Max-Planck-Institut für demografische Forschung
Max Planck Institute for Demographic Research
Konrad-Zuse-Strasse 1 · D-18057 Rostock · GERMANY
Tel +49 (0) 3 81 20 81 - 0; Fax +49 (0) 3 81 20 81 - 202;
http://www.demogr.mpg.de

MPIDR WORKING PAPER WP 2015-006
NOVEMBER 2015

Is a Positive Relationship between Fertility and Economic Development Emerging at the Sub-National Regional Level? Theoretical Considerations and Evidence from Europe

Jonathan Fox
Sebastian Klüsener (kluesener@demogr.mpg.de)
Mikko Myrskylä (myrskyla@demogr.mpg.de)

Is a Positive Relationship between Fertility and Economic Development Emerging at the Sub-National Regional Level? Theoretical Considerations and Evidence from Europe[1]

Jonathan Fox*, Sebastian Klüsener**, Mikko Myrskylä***

*   Freie Universität Berlin

** Max Planck Institute for Demographic Research

*** Max Planck Institute for Demographic Research; London School of Economics; University of Helsinki

Abstract

Evidence for nation-states suggests that the long-standing negative relationship between fertility and economic development turns positive at high levels of development. The robustness of the reversal continues to be debated. We add to this discussion from a novel angle by considering whether such reversal could occur at the sub-national regional level. Our contributions are both theoretical and empirical. We first discuss important trends which might foster the emergence of a positive fertility-development relationship within highly developed countries. Then we investigate data covering 20 European countries and 256 sub-national regions between 1990 and 2012. We document a weakening of the negative relationship between fertility and economic development within many countries, and among some countries a positive relationship. These findings do not seem to be driven by postponement effects alone. However, there is substantial variation in the fertility and the economic development levels at which such tendencies toward a reversal are observed.

[1] The authors wish to thank Josh Goldstein, Miriam Hils, Sebastian Beck, Hill Kulu, and Price Fishback, as well as seminar participants at the University of Rostock, University of Arizona, the European Population Conference in Budapest, the Alpine Population Conference in La Thuile, the International Conference on Population Geographies in Groningen, the Population Association of America Conference in Boston, and the Freie Universität Area Studies Colloquium. This research was supported in part by European Research Council Grant #336475.

1 The Negative Association between Fertility and Economic Development – Is It Here to Stay?

Over most of the 20th century, it was generally observed that areas with advanced levels of economic development tend to have lower fertility levels than less developed areas. While this pattern continues to hold true when we compare low-income, middle-income, and high-income countries, recent evidence suggests that among high-income countries the relationship between development and fertility may change from negative to positive. For example, Myrskylä et al. (2009) found that at high levels of socioeconomic development, as measured by the Human Development Index (HDI), the relationship between development and fertility changes from negative to positive. This observation has been referred to under different names in the literature, including “the income/development-fertility reversal,” “inverse J-shape association,” or “convex relationship between income/development and fertility.” These terms are used synonymously throughout this paper. As part of this discussion, Luci-Greulich and Thévenon (2014) determined there to be a convex relationship between GDP per capita and fertility in their examination of the income aspect of development for OECD countries. The authors attributed the new patterns in the fertility-development association to the changing relationship between female employment and fertility. A similar mechanism was suggested by Myrskylä et al. (2011), which linked the empirical findings of their 2009 paper to gender aspects. They argued that the observed trend toward a positive association is mostly driven by countries with comparatively high gender equality levels.

However, whether a reversal is indeed occurring remains contested. A critique specific to the Myrskylä et al. (2009) paper is that the results are not robust to different measures of HDI. This critique is outlined in Harttgen and Vollmer (2014), which argued that the reversal does not show up when the updated UN HDI measures are used, and is also not present when the HDI is separated into its health, education, and standard of living components. A more general criticism concerns the question of whether the reversal is occurring due to increases in the quantum of fertility, or whether it is simply a sign of the end of postponement. Bongaarts and Sobotka (2012), for instance, argued that recent rises in fertility in highly developed countries might be mostly driven by postponement effects. Period fertility rates can be depressed as a result of women postponing their births to higher ages, and when fertility postponement slows down, period fertility may increase (Goldstein et al. 2009; Bongaarts and Sobotka 2012). Bongaarts and Sobotka (2012) in particular suggest that a reversal of the association between development and fertility is driven primarily by further advances in economic development and the simultaneous slowing or ending of fertility postponement. It is also possible that the end of postponement and improvements in economic outcomes happen to occur simultaneously, and that there is no causal relationship between the two. However, analyses of cohort fertility trends suggest that at least a portion of the fertility increases in highly developed countries is attributable not to such a tempo effect, but rather to true increases in the quantum of fertility (Myrskylä et al. 2013; Schmertmann et al. 2014). In addition, even if postponement effects are an important mechanism that links trends in economic development to changes in fertility, the relationship between economic development and fertility is nevertheless important.

The goals of this paper are to add the sub-national regional dimension to this discussion both in terms of theoretical considerations and empirical findings, and to explore to what extent changes in postponement contribute to the observed pattern within countries. Looking at the sub-national dimension can improve our understanding of the potential mechanisms that underlie this relationship, as any findings for nation-states could be largely driven by national-level variation in economic structures and policies that affect factors such as female labor force participation, educational levels, and postponement; these may in turn be simultaneously related to levels of development or per capita income. As most countries exhibit relatively high levels of internal regional homogeneity in terms of their culture, economic structure, and policy framework (Watkins 1991), the presence or absence of a change in the income-fertility association at the regional level might provide a clearer picture of the relevance of income itself in the observed trends.

In our theoretical section we explain why we might expect to see a reversal in the positive relationship between fertility and economic trends at the sub-national regional level in highly developed countries under specific conditions. While in the 19th and 20th centuries a number of processes supported the emergence of a negative association between fertility and economic change, more recent development trends might contribute to a turnaround of this association. These trends include the new generation of family policies that focus on supporting parents in balancing work and family, changes in the spatial organization of the economic sphere to allow for more place-flexible working arrangements, and the effects of selective international and internal migration into highly developed areas on sub-national variation in fertility levels.

Our empirical analyses focus on Europe, as previous work has shown that a number of highly developed European countries appear to be susceptible to a reversal in the fertility-income relationship (Myrskylä et al. 2009, 2011; Luci-Greulich and Thévenon 2014). In addition, the quality of the European data and its availability at the regional level allows us to control for time-varying country effects that can confound estimates of national-level relationships. The analysis includes sub-national regional level data for 20 European countries over the period 1990-2012.[2] As measures of fertility, we use the total fertility rate (TFR) and an estimate of the tempo-adjusted TFR (Potančoková et al. 2008), which uses the mean age at childbirth as a control for the role of tempo effects in driving the potential income-fertility reversal. Per capita income is measured by employee compensation per capita, as this metric accounts for regional household income levels better than the more commonly used Gross Domestic Product (GDP).

Our results suggest that a turnaround in the relationship between fertility and economic development from negative to positive is occurring in a number of European countries. While postponement effects do seem to be contributing to this turnaround, the estimated relationship remains after controlling for the mean age at childbirth. In addition, across countries there seems to be substantial variation in the factors that determine the turnaround, as well as in the fertility and economic development levels at which such a turnaround is observed.

