=0,t=0}\right).$$

Note that the error term $\varepsilon_{i,t,g}$ is i.i.d..

B.1.2 Unobserved Heterogeneity

It is possible that there are regional-specific effects α_i that cannot be controlled for, but which are correlated with the covariates $x_{i,t}$. In a linear unobserved effects model,

$$y_{i,t} = x_{i,t}\beta + \alpha_i + \varepsilon_{i,t}, \tag{B.2}$$

this leads the composite error term $\nu_{it} = \varepsilon_{it} + \alpha_i$ causing OLS to be inconsistent, since $E(x'_{it}\nu_{it}) \neq 0$. The most common approach to solve this problem is the within transformation, commonly known as the fixed effects estimator, i.e. the elimiation of the time-constant individual-specific effects by data transformation in which the averaged data is subtracted from each observation:

$$y_{i,t} - \bar{y}_i = (x_{i,t} - \bar{x}_i)'\beta + (\varepsilon_{i,t} - \bar{\varepsilon}_i). \tag{B.3}$$

As $\bar{\alpha}_i = \alpha_i$ by assumption, the transformed model can be estimated by OLS. This requires strict exogeneity, i.e. $E[\varepsilon_{i,t}|\alpha_i, x_{i,1}, ..., x_{i,T}] = 0$, $t = 1, ..., T$. If either $N \to \infty$ or $T \to \infty$, this estimator is consistent.

A first-differences estimator is the pooled OLS estimator of

$$y_{i,t} - y_{i,t-1} = (x_{i,t} - x_{i,t-1})'\beta + (\varepsilon_{i,t} - \varepsilon_{i,t-1}). \tag{B.4}$$

A first differences estimator is consistent under weak exogeneity, i.e. $E[\varepsilon_{i,t}|\alpha_i, x_{i,1}, ..., x_{i,t}] = 0$, $t = 1, ..., T$. However, it is not the most efficient estimator if strict exogeneity holds.

If the individual effects are fixed, a first differences estimator provides consistent estimates, even if it may not be the most efficient estimator. However, a first differences estimator is attractive when the number of time periods is small, and also since introducing level variables is convenient when working with historical data that are not available for every time period. Several variables of interest are only available for at most two years, and some variables, like the information on internal migration, are only available for one year. The only possibility of making use of the information in these variables is introducing them as time-constant variables, which is not possible when using the within transformation.

If the composite error term $(\varepsilon_{i,t} - \varepsilon_{i,t-1})$ is homoskedastic and a non-serially classical error, the errors for adjacent periods are correlated (Arellano 2003). The problem of serial correlation may arise in a first differences setting, as it generally does in fixed effects models (e.g. Bhargava et al. 1982). One solution to this problem, which conveniently is a solution to the group-correlated error problem as well, is aggregating the data to two time periods (as discussed in section B.2). We use this approach frequently, because it nicely solves two concerns regarding a potential bias in standard errors, but we also contrast this approach with other estimation procedures.

B.1.3 First Differences and Difference-in-differences

The difference-in-differences estimator for $T = 2$ is equivalent to the first differences estimator

$$y_{g,t} - y_{g,t-1} = (x_{g,t} - x_{g,t-1})'\beta + \gamma_g D_g + (\varepsilon_{g,t} - \varepsilon_{g,t-1}). \tag{B.5}$$

γ_g describes the difference between the groups with regard to the change in each group. This is equivalent to $\gamma_{g,t}$ in equation (B.1). As soon as $T > 2$, γ_g and $\gamma_{g,t}$ differ. Of course, if $T > 2$ the first differences can be set such that the average before the policy change is subtracted from the average after the policy change. Then the panel collapses to a two by two case and the estimated coefficients are equivalent. However, this would not make use of most of the time series information and would correspond to a simple averaging approach.

A difference-in-differences approach on equation (B.4),

$$y_{g,t} - y_{g,t-1} = \gamma_g D_g + \gamma_t D_t + (x_{g,t} - x_{g,t-1})'\beta + \gamma_{g,t} D_{g,t} + (\varepsilon_{g,t} - \varepsilon_{g,t-1}),$$

would yield the difference between treatment and control group in the *rate* of change.

Any concerns regarding the unbiasedness of the difference-in-differences estimator when $T > 2$ also hold when using methods to correct for unobserved heterogeneity. Section B.2 discusses potential sources of a bias in standard errors.

B.2 Difference-in-differences with Group-correlated Errors

Using a difference-in-differences approach when the level of treatment is not the lowest level of observation raises concerns related to recent work on a possible severe downward bias in standard errors due to group-correlated errors and/or serial correlation (most notably Wooldridge 2003, Bertrand et al. 2004, Donald and Lang 2007, Hansen 2007, Cameron et al. 2008 and Cameron and Miller 2010). Correcting for this bias is complex, especially when the number of groups is small. In the difference-in-differences case there are only two groups: the treatment group and the control group. It is helpful to sketch the econometric model from equation (B.1) more broadly to discuss the issue of how to correct for a potential bias in standard errors if the total number of treatment and control groups is small.

We augment the basic model for outcome $y_{i,g,t}$ for province i in group g in year t by time-specific effects $T(t)$ that are common across groups,[1] covariates $x_{\mathbf{i,g,t}}$, and allow the error term $\alpha_{i,g}$ to be correlated within each group g.[2] $\varepsilon_{i,t,g}$ is a province-specific error term , which is i.i.d.:

$$y_{i,t,g} = a_g + T_t + x_{\mathbf{i,g,t}}\beta_x + D_{g,t}\gamma + \alpha_{i,g} + \varepsilon_{i,g,t} \qquad \text{(B.6)}$$

Inference based on this model is possible both when the number of groups is large (e. g. $g = 50$) or when the number of groups is small (e. g. $g = 10$), but the within-group correlation has to be accounted for. Most approaches dealing with potential group-correlated errors in small samples involve some form of aggregation. This is achieved either by estimating the group fixed effects in a first stage (Donald and Lang 2007), or by averaging residuals over groups (Bertrand et al. 2004) or by using only group averages in the estimation, and thereby assuming $\beta_g = \beta$ (Wooldridge 2003).[3]

Another problem arising with the traditional difference-in-differences model is serial correlation, because the treatment variable is usually time-invariant and thus serially correlated. In addition, the dependent variable in our study – the crude marital birth rate – is likely to be serially correlated. Including a

[1] This trend is most often simply captured by time dummies.

[2] Note that we assumed this error term to be a group constant effect in equation (B.3) and equation (B.4), which could be eliminated by differencing. This is not sufficient if the fixed effects are correlated within each group.

[3] If the number of groups is small, using the t-distribution for inference requires some additional assumptions, see e.g. Donald and Lang (2007) and Wooldridge (2003). Even when the t-distribution is applicable, the degrees of freedom must be adjusted.

lagged dependent variable and applying other standard methods for correcting for serially correlated errors is not enough to avoid the downward bias that serial correlation exerts on standard errors even if the researcher properly accounts for a potential bias due to group-correlated errors (Bertrand et al. 2004).

To account for these concerns we report results using different estimators, some of which also account for serial correlation. As a benchmark, we report pooled OLS estimates and correct errors with the Liang and Zeger (1986) method[4] at the province level. We also report the aggregation technique suggested by Donald and Lang (2007) and the aggregation technique suggested by Bertrand et al. (2004), because the latter also accounts for serial correlation.[5]

When applying the aggregation approaches, we control for other determinants of the dependent variable in each group g and in each year t separately. Therefore, we run the following regression for each year in T, i.e. in total $g \cdot T$ regressions:

$$y_{i,g} = a_g + x_{\mathbf{i},\mathbf{g}}\beta + \varepsilon_{i,g}. \tag{B.7}$$

Thus, the coefficient β is identified by between-province variation only. We add level variables z where applicable:

$$y_{i,g} = a_g + x_{\mathbf{i},\mathbf{g}}\beta + z_{i,g}\beta_z + \varepsilon_{i,g}. \tag{B.8}$$

Next, we aggregate the predicted outcome variable $\hat{y}_{g,t}$ to group/year cells, which yields T observations. We run the standard difference-in-differences model

$$\bar{y}_{t,g} = T_t + \alpha_g + D_{g,t}\gamma + u_{g,t} \tag{B.9}$$

on this averaged data. T_t denotes the year dummies and α_g denotes the group dummy equal to 1 for the treatment group.

For the Bertrand et al. (2004) approach, we aggregate the predicted outcome variable $\hat{y}_{g,t}$ to group/treatment cells. This yields $\frac{T}{2}$ observations.

$$\bar{y}_{t,g} = a_g + T_t + \alpha_g + D_{g,t}\gamma + u_{g,t} \tag{B.10}$$

The same aggregation procedure can be applied to the residuals from the first stage, which yields qualitatively similar results.

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[4] Also known as the frequently used ‘cluster’-option in STATA.

[5] Note that other methods imply significant pooling over time and thus the assumption of equal effects of the control variables over time. As suggested by Baltagi (1981), we run a Roy-Zellner test for the equality of these coefficients over time. Poolability of the data before and after each reform is rejected. As a consequence, we only use the residual aggregation technique suggested in Bertrand et al. (2004) and the two-step procedure suggested in Donald and Lang (2007), which allows for different effects of the control variables at the individual level over time.

Appendix C

The Definition of Disability

To qualify for a disability pension, workers had to prove that they had paid contributions for at least five years and at least 47 weeks a year according to the 1889 text of the law. During the transition period (1891-1900), it sufficed to have collected stamps for one year only, but a worker had to use at least 47 stamps in the four years that followed his approved pension application.[1]

The law was amended in 1899. From 1900 onwards, when the 1899 amendment came into force, a worker had to collect stamps for at least 200 weeks and cash at least 20 stamps within the first two years after a successful application for a disability pension.[2]

Both texts provide a definition of disability. The wording of both versions is reproduced in table C.1. Kaschke and Sniegs (2001) note three interesting facts about these definitions. First, §4.2 in the 1889 law defines people, who should be insured, but are already disabled and thus cannot not make a contribution due to their physical impairment as

§4.2 Invaliditäts- und Altersversicherungsgesetz (1889): People [...] who are unable to earn at least one third of the usual regional day labourer's wage as defined in §8 of the law on health insurance owing to their mental or physical state.

This differs from the disability definition in §9.3 of the same law (as reproduced in table C.1) and caused a non-uniform interpretation of disability across insurance agencies.

Second, both the 1889 text and the 1899 amendment allow a worker to earn about 1/3 of the salary of an ordinary worker while still being considereddisabled, but, third, the 1889 law is more specific than the 1899 amendment. The 1899 definition is related to the reasonability of the worker's occupation given the worker's ability to perform it rather than the worker's ability in general (Frerich and Frey 1996). This lead to a more generous interpretation of the law after 1899. Often it was regarded as sufficient if a worker proved that he was unable to perform his current job.

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[1] RGBl 1889/13.

[2] RGBl 1899/33, §§29,46.

Table C.1: Defintions of Disability according to the 1889 law and the 1899 law

§9.3 Invaliditäts- und Altersversicherungsgesetz (1889)	
Erwerbsunfähigkeit ist dann anzunehmen, wenn der Versicherte in Folge seines körperlichen oder geistigen Zustandes nicht mehr im Stande ist, durch eine seinen Kräften und Fähigkeiten entsprechende Lohnarbeit mindestens einen Betrag zu verdienen, welcher gleichkommt der Summe eines Sechstels des Durchschnitts der Lohnsätze (§23), nach welchen für ihn während der letzten 5 Jahre Beiträge entrichtet worden sind, und eines Sechstels des dreihundertfachen Betrages, des nach §8 des Krankenversicherungsgesetzes [...] festgesetzten Tageslohns gewöhnlicher Tagearbeiter des letzten Beschäftigungsortes, in welchem er nicht lediglich vorübergehend beschäftigt ist.	A person should be considered disabled if they are not able to earn a certain amount by an activity corresponding to their strengths and abilities owing to their mental or physical state. This amount is equal to the sum of one sixth of the average wage rates (§23) according to which the person and his employer have contributed for the previous 5 years and it is equal to one sixth of threehundred times the amount of the usual day labourer's wage at the place of the insured person's last non-temporary employment according to §8 of the law on health insurance.
§5.4 Invalidenversicherungsgesetz (1899)	
[...] Personen, deren Erwerbsfähigkeit in Folge von Alter, Krankheit oder anderen Gebrechen dauernd auf weniger als ein Drittel herabgesetzt ist. Dies ist dann anzunehmen, wenn sie nicht mehr im Stande sind, durch eine ihren Kräften und Fähigkeiten entsprechende Thätigkeit, die ihnen unter billiger Berücksichtigung ihrer Ausbildung und ihres bisherigen Berufs zugemuthet werden kann, ein Drittel desjenigen zu erwerben, was körperlich und geistig gesunde Personen derselben Art mit ähnlicher Ausbildung in derselben Gegend durch Arbeit zu verdienen pflegen.	A person should be considered disabled if their ability to earn a living is permanently reduced to less than one third caused by age, illness or other impairments. More specificially, to be considered disabled, a person should be unable to earn a third of the amount that mentally and physically healthy persons with a similar education would be able to earn in the same region in an activity corresponding to their strengths and abilities.