[2] These countries are Austria, Belgium, Bulgaria, the Czech Republic, Denmark, Germany, Greece, France, Finland, Hungary, Italy, the Netherlands, Norway, Poland, Portugal, Romania, the Slovak Republic, Spain, Sweden, and the United Kingdom.

2 Development, Economic Centers and Peripheries, and Fertility - Theoretical Background

2.1 The Emergence of the Negative Relationship

Before discussing the mechanisms that might underlie a turnaround in the association between fertility and economic development across sub-national regions of highly developed countries, we first reflect on the main factors that contributed to the negative association typical of many of these states in the 20th century. As there is a vast literature on this topic (e.g., Becker 1960; Oppenheim Mason 1997; Cleland and Wilson 1987; Goldstein and Klüsener 2014), we will outline these developments only briefly here, and refer readers interested in a more detailed discussion to these publications. We would also like to note that in most countries we find a positive relationship between per capita income levels and the degree of urbanization across the sub-national regions.[3] Thus, urban-rural or center-periphery disparities will be of interest in our theoretical considerations as well.

Europe's distant past was likely characterized by Malthusian cycles of boom and bust in which increases in income generated increases in fertility (Guinnane 2011). Over the course of the demographic transition during the 19th and 20th centuries, this relationship began to break down, such that higher levels of per capita income no longer translated into higher levels of fertility (Skirbekk 2008; Dribe and Scalone 2014). This was the case for both urban and rural areas (Klüsener et al. 2013). For economists in the first half of the 20th century, the observed negative relationship between income and fertility in post-transitional societies was puzzling. Based on the prevailing economic theory, this empirical observation implied that children were

---

[3] Capital regions and centers of economic activity are commonly characterized by high degrees of urbanization, as the prospect of having access to political institutions and economic opportunities has made these regions attractive destinations for migrants for centuries. The only larger exception where highly urbanized areas might not be among the most developed areas of a country can be found among regions that industrialized early and relied heavily on economic sectors that have lost relevance over the last 50 years (e.g., coal mining and the steel industry). Examples of such regions are the German Ruhr area, northeastern England, central Belgium, and Polish Upper Silesia.

an inferior good, and that the demand for them should be highest when income was low. A formal solution to this conundrum was offered by Becker (1960), who considered the ability of parents to trade investments in the quantity of children for investments in quality.

Although there is limited evidence for this quantity-quality trade-off in high fertility contexts, modernization has tended to intensify relationships between parental investment and child success, thereby favoring quality over quantity (Lawson and Mace 2011). When infant and child mortality risks are high, the chances of survival until adulthood—and thus the incentive to invest in any single offspring—are low. If the goal of the parents is the propagation of their heritage or the guarantee of support in their old age, their preferred strategy may be to invest in the quantity of children, thereby increasing the probability that a sufficient number of their offspring will survive childhood. This strategy is likely to become less attractive when the chances that a child will reach adulthood are substantially higher, and approach 100%. This is a process over which parents can have some influence by, for example, observing hygiene rules and providing their children with better nutrition. The incentive to invest in quality over quantity can be enhanced by increased social mobility opportunities, which have mostly emerged in centers of economic activity (Lipset and Bendix 1991: 217). Thus, the move from investments in quantity to investments in quality is most likely to occur first in highly developed areas, and this shift may be expected to contribute to the negative association between economic development and fertility across sub-national regions of countries.

A related process that occurred at that time was the rise in the financial costs and the opportunity costs of having children. Given that higher densely populated areas are characterized by higher costs of living, particularly with regards to real estate, the costs of providing space and resources to children would have been higher in urban areas. The extension of schooling further contributed to higher costs associated with having children, as more time spent in education prolonged the period during which children were dependent on the economic support of their parents. Rural areas were likely to be less affected, as accommodation in the form of scheduled school vacations or extra time off were often given so that children could still help with harvest work (see e.g. Hopkins 1994; Moderow 2007: 115).

The opportunity costs associated with having children also increased as the Western world underwent substantial changes in the spatial organization of the economic sphere as part of the societal modernization trends of the 19th and 20th centuries (Hayford 1974). In pre-modern societies, a large share of the population were engaged in economic activities near their place of residence. Agricultural laborers usually lived close to their fields, and proto-industrial forms of work such as weaving or craftsmanship were often carried out in the household. This type of spatial organization would have supported parents in combining economic and childrearing activities.

Industrialization and the eventual expansion of the service sector created employment opportunities in factories and commercial zones, which required employees to be away from home for a substantial part of the day. These opportunity costs would have been particularly high for women, as many of these new employment opportunities were offered primarily to female workers, who had previously been underutilized in formal labor markets. According to the German census of 1875, nearly half of the workforce of the German textile and clothing factories was female (Kocka 1990). In Britain, the corresponding figure was about 40 percent (Blythell 1993). These changes had consequences for would-be mothers, as participating in economic activities outside of the home substantially limited the amount of time available for childrearing tasks. This engagement in economic activities outside of the household was likely both positively related to the increase in the economic gains available by pursuing such strategies, and stronger in urban areas. Rural populations were less affected in their fertility behavior, as rural areas experienced this spatial re-organization of economic activities to a lesser degree and at a later stage (Dart 2006). Thus, these changes in the spatial organization of the economic sphere likely also fostered a negative association between economic development and fertility levels at the sub-national regional level. It is therefore not surprising that urban economic centers were often leaders in the fertility decline, while peripheral areas followed with some delay (Coale and Watkins 1986; Basten et. al 2011).

2.2 Why We Might Witness a Reversal of the Relationship

Fertility trends in modern societies are influenced by a multitude of factors (Esping-Andersen and Billari 2015; Goldscheider et al. 2015; Lesthaeghe 2010). In the following we highlight a number of recent and current developments that could contribute to a weakening or a reversal of the relationship between fertility and income levels. These include shifts in family policies, changes in employee relationships, and selective migration processes.

In discussing shifts in family policies, we first look at past patterns from which these shifts represented a deviation. Occurring parallel to these rapid economic developments of the 19th and 20th centuries was the rise of European nation-states (Watkins 1991). An increased ability to tax, and growing acceptance of the involvement of the state in social welfare programs, allowed state governments to intervene in what were identified as being problem areas. Many governments saw declining fertility rates as a development challenge, and thus implemented policies aimed at improving the situations of families with children (Lorimer 1945). In the first part of the 20th century, these pro-family policies mostly provided child benefits or tax deductions (PERFAR 2015). Apart from additional support given to families with multiple children, these payments were generally not means-tested. As these benefits were imperfectly adjusted for the cost of living in the place of residence, in real terms they were most beneficial for residents of less-developed regions within a country. Thus, this first generation of family policies may have further intensified the negative relationship between economic development and fertility levels within countries.

However, in recent decades the focus of family policy reforms has shifted to extending parental leave schemes and childcare (PERFAR 2015). Rather than providing transfer payments, these new family policies are aimed at decreasing the opportunity costs of childrearing, as opportunity costs tend to be particularly high when both partners have acquired substantial human capital and have high earning potential. Parental leave support payments are often linked to prior income levels, which better adjusts for regional variation in cost of living. In addition, because many parental leave programs guarantee that after taking a period of leave a parent can return to his or her previous job, uncertainties regarding future career options are reduced.