Appendix D

Regional Variation in the Implementation of Pension Insurance

We analyse the effects of pension insurance on fertility using variation between the provinces of Imperial Germany. The provinces did not only differ with regard to fertility and industrial structure, but also in terms of how the pension rules were implemented. Were these differences in implementation exogenous to the factors that affected fertility? Two peculiarities of the pension system allow us to assess the primary determinants of regional variation.

Appendix C describes that the law on disability insurance gave Regional Insurance Agency officials discretion in the approval of a disability pension applications, particularly after 1900. Differences in the approval of disability pension applications convert into differences in the number of disability pensioners and into differences in expenditures. If officials used this discretion – as claimed e.g. by Kaschke and Sniegs (2001) – differences in the number of disability pensioners and differences in expenditures would also be related to ambiguities in the law. Variation in variables such as the number of disability pensioners or expenditures that is related to an exogenous factor such as discretion in the interpretation of the law is desirable to identify the effect of the pension system on fertility.

D.1 Approval Rates as a Measure of Regional Variation in the Implementation of Pension Insurance

Kaschke and Sniegs (2001) consider the approval rate of pension applications as the most important indicator for regional differences in the interpretation and application of the pension law. Contraty to what one might suspect, the approval rate is not defined as the fraction of approved pension applications as a share of the total number of pension applications. Instead, it is defined as the fraction of approved pension applications as a share of all approved pension applications that were approved at first instance.[1] This is a measure

[1] A Regional Insurance Agency Official could approve a pension application immediately, i.e. at first instance, or he could file it for review and approval thereafter, i.e. at second instance.

of the generosity of a Regional Insurance Agency, because approval at first instance meant that a pension application was not reviewed.

Hypothesis A1: Disability Pension Approval Rates

The between-province variation in disability approval rates was mainly driven by a different application of the disability insurance law.

We use two approaches to identify an effect of differences in the application of disability pension law. Both approaches build on the observation that there was ambiguity with regard to the definition of disability in the 1889 law and that this ambiguity was even more pronounced in the 1899 amendment of the 1889 law (see also chapter 3 and appendix C). This amendment was not passed as a specific measure to allow more discretion, but was one of many changes after a review of the 1889 law. Like all other changes, the new definition of disability came into effect in 1900.

We establish that the ambiguity in the 1899 law affected the East Prussian provinces differently from other provinces. Based on this observation we compare disability pension approval rates before and after 1900 between the East Prussian provinces and the other provinces. Subsequently, we compare the difference between old age pension approval rates and disability pension approval rates before and after 1900, since regional insurance agencies did not enjoy the same discretion with the approval of old age pension applications.

D.1.1 Discrimination of Slav Minorities

Kaschke and Sniegs (2001) report that discrimination against Slav minorities was widespread in the East Prussian provinces.[2] In the business report of the Regional Insurance Agency in East Prussia they discovered local guidelines on how to interpret and enforce the law correctly. These guidelines were published in German and in Lithuanian, but not in Polish, which made it easier for officials to interpret the guidelines as they wished. Therefore, it is likely that Regional Insurance Agency officials in those East Prussian provinces with large Slav minorities made use of the increased discretion granted by the 1899 law.

[2] According to Kaschke and Sniegs , many public officials working for the Regional Insurance Agencies in the East Prussian provinces were members of associations that displayed xenophobic tendencies (the so-called *Ostmarkvereine*).

As the distribution of ethnic minorities across Europe is non-random, the division into treatment and control group is not random either. However, our main aim is to establish whether the ambiguity in the official definition of disability triggered differences in approval rates. As long as the distribution of Slav minorities is not related to other factors that might influence approval rates (as discussed in section D.4) this is not a problem for the analysis.

We estimate a difference-in-differences (DD) model in which treatment is defined as 1900 or later, because the changed law came into effect in 1900. In addition, we check for an effect in 1904, because the Imperial Insurance Agency initiated a review of the Regional Insurance Agencies' code of practice in 1903 that was finished in 1904.[3] Accordingly, the period between 1889 and 1899 is the pre-treatment period for the 1900 policy change.

The outcome $y_{i,g,t}$ is the disability approval rate for province i in group g in year t, which is determined by time fixed effects $T(t)$ that are common across groups, by an error term $\alpha_{i,g}$ that can be correlated within each group g, and an error term $\varepsilon_{i,t,g}$, which is i.i.d.:

(D.1) $$y_{i,t,g}(DD) = D_{g,t} + T_t + x_{\mathbf{i,g,t}}\beta_x + \mathbf{DD_{g,t}}\gamma_{DD} + \alpha_{i,g} + \varepsilon_{i,g,t}.$$

$D_{g,t}$ is an indicator variable that switches to 1 if a province has a large Slav minority. $\mathbf{DD_{g,t}}$ is a set of two treatment dummies that interact the treatment group dummy with a time dummy for the periods 1900-1903 and 1904-1913 respectively. Thus, the coefficient vector of interest is γ_{DD}.

D.1.2 Comparison of Old Age Pension and Disability Pension Approval Rate

To analyse whether disability pension approval rates changed more strongly after 1900 than old age pension approval rates, we use a two-step approach. First, we regress the respective approval rate on a set of explanatory variables:

(D.2) $$y_{i,t,g} = T_t + x_{\mathbf{i,g,t}}\beta_x + \alpha_{i,g} + \varepsilon_{i,g,t}.$$

The set of explanatory variables consists of population, population density, productivity in agriculture and revenues from contributions.[4] We both allow for time specific effects and province specific effects and use a fixed effects estimator to deal with time invariant heterogeneity. Second, we use the predicted values in a difference-in-difference model

(D.3) $$\hat{y}_{i,t,g}(DD) = D_{g,t} + T_t + + \mathbf{DD_{g,t}}\gamma_{DD} + \alpha_{i,g} + \varepsilon_{i,g,t}$$

[3] This review of the code of practice was triggered precisely as it was observed that some insurance agencies were more generous than others in approving pension applications.

[4] We use a relatively restricted set of covariates, as expenditure variables are likely to be endogenous, such as the number of pensioners.

in which the treatment group indicator $D_{g,t}$ switches to 1 for the predicted disability pension approval rate. The difference-in-difference estimates are derived by interacting the treatment group indicator with dummies for 1900 and 1904.[5] If this approach does not indicate significant differences between disability and old age pensions, it is safe to conclude that differences in approval rates were not caused by the law allowing for discretion in the approval of disability pensions.

Even after controlling for province-specific effects in equation (D.2), errors may still be correlated in equation (D.3), since treatment is defined at the approval rate type level and not at the province level. In other words, the level of treatment is different from the the level of observation. As factors that affect the approval rates are collected at the province level there are 25 units of observation for the control variables, whereas there is only one treatment and one control group. This causes error correlation at the group level. If not sufficiently controlled for, this correlation can cause a serious downward bias in standard errors. Appendix B discusses the adequate methods to deal with this. We use the Bertrand et al. (2004) aggregation approach, because it has performed most robust in a comparison of several estimators (e.g. Scheubel 2009). In addition, this approach simultaneously deals with serial correlation.

D.2 Descriptive Evidence on Variation in Approval Rates

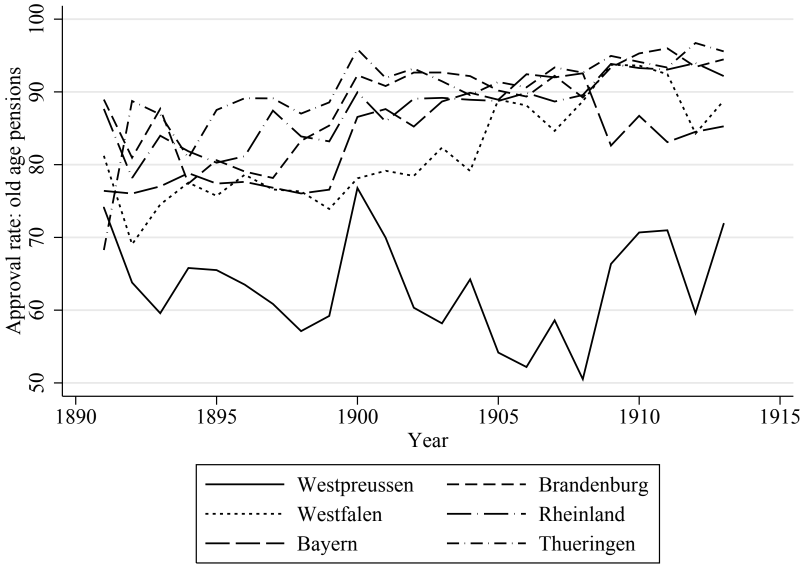
Figure D.1 shows the variation in old age pension approval rates and disability pension approval rates over time in selected provinces. After 1892, approval rates for both types of pension applications varied between 60% and nearly 100%. This shows that the majority of applications was approved at first instance. Approval rates also varied between provinces, both for old age pension applications and disability pension applications. It is possible that this variation was largely driven by the Regional Insurance Agencies' interpretation of the law.

Interestingly, regional differences between disability pension approval rates are smaller than between old age pension approval rates. The top panel of figure D.1 shows that while after 1900 old age pension approval rates decreased only in Westpreußen, disability pension approval rates decreased in all provinces, as shown in the bottom panel of figure D.1. This illustrates a general regional pattern. Approval rates were the lowest in the East Prussian provinces for both pension types, as shown in figure D.2. Moreover, figure

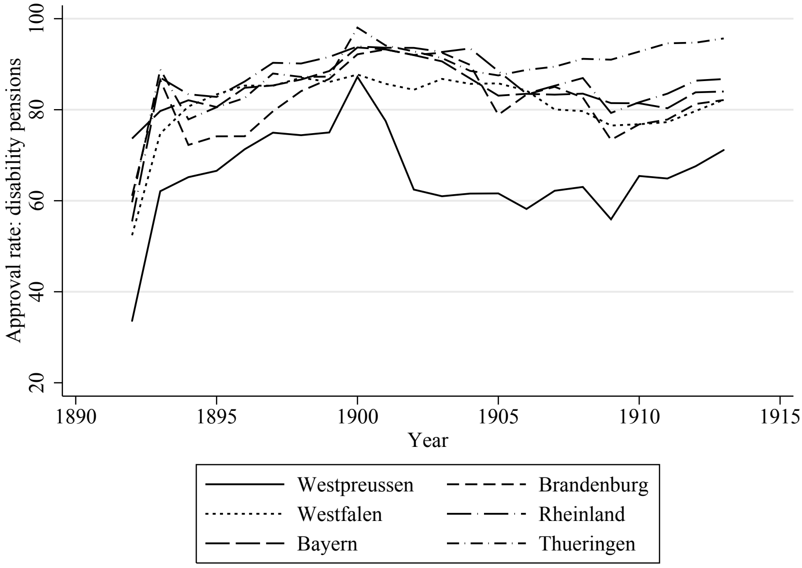
[5] Note that we check again for a 1904 effect that could be related to the Imperial Insurance Agency's review of the code of practice.

Figure D.1: Pension approval Rates in Selected Regions

Old age pension



Disability pension



Source: Data from Regional Insurance Agencies as collected by Kaschke and Sniegs (2011).

D.2 suggests that there is a difference between the East Prussian provinces and the other provinces for both old age and disability pension approval rates.

Between 1895 and 1907 approval rates increased in most provinces, while they decreased in the East Prussian provinces. The decline was stronger for disability pension approval rates. The next section evaluates whether this difference is significant.