Related to parental leave is access to childcare outside of the home, as childcare services offer parents an alternative to remaining at home after the parental leave period ends. Access to affordable private or public childcare allows dual-earner couples to have larger families without necessarily experiencing the time trade-off they would otherwise face without such services. Overall, it seems that relative to the first generation of family policies, the second generation provides better support for dual-earner couples with high incomes. Since these individuals are concentrated in highly developed areas (de Meester and van Ham 2009), we believe that these policies might weaken the negative relationship, or even contribute to a turnaround.

Changes in family policies also support recent changes in gender roles toward a higher degree of gender egalitarianism. Esping-Andersen and Billari (2015) argued that fertility tends to decline when women enter the labor market in large numbers, but that it begins to increase if a society achieves gender egalitarianism. Family policies that support parents in reconciling work and family can be a crucial element in this process. Since highly educated women seem to be achieving gender egalitarianism in their partnerships more quickly than their less educated counterparts (Esping-Andersen and Billari 2015), and these women are more concentrated in highly developed regions, this shift in gender roles could also positively affect fertility in these regions.

For this second wave of family policies, there is temporal variation across European countries in the introduction of a family policy mix that supports parents in reconciling family and career goals. Northern and Western European countries were the forerunners in implementing such policies, while Central and Southern European countries lagged behind (PERFAR 2015). This pattern might also help to explain why the former group of countries are more likely than the latter group to have experienced a turnaround in cohort fertility trends at rather high fertility levels (Myrskylä et al. 2013; for empirical support for a link between family policies and fertility levels, see Klüsener et al. 2013).

In addition to these shifts in family policies, another important process influencing recent trends has been the changes in the spatial organization of the economic sphere. The

Internet and associated technologies have opened up opportunities for individuals to create more flexible working arrangements than were previously possible. Under such arrangements, which are often referred to as teleworking, flex-place, or flex-time, employees are freed from the obligation to be present at a regular workplace for all their work hours. Thus, just as industrialization changed the spatial organization of economic activities in the 19th and 20th centuries, technological advancements that allow for more flexible working arrangements may be changing the spatial organization of economic activities in the 21st century. In this process, work is to some extent coming home again, and residential households are regaining importance as places for generating income through economic activities. Flexible working arrangements offer new options for combining childrearing obligations with career plans, and as such also support trends toward increased gender equality. This trend could have positive effects on the fertility decisions of working couples, as childbearing intentions seem to be influenced by the amount of subjective control over his or her work a person is able to achieve (Begall and Mills 2011). Although the share of employees who are able to make use of such flexible opportunities is still low in many countries, these opportunities have increased in recent years, especially for the highly educated. A 2013 study performed by researchers at Catalyst, a nonprofit business research organization, found that among U.S. MBA alumni surveyed, over 80% had access to some sort of flexible working arrangement (Beninger and Carter 2013).

The relationship between flexible work arrangements and the economic centrality of places is not completely clear, but should encourage fertility in more centralized places. A possible argument against is that if employees obtain complete flexibility over their workplace arrangements, weak location factors such as climate, environmental conditions, or the cultural richness of an area might gain in importance for housing location decisions. The regions that score high on these dimensions might not necessarily be the most developed ones. If, however, many jobs remain relatively location-dependent and require employees to be present at a regular workplace for at least part of the time, the economic centrality of workplaces will continue to matter. In addition, as knowledge continues to grow in importance as an economic production factor, spatial proximity and frequent direct social interaction is likely to remain relevant (Bathelt et al. 2004). Thus, unless further technical developments allow individuals to interact through the internet as they do in reality, individuals will continue to benefit from economic centrality and agglomeration effects. We therefore expect populations in more economically advanced contexts to have larger gains from the emergence of flexibility in work options, and that these populations will therefore be supported in the decision to have a(nother) child to a greater extent than populations in more peripheral contexts.

The final important trend related to the potential reversal between fertility and income we wish to point out here is that of selective international and internal migration, and the ensuing developmental challenges in peripheral areas. With the industrial revolution, the relevance of soil as a production factor was reduced. This development, together with innovations in agricultural production that reduced the demand for rural labor, contributed to substantial migration streams from peripheral to more centralized areas. This general trend continues up to today. Migration is usually selective in terms of individual assets, such as health status and the resources to migrate. As such, this long period of outflow from less-developed regions might create development challenges in these areas, with negative effects on available human capital, partner markets, and fertility levels.

Effects of migration on fertility patterns can be observed not only within countries, but also between countries. Like domestic migrants, international migrants tend to settle in highly developed areas, as these are usually the places with more opportunities and social and communication links to countries abroad. This inflow of international migrants into highly developed areas can have significant effects on fertility levels, particularly in low-fertility contexts (Billari and Dalla-Zuanna 2011). In addition to having different parity levels, many migrants postpone fertility until they reach their destination (Wilson 2013). Overall, processes of selective international and internal migration might be of particular relevance for countries with low fertility levels. If these migration processes contribute to a positive association between economic development and fertility, they may do so at fertility levels far below the replacement level.

2.3 The "Noise" of Mid-Term Transitions within Long-Term Transitions

The broad trends outlined above are long-term transition processes that operate over decades or even centuries. In addition to these long-term developments, we might also witness transitions that operate at shorter time scales, but that could nevertheless make substantial contributions to the changes in the observed empirical relationship between income and fertility. Two of these shorter term transitions that we consider here are the postponement of births to higher ages and the transition processes in Eastern Europe following the collapse of communism.

As we mentioned in the introduction, an alternative interpretation of the empirical evidence pointing to a turnaround in the relationship between period fertility rates and income is the end of postponement (Bongaarts and Sobotka 2012). The reversal in the association between development and fertility—and, more generally, increases in fertility—can at least in part be linked to a temporary depression of fertility levels due to the postponement of births. Thus, it is important that we investigate how trend patterns in the association between economic development and fertility relate to postponement. However, postponement effects on fertility should not be interpreted as resulting from demographic pressures alone. Social and economic forces start the process of fertility postponement, and it is likely that these forces also play an important role in determining how long postponement can continue. In addition to postponement effects, there may also be true increases in the quantum of fertility. Evidence for the reversal of cohort fertility rates has been presented in previous work (Myrskylä and Goldstein 2013; Myrskylä et al. 2013; Schmertmann et al. 2014), and the range of factors outlined above may lead us to expect to see the kind of reversal documented in Luci-Greulich and Thévenon (2014) and Myrskylä et al. (2009).

The transition Central-Eastern and Eastern Europeans experienced during the 1990s—i.e., from living under a dictatorship and a command economy to living under a more democratic form of government and a more liberal economy—may have also contributed to changes in the regional relationship between fertility and economic development. As the economies of these countries entered this transition process, many of the local companies were unable to fully compete on global markets. The difficulties these companies faced in competing with international imports resulted in economic crises of differing levels in the former communist countries. This period of economic transition had consequences for both the timing and the quantum of fertility behavior (Sobotka 2003; Myrskylä et al. 2013).