D.3 Variation in Approval Rates: Results

D.3.1 Discrimination of Slav Minorities

Was the difference in disability pension approval rates between provinces with large Slav minorities and other provinces significant after the 1900 policy change? Table D.1 shows difference-in-differences (DD) results without covariates.[6]

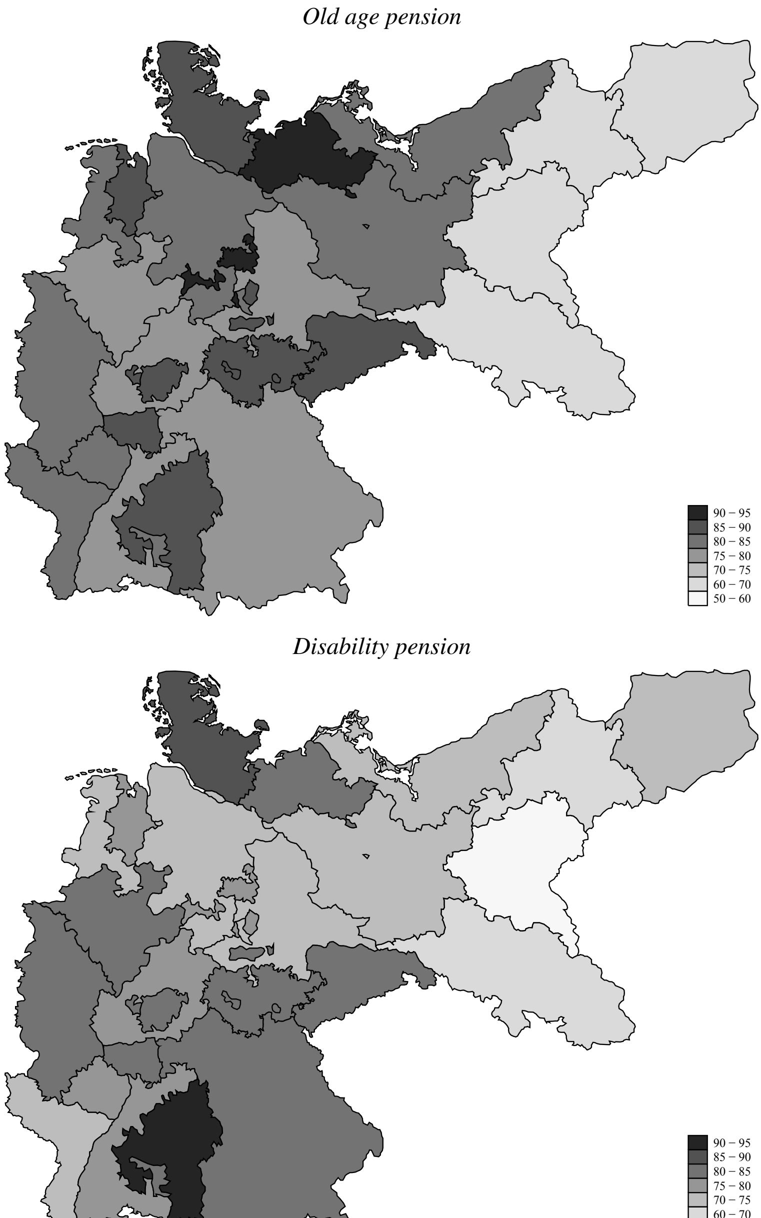
The indicator variable for provinces with a large Slav minority is highly significant. It shows that there are ex ante differences between treatment and control group and confirms our conjecture that the division into treatment and control group is non-random. The 1904 DD term is highly significant in all specifications and the 1900 DD term is significant in some specifications.

Consider specification (1). Column (1) presents pooled OLS estimates. The 1900 DD term indicates that the disability pension approval rate was 5.6 percentage points lower in provinces with a large Slav minority after 1900 compared to the years before 1900 . The 1904 DD term indicates that the disability pension approval rate was 10.3 percentage points lower after 1904 compared to before 1904. As the latter effect includes the 1900 DD effect, we have to subtract the 1900 DD effect from the 1904 DD effect to get the effect of years following 1904 versus the years 1900-1903. This gives a net effect of a 4.7 percentage point reduction in the disability pension approval rate in provinces with a large Slav minority after 1904 when compared to 1900-1903. These results support *Hypothesis A1*.

Columns (2)–(5) underpin the results from column (1). First, observations for the disability pension approval rate are missing for Hessen for 1892 and 1894 and for the Hansestädte for 1910 and 1911. Therefore, we completely exclude these years in the pooled OLS analysis in column (2). This does not affect DD estimates. In column (3), we use the within transformation to account for province-specific time-invariant effects. both the 1900 DD indicator and the 1904 DD indicator are significant. In column (4), we aggregate across treated and control provinces. The resulting data set consists of two

[6] Note however that estimates are robust to adding covariates.

Figure D.2: Regional distribution of approval rates



Source: Data from Regional Insurance Agencies as collected by Kaschke and Sniegs (2011).

Table D.1: Difference-in-differences – Disability pension

	(1)	(2)	(3)	(4)	(5)
Approval rate: disability					
Slav minorities * post 1900 (D)	-5.592 (2.534)**	-4.551 (2.839)	-4.551 (1.424)***	-4.551 (2.854)	-4.409 (2.864)
Slav minorities * post 1904 (D)	-10.297 (4.063)**	-9.902 (4.075)**	-9.902 (1.191)***	-9.902 (2.388)***	
Post 1900 (D)	4.237 (1.253)***	4.029 (1.211)***	4.029 (1.280)***	8.386 (2.018)***	3.079 (1.146)***
Post 1904 (D)	.892 (1.373)	.813 (1.363)	.813 (1.270)	1.803 (1.688)	
Large Slav minority (D)	-6.009 (2.127)***	-24.920 (2.240)***		-14.664 (1.805)***	
Time fixed effects	YES	YES	YES	NO	
Province fixed effects	YES	YES	YES		NO
Reduced sample	NO	YES	YES	YES	YES
Covariates	NO	NO	NO	NO	NO
Obs.	550	450	450	36	25

Data on the disability approval rate are missing for Hessen for 1892 and 1894 and for Hansestädte for 1910 and 1911 in column (1). The years 1892, 1894, 1910, and 1911 are completely excluded in columns (2) - (5). Column (1) presents OLS results, column (2) presents OLS results for the reduced sample, column (3) presents fixed effects results using the within transformation, column (4) gives presents from simple aggregation by treatment group (i.e. provinces with large Slav minorities) and year, and column (5) presents fixed effects results using first differences on data aggregated before and after 1900. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

observations per year: one treated unit and one control unit. Thus, estimates in column (4) only reflect differences over time. This corresponds to the Bertrand et al. (2004) approach. Using this type of aggregation renders the 1900 DD coefficient insignificant, but does neither affect magnitude nor significance of the 1904 DD coefficient. Column (5) presents the same excercise with aggregation over time. The data are aggregated to one time period before the policy intervention (i.e. before 1900) and to one period after the policy intervention. Thus, the estimate is primarily derived from comparing between-province variation before and after the policy intervention. The magnitude of the 1900 DD estimate is similar to columns (1)–(4), but it is insignificant. As the 1904 review of the code of practice can be considered a consequence of the reorganisation of the system in 1900, this still endorses *Hypothesis A.1*.

To substantiate the results, we present the same exercise for the old age pension approval rate in table D.2. We would not expect the same significant effect for the old age pension approval rate, since Regional Insurance Agency officials enjoyed less discretion when it came to the approval of old age pension applications.

Table D.2: Difference-in-differences – Old age pension

	(1)	(2)	(3)	(4)	(5)
Approval rate: old age					
Slav minorities * 1900–1903 (D)	-3.392 (2.589)	-1.986 (2.388)	-1.986 (1.605)	-1.986 (3.336)	-1.885 (2.488)
Slav minorities * post 1904 (D)	-1.192 (3.173)	-1.834 (3.132)	-1.834 (1.325)	-1.834 (2.755)	
1900–1903 (D)	4.940 (2.232)**	5.648 (2.146)***	5.648 (1.376)***	7.133 (2.359)***	7.381 (1.016)***
Post 1904 (D)	6.448 (2.203)***	9.160 (1.917)***	9.160 (1.367)***	7.505 (1.948)***	
Large Slav minority (D)	-31.288 (.886)***	-28.151 (1.657)***		-15.557 (2.012)***	
Time fixed effects	YES	YES	YES	NO	
Province fixed effects	YES	YES	YES		NO
Reduced sample	NO	YES	YES	YES	YES
Covariates	NO	NO	NO	NO	NO
Obs.	560	456	456	38	24

Data on the old age pension approval rate is missing for Ostpreußen after 1897, for Hessen for 1892 and 1894 and for Hansestädte for 1910 and 1911 in column (1). East Prussia and the years 1892, 1894, 1910, and 1911 are completely excluded in columns (2) - (5). Column (1) presents OLS results, column (2) presents OLS results for the reduced sample, column (3) presents fixed effects results using the within transformation, column (4) presents results from simple aggregation by treatment group (i.e. provinces with large Slav minorities) and year, and column (5) presents fixed effects results using first differences on data aggregated before and after 1900. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

Column (1) in table D.2 presents the OLS estimates that ignore the time structure of the data. The difference-in-difference estimates are not significantly different from zero. As the old age pension approval rate is missing for some provinces for some years (1892, 1894, 1897, 1910, and 1911), we exclude these years in column (2). This changes the estimate of the dummy for provinces with a large Slav minority and reduces the magnitude of the 1900 DD coefficient. Nevertheless, all coefficients are statistically insignificant. Columns (3)-(5) present fixed effects results. Column (3) presents the traditional within transformation,column (4) aggregates over groups, and column (5) aggregates over time.

While these approaches do not render the difference-in-difference estimates significant, the estimator for the dummy variable for provinces with a large Slav minority is highly significant. This indicates ex ante differences between treatment and control group. As there is no significant difference in old age pension approval rates between provinces with large Slav minorities and other provinces as shown in table D.2, these results support the results in table D.1.

D.3.2 Comparison of Old Age Pension and Disability Pension Approval Rate

As a next step we verify that the disability pension approval rate differed from the old age pension approval rate after the 1900 policy change by running a first step regression of the respective approval rate on its main determinants as in equation (D.2). and then aggregating the predicted values over pension type (i.e. disability or old age pension) for each year.[7] Then we run a DD model on the predicted and aggregated values. The results of the second step DD estimation are shown in table D.3.

Columns (1) and (2) of table D.3 show the DD results using the Donald and Lang (2007) approach. Columns (3) and (4) repeat this procedure, but additionally aggregate the data to just one 'before' and one 'after' period, as suggested by Bertrand et al. (2004). As the major change should be visible after 1900, the we set the 'before the policy change' -period to 1892-1899 and the 'after the policy change'-period to 1900-1903. For checking the effect of the review of the Imperial Insurance Agency, we set the 'before the policy change'-period to 1900-1903 and the 'after the policy change' -period to 1904-1913.

Column (2) indicates that after 1904 the difference in disability pension approval rates was 8 percentage points lower than the difference between old age pension approval rates. However, this is not a significant effect when using the complete aggregation approach as in column (4).

The DD coefficient for the 1900 policy change is positive, albeit not significant both for the Donald and Lang (2007) approach in column (1) and the Bertrand et al. (2004) aggregation approach in column (3). Thus, the evidence on the difference between the disability pension approval rate and the old age pension approval rate is relatively weak. Next, we evaluate whether

[7] Donald and Lang suggest to subtract the aggregated predicted values from the mean. The resulting approach is a residual aggregation type of approach, also mentioned in Bertrand et al. (2004). However, the results are qualitatively the same. Both approaches help dealing with group-correlated errors and serial correlation. Dealing with serial correlation is important as a Wooldridge test on first order serial correlation rejects the null hypothesis of no serial correlation at the 5% level. A regression of residuals from a simple OLS estimation on lagged residuals also indicates serial correlation.

the disability pension approval rate and the old age pension approval rate differ in the East Prussian provinces compared to the difference in approval rates in other provinces.

We augment our model from equation D.1 by another interaction term $DDD_{g,s,t}$ that interacts the DD term with the dummy variable for observations from provinces with a large Slav minority.

$$\begin{aligned} y_{i,t,g}(DDD) &= a_g + T_t + x_{\mathbf{i,g,t}}\beta_x + D_{g,t}\gamma_{Dg} + D_{s,t}\gamma_{Ds} \\ &\quad + DD_{g,t}\gamma_{DD} + DDD_{g,s,t}\gamma_{DDD} + \alpha_{i,g} + \varepsilon_{i,g,t}. \end{aligned}$$

$\alpha_{i,g}$ denotes a province-specific unobserved error that is correlated for each pension type g. The parameter estimate γ_{DDD} measures whether after 1900 the disability pension approval rate is significantly different from the old age pension approval rate in provinces with a large Slav minority.