Urban and rural areas were affected differently by the transition. At the beginning of the process in the early 1990s, regions with higher levels of development often had no particular advantage over other areas. In the countries that were most affected, the urban areas were even worse off. The people who were living in these areas often lacked access to food and faced substantial increases in the cost of living (Macours and Swinnen 2008). The people who were living in the rural areas of these countries at least had access to essential goods, and were thus better able to cope with extreme conditions. However, the situation changed substantially as the transition progressed. Capital areas and urban centers had greater economic potential, and thus attracted more foreign investment and trade. In many countries, these regions were the first to recover. More peripheral areas, by contrast, experienced a return to growth much later. Given these patterns, we might expect to find that the most developed centers were leaders in both the initial fertility decline, and the eventual fertility recovery.

Since our study period (1990-2012) spans decades during which there was substantial fertility postponement and the former communist countries underwent a major political and economic transition, it will be important to investigate the effects of these trends on our outcomes. Our empirical analysis therefore includes models for both Europe as a whole, and for the Western European and the former communist Eastern European countries separately. To examine the effects of postponement, we compare the models using the TFR as a fertility measure with the models in which the TFR is replaced by a tempo-adjusted TFR.

3 Data

To investigate the regional relationship between income and fertility, we rely on regional economic data at the NUTS 2 level compiled by Cambridge Econometrics (CE).[4] These data were

[4] The NUTS classification system of the European Union distinguishes three different geographic hierarchies based on comparable population sizes, while taking existing national administrative divisions

originally collected by CE primarily from Eurostat, then adjusted to 2005 euros using GDP deflators. Age-specific fertility data were drawn from a combination of sources. Most of the data were obtained through Eurostat. However, there are some large gaps in regional time series drawn from this source for a number of countries for the period of observation. We thus made substantial efforts to fill in these gaps using data directly derived from national statistical offices.[5] By limiting ourselves to official aggregate statistical data, we excluded a considerable body of potentially relevant information, such as survey data from the Generations and Gender Survey or Understanding Britain. However, the statistical dataset chosen has the advantage of being broadly available for more countries, and less prone to selectivity. Surveys are usually subject to low and potentially selective response rates, and this problem is particularly acute in highly developed and urbanized regions (Stoop et al. 2010).

Table 1 gives the set of countries used in the Section 4 analysis. This list does not represent the total number of countries for which data are available, as we limited ourselves in this project to studying countries that have comparable data for both income and fertility, and that have at least four regions.[6] We estimate the convex relationship between fertility using

---

into account whenever possible. NUTS 1 is the most aggregated level, and represents regional divisions of between three and seven million persons. NUTS 2 offers a finer level of detail, as it separates areas into those with populations between about 800,000 and three million. NUTS 3 provides the finest level of detail and represents areas with populations between about 150,000 and 800,000. This project utilizes the data available at the NUTS 2 level, as this is the lowest level of division for which the required fertility and economic data are available. Among the limitations of the NUTS classification is that the regions do not necessarily reflect long-standing administrative definitions within countries. In addition, population sizes are not always within the proposed ranges. In 2007, for example, 24 percent of the 292 NUTS 2 regions (excluding Turkey) had population sizes below the 800,000 threshold used to differentiate between NUTS 2 and NUTS 3 regions.

[5] For additional details, we refer the reader to Appendix 1.

[6] Limiting ourselves to those countries implies restricting ourselves to the set of countries that are members of European Union or the European Free Trade Association.

two variables (per capita income and per capita income squared) that reflect the variation within countries; thus, at least three different regions are needed to make an estimate. This leads to the exclusion of Cyprus, Estonia, Latvia, Lithuania, Luxembourg, Malta, and Slovenia; these countries contain only a single NUTS 2 region. By setting the threshold at four regions, we also exclude Ireland (2 NUTS 2 regions) and Croatia (3 NUTS 2 regions). Switzerland fits our criteria as it has at least four regions, but it is not included as we were unable to obtain a time series of regional income data for the country. Column (1) of Table 1 shows the number of regions in each of the countries included, while Column (2) displays the regions used from each of the different countries. Column (3) gives the number of years for which data are available for each of those regions.

Finland, Spain, Germany, and Portugal all have one or more regions that will be excluded as the study proceeds. The Swedish-speaking Åland Islands in Finland, the Canary Islands and the two North African exclaves of Ceuta and Melilla in Spain, and the Azores and Madeira in Portugal are all omitted because they are either isolated from the countries' mainland, and/or because of their very small population sizes. For Germany, the region of Berlin is excluded as a result of dynamic between East and West Berlin. This is discussed in more detail below. Most of these regions were granted NUTS 2 regional status due to their location, or, in the case of the Finnish Åland islands, their substantial autonomy. The fixed effects models specified in the section below assume that regions are identical in terms of the factors that affect both fertility and income; since the regions mentioned above can be expected to differ substantially from the other regions in their respective countries with regard to cultural, political, and other factors, we chose to exclude them from the analysis. For some countries we were also unable to obtain a complete time series of regional fertility rates since 1990 (see Appendix 1).

Columns (4) and (5) of Table 1 list the average per capita GDP and the average employee compensation per capita for each of the different countries. We should emphasize that this is not the average per capita income of the different countries, but the average income *across their regions*. Per capita GDP is defined as total gross value added, plus taxes, less subsidies on products, divided by the region's population. We list this metric here primarily as a way to gauge the magnitude of the variable for the per capita compensation of employees, which is defined as the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period.

4 Empirical analyses

4.1 Cross-Sectional Comparisons

As a first step of analysis, we will look at the trends in the cross-sectional relationship between the regional income and the fertility levels for each of the countries under study over the period 1990-2012. We do this by performing cross-sectional regressions on a by-country annual basis. Thus, for each year and for each country, regional total fertility rates are regressed on the lag of adjusted regional employee compensation per capita.[7]

Figures 1 and 2 plot the country-specific cross-sectional correlations for countries in Western Europe (Figure 1) and Eastern Europe (Figure 2). For readability reasons, Figure 1 is further subdivided into those Western European countries situated in the north and west of Europe (Figure 1a) and those situated in the center and the south (Figure 1b). Beginning with Figure 1a, we see that in the early 1990s the relationship was negative for all of the displayed countries, with the exception of France and Belgium. For Finland the cross-sectional correlation remained consistently negative throughout the entirety of the study period, and became slightly more negative toward the end of the panel. Apart from Finland, only the United Kingdom and France reported having a more negative correlation coefficient in 2011 than in the early 1990s. Among the five countries that experienced increases, Norway and Sweden stand out. Both countries moved from having a relatively negative correlation to having a positive one, with Norway maintaining this positive correlation until the end of the study period. For Sweden the correlation declined in the last two years of the period to a value just below zero.

[7] Use of GDP per capita results in similar estimates.

Additionally, although the correlation has remained negative for both Denmark and the Netherlands, these two countries have recently been experiencing movement toward having a less negative relationship between per capita income and fertility.

Figure 1b displays these relationships for the Western European countries in the center and the south of Europe. One trend that is immediately noticeable from Figure 1b is the big change in the fertility-income relationship for Germany, from high positive to negative values. The high positive values in the early 1990s were related to the depression in fertility in the eastern Germany regions as a result of the post-communist transition. At that time, the more affluent regions in western Germany also had fertility levels that were relatively low, but that were still higher than those of eastern Germany. While eastern Germany still lags behind western Germany in terms of economic development, fertility has recovered, and is currently higher than in western Germany (Goldstein and Kreyenfeld 2011). As a result, the coefficient for Germany turned negative in the 2000s. Because the effects of the previous division of this country may be expected to linger, we chose to derive the coefficients for the western and the eastern German areas separately. The trend for western Germany is included in Figure 1b, while the trend for eastern Germany is grouped with those of the other former communist countries in Figure 2.