Columns (5) and (7) show this DDD estimate for the 1900 policy change. They suggest that the disability pension approval rate was reduced by between 9 and 12 percentage points in provinces with a large Slav minority after 1900. Provided that γ_{DD} is positive for the 1900 policy change, the total effect for provinces with a large Slav minority is a reduction of around 4-5 percentage points. This corresponds to our estimates in table D.1. The magnitude of the corresponding effect for 1904, as shown in columns (6) and (8) of table D.3, is even larger. The DDD estimate suggests a reduction between 16 and 19 percentage points for the 1904 effect.

The results from the separate and the combined analysis of disability and old age pension approval rate therefore lend support to *Hypothesis A.1*, i.e. to the hypothesis that the interpretation of the definition of disability led to the variation in approval rates. The possibility of interpreting the eligibility criteria for disability pensions more liberally than the eligibility criteria for old age pensions after 1900 led to a more restrictive approval procedures for disability pension applications.

Table D.3: Difference-in-differences – Pension type

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Predicted approval rate								
Post 1900 * disability pension (D)	.528 (1.889)		.032 (4.737)		8.739 (5.703)		3.987 (2.307)*	
Post 1904 * disability pension (D)		-8.128 (1.294)***		-4.395 (3.036)		-1.553 (5.535)		-2.327 (2.279)
Post 1900 * disab. pension * Slav min. (D)					-12.985 (7.467)*		-9.024 (2.410)***	
Post 1904 * disab. pension * Slav min. (D)						-19.017 (7.247)***		-15.824 (2.039)***
Post 1900 (D)	4.312 (2.275)*						8.097 (2.369)***	
Post 1904 (D)		1.273 (1.629)						-3.426 (2.565)
Disability pension (D)	.186 (1.195)	.714 (1.057)					-2.477 (1.244)**	-3.002 (1.664)*
Slav minorities (D)							-3.961 (1.078)***	-3.193 (1.177)***
Time fixed effects	YES	YES	YES	YES	YES	YES	YES	YES
FE at province level	YES	YES	YES	YES	YES	YES	YES	YES
Time horizon	1892–1903	1900–1914	1892–1903	1900–1914	1892–1903	1900–1914	1892–1903	1900–1914
Obs.	20	24	4	4	8	8	40	48

Data on the approval rates are missing for Hessen for 1892 and 1894 and Hansestädte for 1910 and 1911 in column (1). The years 1892, 1894, 1910, and 1911 are excluded. Columns (1)-(4) present difference-in-difference results and columns (5)-(8) present difference-in-difference-in-difference results. All estimations are based on predicted values from a between-province FE estimation and aggregated to pension type/year or pension type/Slav minorities/year level. For columns (3)-(6) cells are aggregated further to before/after periods. Significance level: *** : $p < 0.01$; ** : $p < 0.05$; * : $p < 0.1$.

D.4 Other Explanations for a Difference in Approval Rates

While the analysis shows that Regional Insurance Agencies used their margin of discretion with regard to the approval of disability pension applications, the discrimination of Slav minorities is not the only reason for such behaviour. Possibly other factors specific to the East Prussian provinces, but unrelated to xenophobic tendencies induced the officials from the East Prussian Regional Insurance Agencies to use their margin of discretion more intensively. Could these explanations also be related to fertility?

One reason for a comparatively low approval rate in East Prussia is a diverging degree of influence of the federal administration (Kaschke and Sniegs 2001). The Imperial Insurance Agency was not entitled to oversee the Regional Insurance Agencies in the southern provinces. On the one hand, as the southern Regional Insurance Agencies did not report to the Imperial Insurance Agency it is possible that they followed the Imperial Insurance Agency's instructions less strictly. On the other hand, if the instructions had been taken seriously, this could have led to a closer revision of appeals. As a consequence, more appeals could have been granted. The approval rates in the southern provinces remained high during all years between 1892 and 1913, particularly the disability pension approval rates. Viewed in the context of differences between the East Prussian provinces and the other provinces, the difference could also be related to *higher* approval rates in the South. However, higher rates in the South do not explain the differences between disability and old age pension approval rates in the East Prussian provinces.

The financial situation of a Regional Insurance Agency – which may have caused the degree to which discretion in the approval of disability pension applications was used – inter alia depended on the number of contributors. The most urbanised areas - the Hansestädte and the capital Berlin - display the lowest number of disability pension applications per mill insured: 2.25 and 2.67 respectively. The share of the working age population was higher in the urbanised areas. For example, the share of the working age population was 65.9% in the Hansestädte and 70.9% in Berlin in 1890, but only 58.1% in Ostpreußen. In fact, only Posen - an East Prussian province - had a lower fraction of the working age population (56.8%). However, the average share of the working age population for Imperial Germany was 60.27%. Thus, Posen can be considered only slightly below average. In 1895, Ostpreußen displayed the highest rate of 10.92 applications per 1000 insured, while the rate of 7.79 was also comparatively high in Posen.

This potentially unfavourable relation between the share of the working age population and disability pension applications could have been driven by internal migration. In 1888, Bismarck himself acknowledged that there was temporary migration from the East Prussian provinces to the Western provinces (von Bismarck 1894). However, Bismarck considered this internal migration as finished by the time when pension insurance was introduced. Moreover, Bismarck stressed that he did not consider the pension system itself as a trigger for migration. Our analysis in chapter 2 shows that people mainly emigrated to neighbouring provinces or to the industrialising regions in the West. This implies that the East Prussian population stayed in the East even if not in the province where they were born. In fact, the share of the working age population did not change much in the East between 1878 and 1890, except for East Prussia, where it decreased from 70.97% to 58.08%, and in Berlin, where it increased from 66.44% to 70.85%.

To examine how migration and population structure affect the DD estimates in tables D.1 and D.3, we add these variables as covariates in a first differences model. While these variables significantly affect both old age and disability pension approval rates, a difference between the provinces with a large Slav minority and the other provinces remains.

D.5 Implications

In the context of our analyses in chapter 2 and 5 we illustrate two important points. First, regional variation in pension system variables was driven by exogenous policy changes. This is important when using regional variation for identification. Second, regional variation in pension system variables reflects initial differences in the population structure. The East Prussian provinces were special with respect to the composition of the population. The population was considerably more heterogenous than in other provinces. In the context of different cultural backgrounds, this may have also cause diverging fertility patterns. We discuss this aspect in chapter 2.

It is possible that the difference between the East Prussian provinces and the other provinces is not only related to discrimination against ethnic minorities, but that it is structural in nature. This has to be kept in mind when analysing differences between the provinces in Imperial Germany – for example with regard to fertility.

Bibliography

Aaron, H. (1966): "The Social Insurance Paradox," *Canadian Journal of Economics*, 32, 371–374.

Abadie, A. (2005): "Semiparametric Difference-in-Differences Estimators," *Review of Economic Studies*, 72, 1–19.

Ahn, N., and P. Mira (2002): "A note on the changing relationship between fertility and female employment rates in developed countries," *Journal of Population Economics*, 15, 667–682.

Alesina, A., and R. Perotti (1997): "The Welfare State and Competitiveness," *American Economic Review*, 87, 921–939.

Anderson, K., and T. Meyer (2006): "New Social Risks and Pension Reform in Germany and Sweden: The Politics of Pension Rights for Child care," in *Post Industrial Welfare States. Politics and Policies*, ed. by K. Armingeon, and G. Bonoli. Routledge, Oxford.

Ansichtskarten-Center (2010): "Des Reiches Fürsorge für die arbeitende Bevölkerung," www.ansichtskarten-center.de, accessed on 25 June 2011.

Apps, P., and R. Rees (2004): "Fertility, Taxation and Family Policy," *Scandinavian Journal of Economics*, 106, 745–763.

Arellano, M. (2003): *Panel Data Econometrics*. Oxford University Press, Oxford.

Aronsson, T., and J. R. Walker (1997): "The Effects of Sweden's Welfare State on Labor Supply Incentives," in *The Welfare State in Transition: Reforming the Swedish Model*, ed. by R. B. Freeman, R. Topel, and B. Swedenborg, pp. 203–266. University of Chicago Press, Chicago.

Arroyo, C. R., and J. Zhang (1997): "Dynamic microeconomic models of fertility choice: A survey," *Journal of Population Economics*, 10, 23–65.

Ashenfelter, O. (1978): "Estimating the Effect of Training Programs on Earnings," *Review of Economics and Statistics*, 60, 47–57.

Ashenfelter, O., and D. Card (1985): "Using the Longitudinal Structure of Earnings to Estimate the Effect of Training Programs," *Review of Economics and Statistics*, 67, 648–660.

Attanasio, O. P., and A. Brugiavini (2003): "Social Security and Households' Saving," *Quarterly Journal of Economics*, 118, 1075–1119.

Bailey, M. J. (2010): "Momma's Got the Pill: How Anthony Comstock and Griwwold v. Connectivut Shaped U.S. Childbearing," *American Economic Review*, 100, 98–129.

Bakketeig, L. S., S. Cnattingius, and L. B. Knudsen (1993): "Socioeconomic Differences in Fetal and Infant Mortality in Scandinavia," *Journal of Public Health Policy*, 14, 82–90.

Baltagi, B. H. (1981): "Pooling : An experimental study of alternative testing and estimation procedures in a two-way error component model," *Journal of Econometrics*, 17, 21–49.

Barr, N. (1993): *The Economics of the Welfare State*. Weidenfeld and Nicolson, London.

Barro, R. J., and G. S. Becker (1986): "Altruism and the Economic Theory of Fertility," *Population and Development Review*, 12, 69–76.

——— (1988): "A Reformulation of the Economic Theory of Fertility," *Quarterly Journal of Economics*, 103, 1–25.

——— (1989): "Fertility Choice in a Model of Economic Growth," *Econometrica*, 57, 481–501.

Baten, J., and J. E. Murray (1997): "Bastardy in South Germany Revisited: An Anthropometric Synthesis," *Journal of Interdisciplinary History*, 28, 47–56.

Becker, G. S. (1960): "An economic analysis of fertility," in *Demographic and Economic Change in Developed Countries*, ed. by N. B. of Economic Research, pp. 225–256. Princeton University Press, Princeton.

——— (1965): "A theory of the allocation of time," *Economic Journal*, 75, 493–517.

——— (1988): "Family Economics and Macro Behavior," *American Economic Review*, 78, 1–13.

——— (1991): *A treatise on the family*. Harvard University Press, Harvard.

——— (1992): "Fertility and the economy," *Journal of Population Economics*, 5, 185–201.

Becker, G. S., and H. G. Lewis (1973): "On the Interaction between the Quantity and Quality of Children," *Journal of Political Economy*, 81, S279–S288.

Becker, G. S., and K. M. Murphy (1988): "The family and the state," *Journal of Law and Economics*, 31, 1–18.

Becker, G. S., K. M. Murphy, and R. Tamura (1990): "Human Capital, Fertility, and Economic Growth," *Journal of Political Economy*, 98, S12–S37.

Becker, G. S., and N. Tomes (1976): "Child Endowments and the Quantitiy and Quality of Children," *Journal of Political Economy*, 84, S143–S162.

——— (1979): "An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility," *Journal of Political Economy*, 87, 1153–1189.

Becker, S. O., F. Cinnirella, and L. Wößmann (2009a): "Does Parental Education Affect Fertility? Evidence from Pre-Demographic Transition Prussia," mimeo.

——— (2009b): "The Trade-off between Fertility and Education: evidence from before the Demographic Transition," Stirling Economics Discussion Paper 2009-17.

——— (2011): "The effect of investment in children's education on fertility in 1816 Prussia," *Cliometrica*, pp. 1–16.

Becker, S. O., and L. Wößmann (2009): "Was Weber Wrong? A Human Capital Theory of Protestant Economic History," *Quarterly Journal of Economics*, 124, 531–596.

Belzyt, L. (1998): *Sprachliche Minderheiten im preussischen Staat*. Herder-Institut, Marburg.

Berger, L. M., and J. Waldfogel (2004): "Maternity Leave and the Employment of new mothers in the United States," *Journal of Population Economics*, 17, 331–349.

Berkel, B., and A. Börsch-Supan (2004): "Pension Reform in Germany: The Impact on Retirement Decisions," University of Mannheim Working Paper 62-2004.