In Figure 1b, we can see that nearly all of the countries exhibited a negative correlation coefficient in the early 1990s, with Austria and Portugal being the exceptions. Except for united Germany with its explainable concave trend, we can see for all of the displayed countries a tendency toward an increasing coefficient. As a result, we estimate a slightly negative association between fertility and income at the end of the study period for western Germany and Greece only, while Italy and Spain had joined Austria and Portugal in reporting positive coefficients.

Figure 2 presents the trends for Eastern Europe. As in Figure 1b, the Eastern European countries display a generally consistent pattern. Only eastern Germany had a positive coefficient at the beginning of the study period; however, as in Figure 1b, this is likely an artifact of the data. Approximately two-thirds of the population of Berlin were living in former

West Berlin, which had been part of West Germany during the division of the country. As a result, Berlin was less affected by the transition. Thus, despite having relatively low fertility levels, Berlin was the region of eastern Germany that had the highest economic development and fertility levels in the 1990s. This pattern changed as the crises that characterized the transition period passed, with the fertility levels of many eastern German regions overtaking those of Berlin.

If Berlin is omitted from eastern Germany, we also obtain a negative coefficient at the beginning of the study period. This negative relationship observed in all Eastern European countries in the early 1990s weakened throughout the 1990s and 2000s, so that by 2012 most of these countries had fertility-income correlations of around zero. Only Romania experienced something of a reversion in the final years of the analysis. However, this is an artifact of the substantial shortcomings in the Romanian population estimates for the 2000s that were reveled in the census of 2011. The census showed that the female population of childbearing age in rural/marginal areas such as the northeast of Romania was much smaller than it actually was. This problem had contributed to a downward bias in the fertility rates of these less-developed areas, which in turn led to a substantial reduction in the size of the negative coefficient in the late 2000s. However, if we just focus on the quite reliable numbers for the census years of 2001 and 2011, we can see that Romania has experienced a weakening of the negative relationship in this period, though to a much smaller degree than the coefficients based on the published intercensal population estimates suggest.

Overall, the trend of these cross-sectional associations suggests that over the last two decades most European countries have experienced a lessening of the negative gradient between economic development and fertility across their sub-national regions. In many countries, this gradient has even turned positive. However, the fertility and the economic levels at which countries report such reversals varies substantially across countries. To illustrate this development, we show the regional trends for a selected number of countries in Appendix 2. In Italy, for example, the reversal of the cross-sectional coefficient occurred at quite low fertility levels (TFR < 1.5), and the trend pattern seems to a large degree to be related to distinct demographic differences between the wealthier northern and the poorer southern parts of the country. In Italy, the north experienced fertility decreases due to postponement effects earlier than the south, while more recently the postponement effects seem to have been particularly focused on the south (Caltabiano et al. 2009). If we disregard the three autonomous regions with substantial ethnic minorities, we see that there is currently no other Italian region that has a TFR above the cohort fertility levels of around 1.5 projected for the Italian cohorts born in the late 1970s (all projections by Myrskylä et al. 2013). This is another indication that in the Italian case the trend pattern is indeed driven to a large degree by postponement effects, and not by quantum increases in highly developed regions. In Poland, as in many of the Eastern European transition countries, the emergence of a positive gradient occurred at a level far below replacement level, and under conditions of substantial postponement (the projected fertility rates for cohort born in the late 1970s are below 1.6).

In Austria, which reported a positive cross-sectional coefficient throughout the period, this relationship is observed at a period fertility level below 1.5. None of the regions has a period fertility level close to the projected cohort fertility levels of 1.6. Zeman et al. (2010) provide support for the view that the observed pattern can to a substantial degree be attributed to selective migration processes. While migrants contributed approximately 0.3 to the total fertility rate for the Vienna region, the net contribution in other regions was just 0.12 (Zeman et al. 2010).

In Belgium, by contrast, the turnaround was similar to the reversals observed in some of the other Northwestern European countries with fertility levels closer to replacement level. At the end of the observation period, the two regions of the country with the highest levels of development (Brussels and Antwerp) had fertility levels of 1.95 and 1.87, which are above or slightly below the projected cohort fertility rates for the Belgian cohorts born in the late 1970s (1.91). This suggests that the positive gradient is not driven by postponement effects alone.

4.2 Country-by-year fixed effects

The preceding analysis looked at the evolution of the cross-sectional association between regional income and fertility levels over time across different European countries. In this second part of our study, we investigate how changes in income are related to changes in fertility by applying country-by-year fixed effects models. The country-by-year fixed effects model assumes that regions within the same country are identical in terms of the factors related to both fertility and income, while it controls for all of the potentially confounding unobserved effects at the country level. These can include factors such as family and childcare policies, the level of female education or labor force participation, or tempo effects in fertility. While these factors can also differ at the regional level, they should vary to a lesser extent than they do across countries.[8] This is particularly the case for Europe, as institutions that promote work-family balance and female educational enrolment are generally administered at the national level (PERFAR 2015). Within this model, a region's total fertility rate is specified as the dependent variable, while logged income per capita and its square in the preceding year are the independent variables. The inclusion of the square term is important for the identification of a reversal in the relationship. For the results presented below, income per capita indicates employee compensation per capita; the results are robust to the alternative measures of income GDP per capita or employee compensation per worker.

$$TFR_{t,c,r} = \chi_c * \lambda_t + \beta_1 \ln\left(inc_{t-1,c,r}\right) + \beta_2 \ln\left(inc_{t-1,c,r}\right)^2 + \varepsilon_{t,c,r} \quad (1)$$

In equation 1, $TFR_{t,c,r}$ denotes the total fertility rate at time t (measured in years), in country c, and in region r. The first term, $\chi_c * \lambda_t$, controls for the country-by-year fixed effects. The inclusion of this interaction term then controls for a country-specific effect that varies over time. This is in contrast to the inclusion of country and year fixed effects, which would control for the time-constant country-level factors and the time-varying factors common to all of the

[8] In consistency checks we included regional fixed effects in the analysis below. This resulted in a reduction of the convexity of the estimated relationship, but the results were qualitatively similar.

countries in the panel. Income per capita is represented by "*inc,*" and appears in both the linear and the squared terms. The error term $\varepsilon_{t,c,r}$ is assumed with conditional mean zero. We estimate this model separately for the full sample, for regions part of Western European countries (including former West Germany), and for regions part of the Eastern European countries (including former East Germany). [9] Germany is divided into its former East and West regions since combining them, as seen in Figure 1a, likely violates the assumption of regional similarity within the country-by-year fixed effects models. Although not shown, the results are qualitatively similar if German regions are combined and considered part of Western Europe and a regional fixed effect is included. The model estimates are presented in Table 2, as is the associated level of per capita income at which the results indicate any sort of a fertility reversal. Because there is a great deal of statistical uncertainty regarding the specific income level at which the potential reversal occurs, we interpret this inversion point simply as a measure of the magnitude of the coefficients, not as the income level at which the relationship between fertility and income is expected to turn positive.