Berkel, B., A. Börsch-Supan, A. Ludwig, and J. Winter (2002): "Pension Reform in Germany: The Impact on Retirement Decisions," University of Mannheim Working Paper 25-2002.

Bernays, M. (1916): *Untersuchungen über den Zusammenhang von Frauenfabrikarbeit und Geburtenhäufigkeit in Deutschland*. W. Moeser, Berlin.

Bertrand, M., E. Duflo, and S. Mullainathan (2004): "How Much Should We Trust Differences-in-Differences Estimates?," *Quarterly Journal of Economics*, 119, 249–275.

Beveridge, W. (1942): *Social Insurance and Allied Services*. H.M. Stationery Office, London.

Bhargava, A., L. Franzini, and W. Narendranathan (1982): "Serial Correlation and the Fixed Effects Model," *Review of Economic Studies*, 49, 533–549.

Blau, D., and P. Robins (1989): "Fertility, Employment, and Child-Care Costs," *Demography*, 26, 287–299.

Bleakley, H., and F. Lange (2009): "Chronic Disease Burden and the Interaction of Education, Fertility, and Growth," *Review of Economics and Statistics*, 91, 52–65.

Bloom, D. E., D. Canning, G. Fink, and J. E. Finlay (2009): "Fertility, female labor force participation, and the demographic dividend," *Journal of Economic Growth*, 14, 79–101.

Bodie, Z. (1990): "Pensions as Retirement Income Insurance," *Journal of Economic Literature*, 28, 28–49.

Boentert, A. (2007): *Kinderarbeit im Kaiserreich 1871-1914*. Schöningh, Paderborn.

Boeri, T., A. Börsch-Supan, and G. Tabellini (2002): "Pension Reforms and the Opinions of European Citizens," *American Economic Review*, 92, 396–401.

Bongaarts, J. (1999): "Fertility Decline in the Developed World: Where Will It End?," *American Economic Review*, 89, 256–260.

Bongaarts, J., and G. Feeney (1998): "On the Quantum and Tempo of Fertility," *Population and Development Review*, 24, 271–291.

Borjas, G. J. (1994): "The Economics of Immigration," *Journal of Economic Literature*, 32, 1667–1717.

Boskin, M. J., and M. D. Hurd (1978): "The Effect of Social Security on Early Retirement," *Journal of Public Economics*, 10, 361–377.

Bosse, R., and E. von Woedtke (1891): *Das Reichsgesetz, betreffend die Invaliditäts- und Altersversicherung, vom 22. Juni 1889*. Duncker & Humblot, Leipzig.

Bräuniger, M., C. Koller, M. Langer, W. Pflüger, and J. Quitzau (2009): *Staatsverschuldung*. Berenberg Bank and HWWI, Hamburg.

Brentano, L. (1909): "Die Malthussche Lehre und die Bevölkerungsbewegung der letzten Dezennien," in *Abhandlungen 24 der historischen Klasse der Königlichen Bayerischen Akademie der Wissenschaft*, vol. 3, pp. 926–1002. Verlag der Königlichen Bayerischen Akademie, München.

Brewster, K. L., and R. R. Rindfuss (2000): "Fertility and Women's Employment in Industrialized Nations," *Annual Review of Sociology*, 26, 271–296.

Brown, J. C., and T. W. Guinnane (2002): "Fertility Transition in a Rural, Catholic Population: Bavaria, 1880-1910," *Population Studies*, 56, 35–49.

——— (2003): "Statistical Problems in the Princeton Project on the European Fertility Transition," Center Discussion Paper No. 869.

——— (2007): "Regions and time in the European fertility transition: problems in the Princeton Project's statistical methodology," *Economic History Review*, 60, 574–595.

Browning, M. (1992): "Children and Household Economic Behavior," *Journal of Economic Literature*, 30, 1434–1475.

Börsch-Supan, A. (2001): "Incentive Effects of Social Security under an Uncertain Disability Option," in *Themes in the Economics of Aging*, ed. by D. A. Wise, pp. 281–310. Univ. of Chicago Press, Chicago.

——— (2004): "Faire Abschläge in der gesetzlichen Rentenversicherung," Beitrag für ein Symposium im "Sozialen Fortschritt".

Börsch-Supan, A., L. Essig, and C. Wilke (2005): *Rentenlücken und Lebenserwartung: Wie sich die Deutschen auf den Anstieg vorbereiten*. Deutsches Institut für Altersvorsorge, Köln.

Börsch-Supan, A., and A. Reil-Held (2001): "How Much is Transfer and How Much is Insurance in a Pay-as-you-go System? The German Case," *Scandinavian Journal of Economics*, 103, 505–524.

Börsch-Supan, A., and R. Schnabel (1998): "Social Security and Declining Labor-Force Participation in Germany," *American Economic Review*, 88, 173–178.

Büttner, T., and W. Lutz (1990): "Estimating Fertility Responses to Policy to Policy Measures in the German Democratic Republic," *Population and Development Review*, 16, 539–555.

Burgdörfer, F. (1929): *Der Geburtenrückgang und seine Bekämpfung. Die Lebensfrage des deutschen Volkes*. Richard Schoetz, Berlin.

Burkhauser, R. V., and J. A. Turner (1978): "Estimating Fertility Responses to Policy to Policy Measures in the German Democratic Republic," *Journal of Political Economy*, 86, 701–715.

Cain, M. (1983): "Fertility as an Adjustment to Risk," *Population and Development Review*, 9, 688–702.

Caldwell, J. C. (1980): "Mass Education as a Determinant of the Timing of Fertility Decline," *Population and Development Review*, 6, 225–255.

Cameron, A. C., J. B. Gelbach, , and D. L. Miller (2008): "Bootstrap-based Improvements for Inference with Clustered Errors," *Review of Economics and Statistics*, 90, 414–427.

Cameron, A. C., and D. L. Miller (2008): "Robust Inference with Clustered Data," UC Davis Working Paper no. 10-6.

Carlsson, G. (1966): "The Decline of Fertility: Innovation or Adjustment Process," *Population Studies*, 20, 149–174.

Cigno, A. (1991): *Economics of the Family*. Oxford University Press, Oxford.

—— (1993): "Intergenerational transfers without altruism. Family, market and state," *European Journal of Political Economy*, 9, 505–518.

—— (2006): "A Constitutional Theory of the Family," *Journal of Population Economics*, 19, 259–283.

—— (2008): "Is there a social security tax wedge?," *Labour Economics*, 15, 68–77.

—— (2010): "How to Avoid a Pension Crisis: A Question of Intelligent System Design," *CESifo Economic Studies*, 56, 21–37.

Cigno, A., L. Casolaro, and F. C. Rosati (2003): "The Impact of Social Security on Saving and Fertility in Germany," *FinanzArchiv*, 59, 189–211.

Cigno, A., and J. Ermisch (1989): "A Microeconomic Analysis of the Timing of Births," *European Economic Review*, 33, 737–760.

Cigno, A., and F. C. Rosati (1992): "The effects of financial markets and social security on saving and fertility behaviour in Italy," *Journal of Population Economics*, 5, 319–341.

—— (1996): "Jointly determined saving and fertility behaviour: Theory, and estimates for Germany, Italy, UK and USA," *European Economic Review*, 40, 1561–1589.

Cigno, A., and M. Werding (2007): *Children and Pensions*. MIT Press, Cambridge, Massachusetts.

Cleland, J., and C. Wilson (1987): "Demand Theories of the Fertility Transition: An Iconoclastic View," *Population Studies*, 41, 5–30.

Coale, A., and S. Watkins (1986): *The Decline of Fertility in Europe*. Princeton University Press, Princeton.

Coale, A. J. (1965): "Factors associated with the development of low fertility: a historic summary," in *World Population Conference*, ed. by U. Nations, pp. 205–209. United Nations, New York.

——— (1969): "The decline of fertility in Europe from the French Revolution to World War II," in *Fertility and family planning: A world view*, ed. by S. Behrman, L. C. Jr., and R. Freedman, pp. 3–24. University of Michigan Press, Ann Arbor.

Coale, A. J., and J. Trussell (1974): "Variations in Model Fertility Schedules: The Age Structure of Childbearing in Human Populations," *Population Index*, 40, 185–258.

Conrad, C., M. Lechner, and W. Werner (1996): "East German Fertility After Unification: Crisis or Adaptation?," *Population and Development Review*, 22, 331–358.

Crafts, N. F. R. (1989): "Duration of Marriage, Fertility and Women's Employment Opportunities in England and Wales in 1911," *Population Studies*, 43, 325–335.

Crawford, V. P., and D. M. Lilien (1981): "Social Security and the Retirement Decision," *Quarterly Journal of Economics*, 96, 505–529.

David, P. A., and W. C. Sanderson (1986): "Rudimentary Contraceptive Methods and the American Transition to Marital Fertility Control," in *Long-Term Factors in American Economic Growth*, ed. by S. L. Engerman, and R. E. Gallman, pp. 307–390. University of Chicago Press, Chicago.

Davis, K. (1945): "The world demographic transition," *Annals of the American Academy of Political and Social Science*, 273, 1–11.

Der Spiegel (1986): "Richtig lächerlich," *Der Spiegel*, 1986, 31–32.

Deutsche Rentenversicherung (2011): "Renten nach SGB VI insgesamt 2010," www.deutsche-rentenversicherung.de/forschungsdatenzentrum, accessed 23 June 2011.

Diamond, P. A. (1977): "A framework for social security analysis," *Journal of Public Economics*, 8, 275–298.

Disney, R. (2000): "Declining public pensions in an era of demographic ageing: Will private provision fill the gap?," *European Economic Review*, 44, 957–973.

——— (2004): "Are contributions to public pension programmes a tax on employment?," *Economic Policy*, 19, 267–311.

Donald, S. G., and K. Lang (2007): "Inference with Difference-in-Differences and Other Panel Data," *Review of Economics and Statistics*, 89, 221–233.

Dribe, M., and F. Scalone (2009): "Detecting Deliberate Fertility Control during the Pre-Transitional Period in a Sample of German Villages," Paper for session 120 'Historical Demography' at the annual meeting of the Population Association of America.

Easterlin, R. A. (1975): "An Economic Framework for Fertility Analysis," *Studies in Family Planning*, 6, 54–63.

Easterlin, R. A. (1978): "The economics and sociology of fertility: A synthesis," in *Historical Studies of Changing Fertility*, ed. by C. Tilly, pp. 57–133. Princeton University Press, Princeton.

Egger, P., and D. M. Radulescu (2010): "Family Income Splitting and the Number of Children: Evidence from a Natural Experiment," mimeo.

Ellerkamp, M. (2000): "Die Frage der Witwen und Waisen, Vorläufiger Ausschluß aus dem Rentensystem und graduelle Inklusion (1889-1911)," in *Geschichte und Gegenwart der*

Rentenversicherung in Deutschland. Beiträge zur Entstehung, Entwicklung und vergleichenden Einordnung der Alterssicherung im Sozialstaat, ed. by S. F. und Ulrike Haerendel, pp. 189–208. Duncker & Humblot, Berlin.

Engstler, H., and S. Menning (2003): *Die Familie im Spiegel der amtlichen Statistik*. Statistisches Bundesamt, Bonn.

Eurostat (2011a): "Crude rate of population change, country profiles," http://epp.eurostat.ec.europa.eu, accessed 23 June 2011.

——— (2011b): "Old age dependency ratio," http://epp.eurostat.ec.europa.eu, accessed 23 June 2011.

——— (2011c): "Pension expenditures as percentage of GDP," http://epp.eurostat.ec.europa.eu, accessed 23 June 2011.

——— (2011d): "Population projections," http://epp.eurostat.ec.europa.eu, accessed 28 June 2011.

——— (2011e): "Total fertility rate," http://epp.eurostat.ec.europa.eu, accessed 23 June 2011.

Euwals, R. (2000): "Do Mandatory Pensions decrease Household Savings? Evidence for the Netherlands," *De Economist*, 148, 643–670.

Fait, B. (1997): "Arbeiterfrauen und -familien im System sozialer Sicherheit. Zur geschlechterpolitischen Dimension der 'Bismarck'schen Arbeiterversicherung'," *Jahrbuch für Wirtschaftsgeschichte*, 1997/1, 171–205.

Fehr, H., M. Kallweit, and F. Kindermann (2009): "Marital Risk, Family Insurance, and Public Policy," University of Würzburg Working Paper.

Feldstein, M. (1974): "Social Security, Induced Retirement, and Aggregate Capital Accumulation," *Journal of Political Economy*, 82, 905–926.