The results from Equation 1 (see Table 2) indicate in point estimate form the results that were visually apparent in Figures 1 and 2. The estimates from the full sample shown in Column 1 indicate that at low levels of per capita income, there is a negative association between per capita income and fertility. This diminishes as per capita income increases, and the models that we specified show a positive association at about 19,000 2005 euros. Compensation per capita is generally about 40-60 percent of GDP per capita for the set of regions in the sample. If we take this estimate of the inversion point as given, this number is generally consistent with the findings of Myrskylä et al. (2009) and of Luci-Greulich and Thévenon (2014). When we compare the Western and the Eastern European countries, the outcomes are generally the same, but the estimates of the reversal point differ. For the Eastern European countries it occurs when

[9] The Western European areas include regions part of Austria, Belgium, Denmark, Finland, France, former West Germany, Greece, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom. The Eastern European areas include regions part of Bulgaria, former East Germany, the Czech Republic, Hungary, Poland, Romania, and the Slovak Republic.

employee compensation per capita is about 7,000 2005 euros, while for the Western European countries it occurs when employee compensation per capita is about 24,000 2005 euros.

4.3 Controlling for Tempo Effects in Fertility Trends across Regions

As discussed above, other studies have indicated the importance of tempo effects in explaining the different fertility trends across European countries. To examine the extent to which trends in postponement may be contributing to the above results, we use information on age-specific fertility in an attempt to control for the tempo effects that are likely present in the fertility trends across the different countries. The arguably most sophisticated approach suggested in the literature (e.g., Bongaarts and Sobotka 2012) requires parity-specific fertility by age for the different regions. As these data are not available, we turn to a second-best method by estimating the tempo-adjusted total fertility rate using the information on the average age at childbearing suggested by Potančoková et al. (2008).[10]

According to Potančoková et al. (2008), the quality of the above estimate is high only if the fertility quantum is relatively low, there are no dramatic changes in higher order fertility, and the changes in the MACB are uniform and sufficiently small. These assumptions all stem from fertility declines being associated with disproportionately large declines in higher order births.[11] Since these higher order births are going to be concentrated among the older age groups, this feature of a fertility decline may lead to observed declines in the overall mean age at childbirth, even if those declines are not representative of the majority of the childbearing population. Although across the different European countries higher order births were not a primary component of the changes in fertility during the period of study, some areas in the early stages of postponement did experience changes in the mean age at childbirth that

[10] Specifically, we estimate the Bongaarts and Feeney (1998) tempo-adjusted TFR by calculating $TFR^* = TFR(1+\Delta MACB/(1-\Delta MACB))$, where $\Delta MACB$ is the annual change in the mean age at childbearing.

[11] According to Potančoková et al. (2008), “relatively low” fertility quantum is less than 2.0, and “sufficiently small” changes in the MACB are no more than 0.1 per year.

exceeded the maximum suggested figure of about 0.1 per year. While the shift in the mean age could result to some degree of overestimation of the tempo effect, this overestimation may in turn lead to the true adjusted TFR declining less than the estimated adjusted TFR, and thus to a smaller likelihood of an increase. This should then reduce the chances of observing an upturn associated with income. Since temporal variance in annual changes introduces a significant amount of noise in the estimates, a smoothed tempo-adjusted TFR ($\widehat{TFR}^{*}$) is included as the dependent variable in equation 1, reproduced below.[12]

$$\widehat{TFR}^{*}{}_{t,c,r} = \chi_c * \lambda_t + \beta_1 \ln\left(inc_{t-1,c,r}\right) + \beta_2 \ln\left(inc_{t-1,c,r}\right)^2 + \varepsilon_{t,c,r} \quad (2)$$

In equation (2), all of the variables on the right-hand side of the equation are the same as in equation (1), but with the new dependent variable $\widehat{TFR}^{*}$. Estimates from equation (2) are given in Table 3.

When we compare the estimates for the tempo-adjusted TFR in Table 3 with the estimates for the TFR in Table 2, we can see that the results are generally the same. One difference between Tables 2 and 3 are the magnitudes for the coefficients for Eastern Europe. Although they are still highly statistically significant, the magnitude of both the linear and the squared term coefficients have been reduced by about 20-25 percent, which implies that the increase in fertility that is associated with increasing income is smaller when tempo effects are accounted for. This reduction in the attenuation trend is nevertheless small. When we compare the different coefficients we can see that the convexity for Eastern Europe is slightly less pronounced, but the presence of an attenuating relationship between income and fertility remains clear. Meanwhile, for Western Europe we can see that accounting for changes in tempo using the mean age at childbirth results in a more convex trend between fertility and income.

[12] The mean age at childbearing is smoothed using a three-year moving average of t-1, t, and t+1.

5 Discussion and Conclusion

National-level studies have documented changes in the patterns in the relationship between fertility and development. While these studies have suggested that at high levels of development national-level fertility increases with development, the robustness and the interpretation of these findings continue to be debated. In this paper we sought to add the sub-national regional dimension to the discussion of a potential reversal in the relationship between fertility and income at high levels of development. The sub-national dimension is important for understanding the potential mechanisms through which development could positively influence fertility, as this approach allows us to control for national-level idiosyncrasies, while also allowing for large variation in income.

Our contribution is both theoretical and empirical. In the theoretical considerations, we discussed a set of processes that could potentially contribute to a weakening or a reversal of the negative relationship between economic development and fertility levels across sub-national regions, as these processes might contribute to enhanced fertility in highly developed areas. The processes include the replacement of more direct transfer payments with a new generation of family policies that are designed to reduce the financial costs and the opportunity costs associated with having children. These policies are increasingly targeted at working families; the growth in location-flexible working arrangements that have helped to decrease the opportunity costs of having children; and the selective international and domestic migration patterns that may have increased fertility directly in highly developed areas through the population composition, and indirectly through the effects on partner markets in the out-migration areas.

By analyzing data from 20 different European countries between 1990 and 2012, we were able to empirically explore the question of whether there are indeed indications of attenuation or even a turnaround in the relationship between fertility and economic development. For most of the countries surveyed, there seems to have been at the very least a weakening of the previously strong negative relationship between fertility and income at the regional level. However, the levels of fertility and economic development at which the association starts to change vary substantially across countries.

In a small number of countries, such as France and Austria, the cross-sectional correlations between income and fertility have already been positive in the early 1990s; while in many others, particularly in Eastern, Central, and Southern Europe, the correlation has rapidly become less negative. For half of the analyzed countries we even obtained a positive correlation by 2012. In longitudinal regression analyses in which we analyzed Eastern and Western European countries separately, the income level at which the association between income and fertility changes from negative to positive was consistently much lower in the east than in the west, but varied in both regions depending on the model specification. Thus, it is not possible to draw strong conclusions about any specific turning point. For Eastern Europe, the models generally suggest that a large number of countries are around or beyond the level at which increases in income are expected to increase fertility. In the west, the models consistently show a decline in the negative association between income and fertility, but depending on the model specification, only a few or none of the countries are at income levels at which the reversal is estimated to occur. Nevertheless, the results suggest that the negative association between income and fertility is declining.