——— (1976): "Social Security and Saving: The Extended Life Cycle Theory," *American Economic Review*, 66, 77–85.

——— (1980): "International differences in social security and saving," *Journal of Public Economics*, 14, 225–244.

Feldstein, M., and J. B. Liebman (2002): "Social Security," in *Handbook of Public Economics, Vol. 4*, ed. by A. J. Auerbach, and M. Feldstein, pp. 2245–2324. Elsevier, New York.

Feldstein, M., and A. J. Pellechio (1979): "Social Security and Household Wealth Accumulation: New Microeconomic Evidence," *Review of Economics and Statistics*, 61, 361–368.

Fenge, R. (1997): "Effizienz der Alterssicherung," in *Wirtschaftswissenschaftliche Beiträge, Bd. 149*, ed. by A. Müller. Physica Verlag, Heidelberg.

Fenge, R., and V. Meier (2005): "Pensions and fertility incentives," *Canadian Journal of Economics*, 38, 28–48.

——— (2009): "Are family allowances and fertility-related pensions perfect substitutes?," *International Tax and Public Finance*, 16, 137–163.

Fenge, R., and B. Scheubel (2010): "Pensions and Fertility – Back to the Roots," mimeo.

Fenge, R., and J. von Weizsäcker (2009): "Mixing Bismarck and Child Pension Systems: An Optimum Taxation Approach," *Journal of Population Economics*, In Press, Corrected Proof, 805–823.

Festy, P. (1979): *La fécondité des pays occidentaux de 1870 a 1970*. Presses Universitaires de France, Paris.

Folbre, N. (1994): "Children as Public Goods," *American Economic Review*, 84, 86–90.

Foreman-Peck, J. (2011): "The Western European marriage pattern and economic development," *Explorations in Economic History*, 48, 292–309.

Fraser, C. D. (2001): "Income Risk, the Tax-Benefit System and the Demand for Children," *Economica*, 68, 105–125.

Frerich, J., and M. Frey (1996): *Handbuch der Geschichte der Sozialpolitik in Deutschland*. R. Oldenbourg Verlag, München, Wien.

Galloway, P. R. (2009): "Fertility Decline and Social Democracy in Prussia 1875 to 1910," mimeo.

Galloway, P. R., R. D. Lee, and E. A. Hammel (1994a): "Fertility Decline in Prussia, 1875-1910: A Pooled Cross-Section Time Series Analysis," *Population Studies*, 48, 135–158.

—— (1994b): "Fertility Decline in Prussia: Estimating Influences on Supply, Demand, and Degree of Control," *Demography*, 31, 347–373.

—— (1997): "Urban versus Rural: Fertility Decline in the Cities and Rural Districts of Prussia, 1875 to 1910," *European Journal of Population*, 31, 209–264.

—— (1998): "Infant Mortality and the Fertility Transition: Macro Evidence from Europe and New Findings from Prussia," in *From Death to Birth. Mortality Decline and Reproductive Change*, ed. by N. R. Council, pp. 182–226. National Academy Press, Washington.

Gestrich, A. (1999): "Die Geschichte der Familie im 19. und 20. Jahrhundert," in *Enzyklopädie Deutscher Geschichte*, ed. by L. Gall, and P. Blickle, vol. 50. Oldenbourg, München.

Geyer, A. (1924): *Die Frauenerwerbsarbeit in Deutschland*. Thüringer Verlagsanstalt und Druckerei, Jena.

Gladen, A. (1974): "Geschichte der Sozialpolitik in Deutschland. Eine Analyse ihrer Bedingungen, Formen, Zielsetzungen und Auswirkungen," in *Wissenschaftliche Paperbacks. Sozial- und Wirtschaftsgeschichte 5*, ed. by H. Pohl. Franz Steiner Verlag, Wiesbaden.

Goldin, C., and L. F. Katz (2002): "The Power of the Pill: Contraceptives and Women's Career and Marriage Decisions," *Journal of Political Economy*, 110, 730–770.

Goldstein, J. R., and S. Klüsener (2010): "Culture Resurfaces – A Geographic Analysis of Fertility Decline in Prussia," MPIDR working paper 2010-012.

Gottschall, K., and K. Bird (2003): "Family Leave Policies and Labor Market Segregation in Germany: Reinvention or Reform of the Male Breadwinner Model?," *Review of Policy Research*, 20, 115–134.

Gruber, J. (2000): "Disability Insurance Benefits And Labor Supply," *Journal of Political Economy*, 108, 1162–1183.

Grumbach, F., and H. König (1957): "Beschäftigung und Löhne der deutschen Industriewirtschaft 1888-1954," *Weltwirtschaftliches Archiv*, 79, 125–155.

Guildea, Z. E. S., D. L. Fone, F. D. Dunstan, J. R. Sibert, and P. H. T. Cartlidge (2001): "Social deprivation and the causes of stillbirth and infant mortality," *Archives of Disease in Childhood*, 84, 307–310.

Guinnane, T. (2011): "The Historical Fertility Transition: A Guide for Economists," *Journal of Economic Literature*, 49, 589–614.

Guinnane, T., and S. Ogilvie (2008): "Institutions and Demographic Responses to Shocks: Württemberg, 1634-1870," University of Yale Economics Department Working Paper No. 44.

Guinnane, T., B. S. Okun, and J. Trussell (1994): "What Do We Know About the Timing of Fertility Transitions in Europe?," *Demography*, pp. 1–20.

Gustman, A. L., O. S. Mitchell, and T. Steinmeier (1993): "The role of pensions in the labor market: a survey of the literature," *Industrial and Labour Relations Review*, 417, 417–438.

Haerendel, U. (2000): "Regierungen, Reichstag und Rentenversicherung. Der Gesetzgebungsprozeß zwischen 1887 und 1889," in *Geschichte und Gegenwart der Rentenversicherung in Deutschland. Beiträge zur Entstehung, Entwicklung und vergleichenden Einordnung der Alterssicherung im Sozialstaat*, ed. by S. F. und Ulrike Haerendel, pp. 189–168. Duncker & Humblot, Berlin.

—— (2001): *Die Anfänge der gesetzlichen Rentenversicherung in Deutschland. Die Invaliditäts-und Altersversicherung von 1889 im Spannungsfeld von Reichsverwaltung, Bundesrat und Parlament*. Forschungsinstitut für öffentliche Verwaltung Speyer, Speyer.

Hajnal, J. (1953): "The Marriage Boom," *Population Index*, 19, 80–101.

—— (1965): "European Marriage Patterns in Perspective," in *Population in History*, ed. by D. V. Glass, and D. E. C. Eversley, pp. ——-. Arnold, London.

Hakim, C. (2003): "A New Approach to Explaining Fertility Patterns: Preference Theory," *Population and Development Review*, 29, 349–374.

Hamermesh, D. S. (1996): *Labor demand*. Princeton University Press, Princeton.

Hank, K., and M. Kreyenfeld (2003): "A Multilevel Analysis of Child Care and Women's Fertility Decisions in Western Germany," *Journal of Marriage and Family*, 65, 584–596.

Hansen, C. B. (2007): "Generalized least squares inference in panel and multilevel models with serial correlation and fixed effects," *Journal of Econometrics*, 140, 670–694.

Hanushek, E. A. (1992): "The Trade-off between Child Quantitiy and Quality," *Journal of Political Economy*, 100, 84–117.

Hayashi, F. (1982): "The Permanent Income Hypothesis: Estimation and Testing by Instrumental Variables," *Journal of Political Economy*, 90, 895–916.

Henman, B., and M. Voigtländer (2003): "Unzureichende Berücksichtigung der Kindererziehung als Ursache der Rentenkrise," Otto-Wolff-Institut Discussion Paper 4.

Henry, L. (1961): "Some data on natural fertility," *Eugenics Quarterly*, 8, 81–91.

Hernæs, E., M. Sollie, and S. Strom (2002): "Early Retirement and Economic Incentives," *Scandinavian Journal of Economics*, 102, 481–502.

Hessisches Statistisches Landesamt (2011): "Lebend Geborene und Gestorbene in Hessen 1950 bis 2009," www.statisik-hessen.de, accessed 15 May 2011.

Hirschman, C. (2001): "Globalization and Theories of Fertility Decline," *Population and Development Review*, 27, 116–125.

Hänlein, A. (1989): "Einführung in die Entwicklung des Rentenrechts von 1972 bis 1986," *Neue Zeitschrift für Arbeits- und Sozialrecht*, 6, 28–39.

Hoffmann, W. G., F. Grumbach, and H. Hesse (1965): *Das Wachstum der deutschen Wirtschaft seit der Mitte des 19 Jahrhunderts*, Enzyklopädie der Rechts- und Staatswissenschaft. Springer-Verlag, Berlin.

Hohm, C. (1975): "Social security and fertility: An international perspective," *Demography*, 12, 629–644.

Homburg, S. (2000): "Compulsory savings in the welfare state," *Journal of Public Economics*, 77, 233–239.

Hradil, S. (2006): *Die Sozialstruktur Deutschlands im internationalen Vergleich*. Vs Verlag, Wiesbaden.

Hubbard, R. G., and K. L. Judd (1987): "Social Security and Individual Welfare: precautionary Saving, Borrowing Constraints, and the Payroll Tax," *American Economic Review*, 77, 630–646.

Kaiserliches Statistisches Amt (1880–1914): "Band 1880 – Band 1914," in *Statistisches Jahrbuch für das Deutsche Reich*. Verlag von Puttkammer & Mühlrecht, Berlin.

——— (1884): *Statistik des Deutschen Reiches. Neue Folge. Band 2. 1, Berufsstatistik des Reichs ein der kleineren Verwaltungsbezirke*. Verlag von Puttkammer & Mühlrecht, Berlin.

Kalwij, A. S. (2000): "The effects of female employment status on the presence and number of children," *Journal of Population Economics*, 13, 221–239.

Kaschke, L., and M. Sniegs (2001): *Kommentierte Statistiken zur Sozialversicherung in Deutschland von ihren Anfängen bis in die Gegenwart. Band 1: Die Invaliditäts- und Alterssicherung im Kaiserreich (1891 - 1913)*. Scripta Mercature Verlag, St. Katharinen.

Khoudor-Castéras, D. (2008): "Welfare State and Labor Mobility: The Impact of Bismarck's Social Legislation on German Emigration before World War I," *Journal of Economic History*, 68, 211–243.

Kifmann, M., and D. Schindler (2001): "Smoothing the Implicit Tax Rate in a Pay-as-you-go Pension System," *FinanzArchiv*, 57, 261–283.

Köllmann, W. (1964): *Quellen zur Bevölkerungs-, Sozial- und Wirtschaftsstatistik Deutschlands 1815–1875*. Harald Boldt Verlag, Boppard am Rhein.

Knodel, J. (1967): "Law, Marriage and Illegitimacy in Nineteenth-Century Germany," *Population Studies*, 20, 279–294.

——— (1977): "Town and Country in Nineteenth-Century Germany: A Review of Urban-Rural Differentials in Demographic Behavior," *Social Science History*, 1, 356–382.

Knodel, J., and M. J. Maynes (1976): "Urban and Rural Marriage Patterns in Imperial Germany," *Journal of Family History*, 1, 129–168.

Knodel, J., and E. van de Walle (1986): "Lessons from the Past: Policy Implications of Historical Fertility Studies," in *The Decline of Fertility in Europe*, ed. by A. Coale, S. Watkins, and H. Page, pp. 390–419. Princeton University Press, Princeton.

Knodel, J. E. (1974): *The Decline of Fertility in Germany, 1871-1939*. Princeton University Press, Princeton, New Jersey.

Kohler, H.-P., F. C. Billari, and J. A. Ortega (2002): "The Emergence of Lowest-Low Fertility in Europe During the 1990s," *Population and Development Review*, 28, 641–680.

Kolmar, M. (1997): "Intergenerational redistribution in a small open economy with endogenous fertility," *Journal of Population Economics*, 10, 335–356.

Kresse, O. (1912): *Der Geburtenrückgang in Deutschland. Seine Ursachen und die Mittel zu seiner Beseitung*. John Schwerins Verlag K.-G., Berlin.

Kreyenfeld, M. (2003): "Crisis or Adaptation Reconsidered: A Comparison of East and West German Fertility Patterns in the First Six Years after the 'Wende'," *European Journal of Population*, 19, 303–329.

——— (2004): "Fertility Decisions in the FRG and GDR: An Analysis with Data from the German Fertility and Family Survey," *Demographic Research*, Special Collection 3, 276–318.