An important contributor to the fall and rise of fertility in European countries in the period we have analyzed is fertility postponement, which first suppressed period fertility measures, and then boosted the period fertility measures as postponement slowed. It is unclear to what extent this pattern might explain the national-level reversal in the association between fertility and development. Our longitudinal analyses at the sub-national level turned out to be relatively robust to accounting for the tempo effect in fertility. Prior research has suggested that the fertility rebound in Eastern Europe is largely driven by postponement (e.g., Goldstein et al. 2009). However, the association between income and increasing fertility is not strongly dependent on whether or not we adjust for tempo effects in fertility: in both cases we observed that the association between income and fertility becomes positive at income levels that have already been achieved by several Eastern European countries. These findings do not need to be inconsistent, as it is fully possible that the national-level trends are largely driven by postponement, while within-country variation is influenced to a greater extent by other factors, of which income may be particularly important.

Although postponement is also important as an explanatory variable across Western European countries, the relationship between fertility and income, and its transition from a negative to a positive relationship, remains significant after attempts to control for the timing of fertility. We interpret this as evidence that supports the findings of Myrskylä et al. (2011) and of Luci-Greulich and Thévenon (2014). With a few exceptions, the relationship between fertility and income within Western European countries is either weakening or positive.

Data restrictions did not allow us to explore in our models whether the observed changes are indeed related to the processes we outlined in our theoretical considerations. However, among the Western European countries that currently have a positive or a slightly negative relationship, and that experienced the turnaround at relatively high fertility levels, are France, Belgium, Sweden, and Norway. These countries were among the forerunners in the introduction of family policies aimed at supporting parents in reconciling their family and career goals (PERFAR 2015). In Austria, on the other hand, we also find a positive relationship throughout the period, but at very low fertility levels. Existing research has attributed this distinctive pattern to selective international migration to the most developed region of Vienna (Zeman et al., 2010). Thus, the observed patterns seem to be consistent with the development trends outlined.

Data restrictions also prevented us from making fertility tempo adjustments by parity. This may distort the results, as the changes in the timing of first births are often different from those observed for all births or for higher order births. It is useful to speculate about how the story might change if we had regional data that would allow us to make parity-specific tempo adjustments, and whether such adjustments would enable us to explain away the reversal of the income-fertility association. A potential interpretation of such a hypothetical finding would be that increases in income trigger processes that slow down or halt fertility postponement. Such a finding would still be consistent with the main finding that the association between income and fertility is reversing at the regional level, and would enrich the finding by illustrating the mechanism. However, this possibility cannot be tested with the currently available data. Another restriction is that we only had access to income data which was measured at the place of work, while a measurement at the place of residence would have been preferable. This might create biases when big cities or metropolitan areas constitute own regions into which people commute into for work. However, bias introduced by this limitation would rather prevent us from identifying the convex relationship as high incomes generated in the most developed regions would be used for investments in children in less developed surrounding regions.

Our study focused on female fertility. It would also be promising to perform a similar study on male fertility, as many less-developed peripheral areas have unbalanced sex ratios among the inhabitants of childbearing age, with males dominating. Thus, the observed trend toward a positive relationship might even be stronger if male fertility were considered. Overall, our results suggest that a turnaround in the relationship between fertility and economic development might occur at the sub-national regional level in highly developed countries as well. This provides further evidence in support of the hypothesis that we are indeed currently witnessing significant shifts in how fertility and economic development are related.

6 References

Bathelt, Harald, Anders Malmberg, and Peter Maskell. 2004. “Clusters and knowledge: Local buzz, global pipelines and the process of knowledge creation,” *Progress in Human Geography* 28(1): 31–56.

Begall, Katia and Melinda Mills. 2011. “The impact of subjective work control, job strain and work-family conflict on fertility intentions: A European comparison,” *European Journal of Population* 27(4): 433–456.

Becker, Gary S. 1960. *An Economic Analysis of Fertility: Demographic and Economic Changes in Developed Countries*. Princeton: Princeton University Press.

Basten, Stuart, Johannes Huinink, and Sebastian Klüsener. 2011. “Spatial variation of sub-national fertility trends in Austria, Germany and Switzerland,” *Comparative Population Studies* 36(2-3): 573–614.

Beninger, Anna and Nancy M. Carter. 2013. *The Great Debate: Flexibility vs. Face Time: Busting the Myths Behind Flexible Work Arrangements*. Catalyst. Accessed 28 October 2015 at http://www.catalyst.org/system/files/the_great_debate_flexibility_vs_face_time.pdf.

Billari, Francesco C. and Gianpiero Dalla-Zuanna. 2011. “Is replacement migration actually taking place in low fertility countries?” *Genus* 67(3): 105–123.

Blythell, Duncan. 1993. “Women in the Workforce,” in *The Industrial Revolution and British Society*, ed. Patrick O’Brien and Roland Quinault, 31–53. Cambridge and New York: Cambridge University Press.

Bongaarts, John and Griffith Feeney. 1998. “On the quantum and tempo of fertility,” *Population and Development Review* 24(2): 271–291.

Bongaarts, John and Tomáš Sobotka. 2012. “A demographic explanation for the recent rise in fertility,” *Population and Development Review* 38(1): 83–120.

Caltabiano, Marcantonio, Maria Castiglioni, and Alessandro Rosina. 2009. “Lowest-low fertility: Signs of a recovery in Italy,” *Demographic Research* 21(23): 681–718.

Cleland, John G. and Christopher Wilson. 1987. “Demand theories of the fertility transition: An iconoclastic view,” *Population Studies* 41(1): 5–30.

Dart, Jon. 2006. “Home-based work and leisure spaces: Settee of work-station?” *Leisure Studies* 25(3): 313–328.

de Meester, Edith and Maarten van Ham. 2009. “Symmetry and asymmetry in working and commuting arrangements between partners in the Netherlands: Does the residential context matter?” *Environment and Planning A* 41(9): 2181-2200.

Dribe, Martin and Francesco Scalone. 2014. “Social class and net fertility before, during, and after the demographic transition: A micro-level analysis of Sweden 1880-1970,” *Demographic Research* 30(15): 429–464.

Esping-Andersen, Gøsta and Francesco C. Billari. 2015. “Re-theorizing family demographics,” *Population and Development Review* 41(1): 1–31.

FDZ [Forschungsdatenzentrum] der Statistischen Ämter des Bundes und der Länder. 2015. *Geburtenstatistik 1991-2010*. Wiesbaden: Statistisches Bundesamt.

Goldscheider, Frances, Eva Bernhardt, and Trude Lappegård. 2015. "The gender revolution: A framework for understanding changing family and demographic behavior," *Population and Development Review* 41(2): 207–239.

Goldstein, Joshua R. and Michaela Kreyenfeld. 2011. "Has East Germany overtaken West Germany? Recent trends in order-specific fertility," *Population and Development Review* 37(3): 453–472.

Goldstein, Joshua R. and Sebastian Klüsener. 2014. "Spatial analysis of the causes of fertility decline in Prussia," *Population and Development Review* 40(3): 497–525.

Goldstein, Joshua R., Tomáš Sobotka, and Aiva Jasilioniene. 2009. "The end of lowest low fertility?" *Population and Development Review* 35(4): 663–699.

Guinnane, Timothy W. 2011. "The historical fertility transition: A guide for economists," *Journal of Economic Literature* 49(3): 589–614.