Krueger, A. B., and B. D. Meyer (2002): "Labor Supply Effects of Social Insurance," in *Handbook of Public Economics, Vol. 4*, ed. by A. Auerbach, and M. Feldstein, pp. 2327–2392. Elsevier, New York.

Kuhn, B. (2000): *Familienstand: Ledig. Ehelose Frauen und Männer im Bürgertum (1850 – 1914)*. Böhlau Verlag, Köln.

Landesamt für Statistik Thüringen (2011): "Geborene und Gestorbene 1955, 1960 und ab 1965 in Thüringen," www.tls.thuerigen.de, accessed 15 May 2011.

Landesbetrieb für Statistik und Kommunikationstechnologie Niedersachsen (2011): "LSKN-Online: Tabelle Z1001696: Fläche, Bevölkerung und Bevölkerungsbewegung in Niedersachsen," www1.nls-niedersachsen.de/statistik, accessed 15 May 2011.

Landesbetrieb Information und Technik Nordrhein-Westfalen (2011): "Bevölkerungsstand und -bewegung nach Geschlecht (ab 1977)," www.it.nrw.de, accessed 15 May 2011.

Langewiesche, D. (1979): "Mobilität in deutschen Mittel- und Großstädten. Aspekte der Binnenwanderung im 19. und 20. Jahrhundert," in *Arbeiter im Industrialisierungsprozeß*, ed. by W. Conze, and U. Engelhardt, pp. 70–93. Klett-Cotta, Stuttgart.

Lüdecke, R. (1988): "Staatsverschuldung, intergenerative Redistribution und umlagefinanzierte Rentenversicherung," in *Wirtschaftliche Strukturprobleme und soziale Fragen*, ed. by J. Klaus, and P. Klemmer, pp. 167–81. Duncker and Humblot, Berlin.

Lees, A. (2002): *Cities, Sin, and Social Reform in Imperial Germany*. University of Michigan Press, Ann Arbor.

Leibenstein, H. M. (1957): *Economic Backwardness and Economic Growth*. Wiley, New York.

Leimer, D. R., and S. D. Lesnoy (1982): "Social Security and Private Saving: New Time-Series Evidence," *Journal of Political Economy*, 90, 606–629.

Leimer, D. R., and D. H. Richardson (1992): "Social Security, Uncertainty Adjustments and the Consumption Decision," *Economica*, 59, 311–335.

Lesthaeghe, R. (1977): *The decline of Belgian fertility, 1800-1970*. Princeton University Press, Princeton.

—— (2010): "The Unfolding Story of the Second Demographic Transition," *Population and Development Review*, 36, 211–251.

Lesthaeghe, R., and K. Neels (2002): "From the First to the Second Demographic Transition: An Interpretation of the Spatial Continuity of Demographic Innovation in France, Belgium and Switzerland," *European Journal of Population*, 18, 325–360.

Lesthaeghe, R., and P. Willems (1999): "Is Low Fertility a Temporary Phenomenon in the European Union?," *Population and Development Review*, 25, 211–228.

Liang, K.-L., and S. L. Zeger (1986): "Longitudinal data analysis using generalized linear models," *Biometrika*, 73, 13–22.

Lindsay, S. M. (1892): "Social Work at the Krupp Foundries, Essen, A.R., Germany," *Annals of the American Academy of Political and Social Sciences*, 3, 74–106.

Lotz, W. (1905): "Der Fiskus als Arbeitgeber im deutschen Staatsbahnwesen," *Archiv für Sozialwissenschaft und Sozialpolitik*, 21, 612–658.

Machtan, L. (1985): "Risikoversicherung statt Gesundheitsschutz für Arbeiter. Zur Entstehung der Unfallversicherung im Bismarck-Reich," *Leviathan*, 13, 420–441.

MacMinn, R., P. Brockett, and D. Blake (2006): "Longevity Risk and Capital Markets," *Journal of Risk and Insurance*, 73, 551–557.

Malthus, T. R. (1807): *An essay on the principle of population: or, A view of its past and present effects on human happiness*. For J. Johnson, by T. Bensley, London.

Manow, P. (2000): “Kapitaldeckung oder Umlage: Zur Geschichte einer anhaltenden Debatte,” in *Geschichte und Gegenwart der Rentenversicherung in Deutschland. Beiträe zur Entstehung, Entwicklung und vergleichenden Einordnung der Alterssicherung im Sozialstaat*, ed. by S. F. und Ulrike Haerendel, pp. 189–168. Duncker & Humblot, Berlin.

Marcuse, J. (1913): *Die Beschränkung der Geburtenzahl*. Reinhardt, München.

Marcuse, M. (1918): “Wandlungen des Fortpflanzungsgedankens und -willens,” *Abhandlungen aus dem Gebiete der Sexualforschung*, 1, 1–73.

Marschalck, P. (????): in *Population Change and Social Planning*, ed. by D. Eversley, and W. Köllmann, London.

——— (1984): *Bevölkerungsgeschichte Deutschlands im 19. und 20. Jahrhundert*. Suhrkamp, Frankfurt a.M.

Matz, B. (2002): “Die Bewertung des Geburtenrückgangs zur Zeit der Weimarer Republik,” in *Bevölkerungslehre und Bevölkerungspolitik vor 1933*, ed. by R. Mackensen, pp. 61–75. Leske + Budrich, Opladen.

May, R. (1916): “Zur Frage des Geburtenrückganges,” *Schmollers Jahrbuch*, 40, 1645–1684.

McNicoll, G. (1980): “Institutional Determinants of Fertility Change,” *Population and Development Review*, 6, 441–462.

Meier, V., and M. Wrede (2008): “Reducing the Excess Burden of Subsidizing the Stork: Joint Taxation, Individual Taxation, and Family Tax Splitting,” CESifo Working Paper No. 2470.

——— (2010): “Pensions, fertility, and education,” *Journal of Pension Economics and Finance*, 9, 75–92.

Michaud, P.-C., and K. Tatsiramos (2011): “Fertility and Female Employment Dynamics in Europe: The Effect of Using Alternative Econometric Modelling Assumptions,” *Journal of Applied Econometrics*, 26, 175–208.

Mincer, J. (1962): “Labor Force Participation of Married Women: A Study of Labor Supply,” in *Aspects of labor economics*, ed. by H. G. Lewis, pp. 63–106. Princeton University Press, Princeton.

Mirrlees, J. A. (1971): “An Exploration in the Theory of Optimum Income Taxation,” *Review of Economic Studies*, 38, 175–208.

Mitchell, B. R. (1980): *European Historical Statistics 1750-1975*. Macmillan, London.

Müller, J. (1922): “Der Streit um die Ursache des Geburtenrückganges,” *Jahrbücher für Nationalökonomie und Statistik*, 119, 396–424.

——— (1924): *Der Geburtenrückgang*. Fischer, Jena.

Mombert, P. (1907): *Studien zur Bevölkerungsbewegung in Deutschland in den letzten Jahrzehnten mit besonderer Berücksichtigung der ehelichen Fruchtbarkeit*. G. Braunsche Hofdruckerei und Verlag, Karlsruhe.

Morgan, S. P. (2003): “Is low fertility a twenty-first-century demographic crisis?,” *Demography*, 40, 589–603.

Moszeik, C. (1909): *Aus der Gedankenwelt einer Arbeiterfrau. Von ihr selbst erzählt*. E. Runge, Berlin.

Moulton, B. R. (1990): “An Illustration of a Pitfall in Estimating the Effects of Aggregate Variables on Micro Units,” *Review of Economics and Statistics*, 72, 334–338.

Neher, P. A. (1971): “Peasants, Procreation, and Pensions,” *American Economic Review*, 61, 380–389.

Neuman, R. P. (1978): "Working Class Birth Control in Wilhelmine Germany," *Comparative Studies in Society and History*, 20, 408–428.

Nipperdey, T. (1993): *Deutsche Geschichte 1866-1918: Machtstaat vor der Demokratie*. C.H. Beck, München.

Notestein, F. W. (1945): "Population: the long view," in *Food for the World*, ed. by T. Schultz, pp. 3–24. Chicago University Press, Chicago.

Nugent, J. B. (1985): "The Old-Age Security Motive for Fertility," *Population and Development Review*, 11, 75–97.

OECD (2011): *Pensions at a Glance 2011: Retirement-income Systems in OECD and G20 Countries*. OECD, Paris.

OECD Working Party on Private Pensions (2005): *Provate Pensions: OECD Classification and Glossary*. OECD, Paris.

Oldenberg, K. (1911): "Über den Rückgang der Geburten- und Sterbeziffer," *Archiv für Sozialwissenschaft und Sozialpolitik*, 32, 319–377 and 401–499.

Ondrich, J., C. K. Spiess, and Q. Yang (2002): "The Effect of Maternity Leave on Women's Pay in Germany 1984-1994," DIW Discussion Paper 289.

Parker, J. A. (1999): "The Reaction of Household Consumption to Predictable Changes in Social Security Taxes," *American Economic Review*, 89, 259–973.

Pennacchi, G. G. (1999): "The Value of Guarantees on Pension Fund Returns," *Journal of Risk and Insurance*, 66, 219–237.

Peters, W. (1995): "Public pensions, family allowances and endogenous demographic change," *Journal of Population Economics*, 8, 161–183.

Polano, O. (1916): "Beitrag zur Frage der Geburtenbeschränkung," *Zeitschrift für Geburtshilfe und Gynäkologie*, 79, 567–578.

Prinz, A. (1990): "Endogenous fertility, altruistic behavior across generations, and social security systems," *Journal of Population Economics*, 3, 179–192.

Projekt Deutsches Kaiserreich (2011): "Sprachliche Minderheiten," www.deutsche-kaiserreich.de, accessed on 27 June 2011.

Rademacher, M. (2011): "Deutsche Verwaltungsgeschichte von der Reichseinigung 1871 bis zur Wiedervereinigung 1990," www.verwaltungsgeschichte.de.

Reichsversicherungsamt (1910): *Das Reichsversicherungsamt und die Deutsche Arbeiterversicherung*. Verlag von Behrend & Co., Berlin.

Reidegeld, E. (2006): *Staatliche Sozialpolitik in Deutschland. Historische Entwicklung und theoretische Analyse von den Ursprüngen bis 1918*. VS Verlag, Wiesbaden.

Ricardo, D. (1817): *On the Principles of Political Economy and Taxation*. John Murray, London.

Richards, T. (1977): "Fertility Decline in Germany: An Econometric Appraisal," *Population Studies*, 31, 537–553.

Ritter, G. A. (1998a): *Bismarck und die Entstehung der deutschen Sozialversicherung*. Kulturamt, Pforzheim.

——— (1998b): "Bismarck und die Grundlegung des deutschen Sozialstaates," in *Verfassung, Theorie und Praxis des Sozialstaats. Festschrift für Hans F. Zacher zum 70. Geburtstag*, ed. by F. Ruland, B. B. von Maydell, and H.-J. Papier, pp. 798–820. Müller, Heidelberg.

Ritter, G. A., and K. Tenfelde (1992): *Arbeiter im Deutschen Kaiserreich 1871-1914*. J.H.W. Dietz, Bonn.

Roesle, E. E. (1914): *Der Geburtenrückgang. Seine Literatur und die Methodik seiner Ausmaßbestimmung*. Verlag von F.C.W. Vogel, Leipzig.

Rosenstock, G. (1934): *Versicherungstechnische Probleme in der Geschichte der Bismarck'schen Sozialgesetzgebung*. C. G. Hendess g.m.b.h., Königsberg.

Rosin, H. (1914): "Prämiendurchschnittsverfahren und Anwartschaftsdeckung," in *Monatsschrift für Arbeiter- und Angestelltenversicherung 2*, ed. by . Kaskel, . Lehmann, and . Rabeling, pp. 95–106. Julius Springer, Berlin.

Sachverständigenrat zur Begutachtung der wirtschaftlichen Lage (2011): *Herausforderungen des demografischen Wandels*. Statistisches Bundesamt, Wiesbaden.

Scheubel, B. (2009): "Cluster-robust inference with difference-in-differences: an application of estimators to GSOEP panel data," mimeo.

Scheubel, B., D. Schunk, and J. Winter (2013): "Strategic Responses: A Survey Experiment on Opposition to Pension Reforms," *Scandinavian Journal of Economics*, 115, 549–574.

Schultz, T. (1969): "An economic model of family planning and fertility," *Journal of Political Economy*, 77, 153–180.

Schwarz, K. (1991): "Kinderzahl der Geburtsjahrgänge 1865–1955," *Zeitschrift für Bevölkerungswissenschaft*, 2/1991, 154.

——— (1997): "100 Jahre Geburtenentwicklung," *ZfB*, 4/1997, 482.

Seeberg, R. (1913): *Der Geburtenrückgang in Deutschland*. A. Deichert'sche Verlagsbuchhandlung, Leipzig.

Simplicissimus (1912): "Der Geburtenrückgang in Deutschland," *Simplicissimus*, 17, 277–292.

Sinn, H.-W. (1990): "Koreferat zum Referat von K. Jaeger," in *Theorie und Politik der Sozialversicherung*, ed. by B. Gahlen, H. Hesse, and H. J. Ramser, pp. 99–101. Mohr-Siebeck, Tübingen.

——— (1996): "Social Insurance, Incentives and Risk Taking," *International Tax and Public Finance*, 3, 259–280.

——— (1997): "A Theory of the Welfare State," *Scandinavian Journal of Economics*, 97, 495–526.

——— (2000): "Why a funded pension system is useful and why it is not useful," *International Tax and Public Finance*, 7, 389–410.

——— (2001): "The value of children and immigrants in a pay as you go pension system: A proposal for a transition to a funded system," *CESifo Economic Studies*, 47, 77–94.

——— (2004a): "Das demographische Defizit," in *Auswirkungen der demographischen Alterung und der Bevölkerungsschrumpfung auf Wirtschaft, Staat und Gesellschaft*, ed. by H. Birg, pp. 53–90. Deutsche Gesellschaft für Demographie, Bielefeld.

——— (2004b): "The pay-as-you-go system as a fertility insurance and enforcement device," *Journal of Public Economics*, 88, 1335–1357.

——— (2005): "Europe's Demographic Deficit. A Plea for a Child Pension System," *De Economist*, 153, 1–45.

Smart, M. (1998): "Taxation and deadweight loss in a system of intergovernmental transfers," *Canadian Journal of Economics*, 31, 189–206.

Smith, H. L. (1989): "Integrating Theory and Research on the Institutional Determinants of Fertility," *Demography*, 26, 171–184.

Sniegs, M. (1998): *Statistik als Steuerungsinstrument in der historischen Entwicklung der Invaliditäts- und Altersversicherung 1891-1911*. mimeo, Bremen.

Statistik Berlin Brandenburg (2011): "Natürliche Bevölkerungsbewegung, Zeitreihen," www.statisik-berlin-brandenburg.de, accessed 15 May 2011.

Statistisches Amt für Hamburg und Schleswig-Holstein (2011a): "Geburten in Hamburg," www.statisik-nord.de, accessed 15 May 2011.

——— (2011b): "Geburten in Schleswig-Holstein 1970–2004," www.statisik-nord.de, accessed 15 May 2011.

Statistisches Bundesamt (2005): *Armut und Lebensbedingungen. Ergebnisse aus LEBEN IN EUROPA für Deutschland 2005*. Statistisches Bundesamt, Wiesbaden.

——— (2009): *Bevölkerung Deutschlands bis 2060. 12. koordinierte Bevölkerungsvorausberechnung*. Statistisches Bundesamt, Wiesbaden.

——— (2011a): "Bevölkerung nach dem Gebietsstand," www.destatis.de, accessed 30 May 2011.

——— (2011b): "Gemeinschaftsstatistik über Einkommen und Lebensbedingungen (EU-SILC)," www.destatis.de, accessed 22 June 2011.

——— (2011c): "Heiratsziffer lediger Männer und Frauen in Deutschland* nach dem Alter, 1910/11, 1950, 1980 und 2008," www.destatis.de, accessed 05 May 2011.

——— (2011d): "Lebendgeborene: Bundesländer, Jahre," www.destatis.de, accessed 2 June 2011.

——— (2011e): "Statistik der Bevölkerung – Geburten, Tabelle: Durchschnittliches Alter der Mutter bei der Geburt ihrer lebendgeborenen Kinder in Deutschland," www.destatis.de, accessed 30 May 2011.

——— (2011f): "StBa-Tabelle Zusammengefasste Geburtenziffer," electronic tables received from the National Statistical Office.

——— (2011g): "StBa-Tabellen über endgültige Kinderzahlen (Altersspezifische Geburtenziffern)," electronic tables received from the National Statistical Office.

Statistisches Jahrbuch für Preußen (1913): *Band 11*. Königreich Preußen, Berlin.

Statistisches Landesamt Baden-Württemberg (2011): "Eheschließungen, Lebendgeborene und Gestorbene in Baden-Württemberg," www.statisik-bw.de, accessed 15 May 2011.

Statistisches Landesamt Bayern (2010): "Invalidenhäuser der Deutschen Versicherungsanstalten 1912," accessed in Munich.

——— (2011): "Eheschließungen, Lebendgeborene und Gestorbene in Baden-Württemberg," www.statisik.bayern.de, accessed 15 May 2011.

Statistisches Landesamt Rheinland-Pfalz (2011): "Natürliche Bevölkerungsbewegung. Eheschließungen, Geborene und Gestorbene 1950-2009," www.statistik.rlp.de, accessed 15 May 2011.

Statistisches Landesamt Sachsen (2011): "Geborene und Gestorbene im Freistaat Sachsen von 1990 bis 2009," www.statistik.sachsen.de, accessed 15 May 2011.

Statistisches Landesamt Sachsen-Anhalt (2011): "Geborene in Sachsen-Anhalt seit 1966," www.statistik.sachsen-anhalt.de, accessed 15 May 2011.

Stier, H.-E., E. Kirsten, H. Quirin, W. Trillmich, and G. Cybulka (1968): *Westermanns großer Atlas zur Weltgeschichte*. Georg Westermann Verlag, Braunschweig.

Stiglitz, J. E., and P. Dasgupta (1971): "Differential Taxation, Public Goods, and Economic Efficiency," *Review of Economic Studies*, 38, 151–174.

Stock, J. H., and D. A. Wise (1990): "Pensions, The Option Value of Work, and Retirement," *Econometrica*, 58, 1151–1180.

Stolleis, M. (1979): "Die Sozialversicherung Bismarcks. Politisch-institutionelle Bedingungen ihrer Entstehung," in *Bedingungen für die Entstehung und Entwicklung von Sozialversicherung*, ed. by H. F. Zacher, pp. 387–411. Duncker & Humblot, Berlin.

Sundström, M., and F. P. Stafford (1992): "Female labour force participation, fertility and public policy in Sweden," *European Journal of Population*, 8, 199–215.

Tennstedt, F. (1981): *Sozialgeschichte der Sozialpolitik in Deutschland: vom 18. Jahrhundert bis zum Ersten Weltkrieg*, Kleine Vandenhoeck-Reihe. Vandenhoeck & Ruprecht, Göttingen.

——— (1995): "Napoleon III. oder Zitelmann & Co., Frankreich oder Braunschweig? Anmerkungen zu möglichen Vorbildern der Alterssicherungspolitik Bismarcks," *Zeitschrift für Sozialreform*, 41, 543–551.

——— (1997): "Der deutsche Weg zum Wohlfahrtsstaat 1871-1881. Anmerkungen zu einem alten Thema aufgrund neu erschlossener Quellen," in *Wohlfahrtspflege in der Region. Westfalen-Lippe während des 19. und 20. Jahrhunderts im historischen Vergleich*, ed. by A. Wollasch, pp. 255–267. Schöningh, Paderborn.

Tennstedt, F., and H. Winter (1993): ""Der Staat hat wenig Liebe - activ wie passiv". Die Anfänge des Sozialstaats im Deutschen Reich von 1871," *Zeitschrift für Sozialreform*, 39, 362–392.

——— (1994): *Grundfragen staatlicher Sozialpolitik. Quellensammlung zur Geschichte der deutschen Sozialpolitik 1867-1914, I. Abt.: Von der Reichsgründungszeit bis zur Kaiserlichen Sozialbotschaft (1867-1881), Bd. 1*. Gustav Fischer, Stuttgart.

Thomson, W. S. (1929): "Population," *American Journal of Sociology*, 34, 959–975.

Tuomi, K., P. Huuhtanen, E. Nykyri, and J. Ilmarinen (2001): "Promotion of work ability, the quality of work and retirement," *Occupational Medicine*, 51, 318–324.

van Groezen, B., T. Leers, and L. Meijdam (2003): "Social security and endogenous fertility: pensions and child allowances as siamese twins," *Journal of Public Economics*, 87, 233 – 251.

Verhandlungen des Reichstages (1888/89): *Stenographische Berichte über die Verhandlungen des Reichstages, 7. Legislaturperiode - IV. Session 1888/89, vierter Band, erster Anlageband*. Julius Sittenfeld, Berlin.

Vögele, J. P. (1994): "Urban Infant Mortality in Imperial Germany," *Social History of Medicine*, 7, 401–425.

Vogel, W. (1951): *Bismarcks Arbeiterversicherung. Ihre Entstehung im Kräftespiel der Zeit*. Georg Westermann, Braunschweig.

von Auer, L., and B. Büttner (2004): "Endogenous Fertility, Externalities, and Efficiency in Old-Age Pension Systems," *Journal of Institutional and Theoretical Economics JITE*, 160, 294–310.

von Bismarck, O. (1894): "Die Alters- und Invaliditätsversicherung," in *Die politischen Reden des Fürsten Bismarck, Zwölfter Band*, ed. by H. Kohl, pp. 597–616. Verlag der J. G. Cottaschen Buchhandlung, Stuttgart.

von Bortkiewicz, L. (1909): *Die Deckungsmethoden der Sozialversicherung*. Wiener Kongress für Versicherungswissenschaft, Wien.

von Gruber, M. (1914): *Ursachen und Bekämpfung des Geburtenrückgangs im Deutschen Reich*. J.F. Lehmann, München.

Wagner, A. (1892): *Grundlegung der politischen Oekonomie: T. Grundlagen der Volkswirthschaft*, Lehr- und Handbuch der politischen Ökonomie. C.F. Wintersche Verlagshandlung, Leipzig.

—— (1907): *Theoretische Sozialökonomik: Allgemeine und theoretische Volkswirtschaftslehre Teil 1*. C. F. Winer.

Watkins, S. C. (1981): "Regional Patterns of Nuotiality in Europe, 1870-1960," *Population Studies*, 35, 199–215.

Weber-Kellermann, I. (1988): *Frauenleben im 19. Jahrhundert*. C.H. Beck, München.

Wehler, H.-U. (2008): *Deutsche Gesellschaftsgeschichte 1849-1914*. C.H. Beck, München.

Wetherell, C. (2001): "Another Look at Coale's Indices of Fertility, I_f and I_g," *Social Science History*, 25, 589–608.

Wigger, B. U. (1999): "Pay-as-you-go financed public pensions in a model of endogenous growth and fertility," *Journal of Population Economics*, 12, 625–640.

Wilcox, D. W. (1989): "Social Security Benefits, Consumption Expenditure, and the Life Cycle Hypothesis," *Journal of Political Economy*, 97, 288–304.

Wingen, O. (1915): *Die Bevölkerungstheorie der letzten Jahre*, Münchener Volkswirtschaftliche Studien. Universität München, Stuttgart and Berlin.

Wolf, J. (1928): *Die neue Sexualmoral und das Geburtenproblem unserer Tage*. Gustav Fischer, Jena.

Wooldridge, J. M. (2003): "Cluster-Sample Methods in Applied Econometrics," *American Economic Review, Papers and Proceedings of the One Hundred Fifteenth Annual Meeting of the American Economic Association*, 93, 133–138.

—— (2006): "Cluster-Sample Methods in Applied Econometrics: An Extended Analysis," *mimeo*.

World Bank (2011a): "Female labour force participation rate," http://databank.worldbank.org, accessed 12 May 2011.

—— (2011b): "Female life expectancy at birth," http://databank.worldbank.org, accessed 12 May 2011.

—— (2011c): "Male labour force participation rate," http://databank.worldbank.org, accessed 12 May 2011.

Woycke, J. (1988): *Birth Control in Germany 1871–1933*. Routledge, London.

Wrohlich, K. (2008): "The excess demand for subsidized child care in Germany," *Applied Economics*, 40, 1217–1228.

Ziegler, D. (2005): "Das Zeitalter der Industrialisierung (1815-1914)," in *Wissenschaftliche Paperbacks. Sozial- und Wirtschaftsgeschichte 4*, ed. by M. North, pp. 197–286. C. H. Beck, München.