Harttgen, Kenneth and Sebastian Vollmer 2014. "A reversal in the relationship of human development with fertility?" *Demography* 51(1): 173–184.

Hayford, Alison M. 1974. "The geography of women: An historical introduction," *Antipode* 6(2): 1–19.

Hopkins, Eric. 1994. *Childhood transformed: working-class children in nineteenth-century England*. Manchester: Manchester University Press.

Klüsener, Sebastian, Karel Neels, and Michaela Kreyenfeld. 2013. "Family policies and the Western European fertility divide: Insights from a natural experiment in Belgium," *Population and Development Review* 39(4): 587–610.

Klüsener, Sebastian, Francesco Scalone, and Martin Dribe. 2014. "Spatial vs. social distance in the diffusion of fertility decline: Evidence from Sweden 1880-1900," paper presented at the PAA 2014 in Boston.

Kocka, Jürgen. 1990. *Arbeitsverhältnisse und Arbeiterexistenzen: Grundlagen der Klassenbildung im 19. Jahrhundert.* Bonn: Dietz.

Lawson, David W. and Ruth Mace. 2011. "Parental investment and the optimization of human family size," *Philosophical Transactions of the Royal Society* 366: 333–343.

Lesthaeghe, Ron. 2010. "The unfolding story of the second demographic transition," *Population and Development Review* 36(2): 211–251.

Lipset, Seymour M., and Reinhard Bendix. 1991. *Social mobility in Industrial Society*. New Brunswick: Transaction Publishers.

Lorimer, Frank. 1945. "Issues of population policy," *The Annals of the American Academy of Political and Social Science* 237(1): 193–203.

Luci-Greulich, Angela, and Olivier Thévenon. 2014. "Does economic advancement 'cause' a re-increase in fertility? An empirical analysis for OECD countries (1960-2007)," *European Journal of Population* 30(2): 187–221.

Macours, Karen, and Johan F.M. Swinnen. 2008. "Rural-urban poverty differences in transition countries," *World Development* 36(11): 2170–2187.

Moderow, Hans-Martin. 2007. *Volksschule zwischen Staat und Kirche: das Beispiel Sachsen im 18. und 19. Jahrhundert*. Geschichte und Politik in Sachsen 25. Köln and Weimar: Böhlau Verlag.

Myrskylä, Mikko, Hans-Peter Kohler, and Francesco C. Billari 2009. "Advances in development reverse fertility declines," *Nature* 460: 741–743.

Myrskylä, Mikko, Hans-Peter Kohler, and Francesco C. Billari. 2011. "High development and fertility: Fertility at older reproductive ages and gender equality explain the positive link," MPIDR Working Paper WP 2011-017, revised November 2013.

Myrskylä, Mikko, Joshua R. Goldstein, and Yen-Hsin Alice Cheng. 2013. "New cohort fertility forecasts for the developed world: Rises, falls and reversals," *Population and Development Review* 39(1): 31–56.

Myrskylä, Mikko, and Joshua R. Goldstein. 2013. "Probabilistic forecasting using stochastic diffusion models, with applications to cohort processes of marriage and fertility," *Demography* 50(1): 237–260.

Oppenheim Mason, Karen. 1997. "Explaining fertility transitions," *Demography* 34(4): 443–454.

PERFAR. 2015. *Population Europe Resource Finder and Archive*. Berlin: Population Europe.

Potančoková, Michaela, Tomáš Sobotka, and Dimiter Philipov. 2008. "Estimating Tempo Effect and Adjusted TFR," in *Documentation to the European Demographic Datasheet 2008.* Vienna: Vienna Institute of Demography.

Schmertmann, Carl, Emilio Zagheni, Joshua R. Goldstein, and Mikko Myrskylä. 2014. "Bayesian forecasting of cohort fertility," *Journal of the American Statistical Association* 109(506): 500–513.

Skirbekk, Vegard. 2008. "Fertility trends by social status," *Demographic Research* 18 (5): 145–180.

Sobotka, Tomáš. 2003. "Re-emerging diversity: Rapid fertility changes in Central and Eastern Europe after the collapse of the communist regimes," *Population* 58(4-5): 451–486.

Stoop, Ineke, Jaak Billiet, Achim Koch, and Rory Fitzgerald. 2010. *Improving survey response: Lessons learned from the European Social Survey*. Chichester: John Wiley & Sons.

Watkins, Susan C. 1991. *From provinces into nations: Demographic integration in Western Europe, 1870-1960*. Princeton: Princeton University Press.

Wilson, Ben. 2013. "Disentangling the quantum and tempo of immigrant fertility," paper presented at the International Conference on Population Geographies in Groningen 25.6.-28.6.2013.

Zeman, Kryštof, Tomáš Sobotka, Richard Gisser, Maria Winkler-Dworak, and Wolfgang Lutz. 2010. *Geburtenbarometer Vienna: An overview report*. Vienna: Vienna Institute of Demography.

Figure 1a – Cross-sectional coefficients for Western European countries, North and West

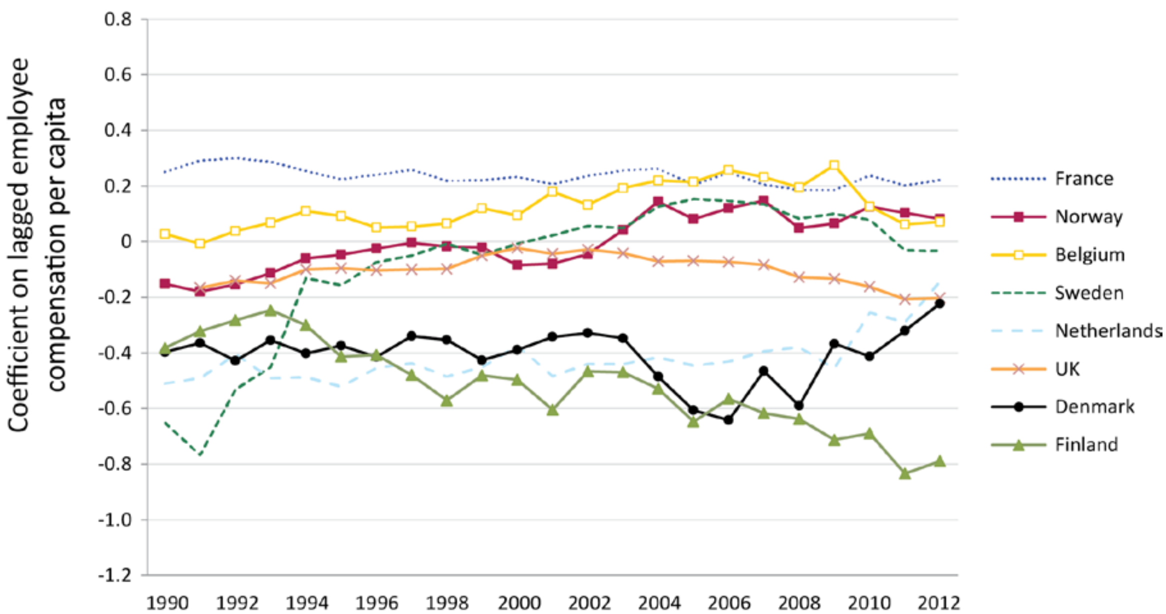
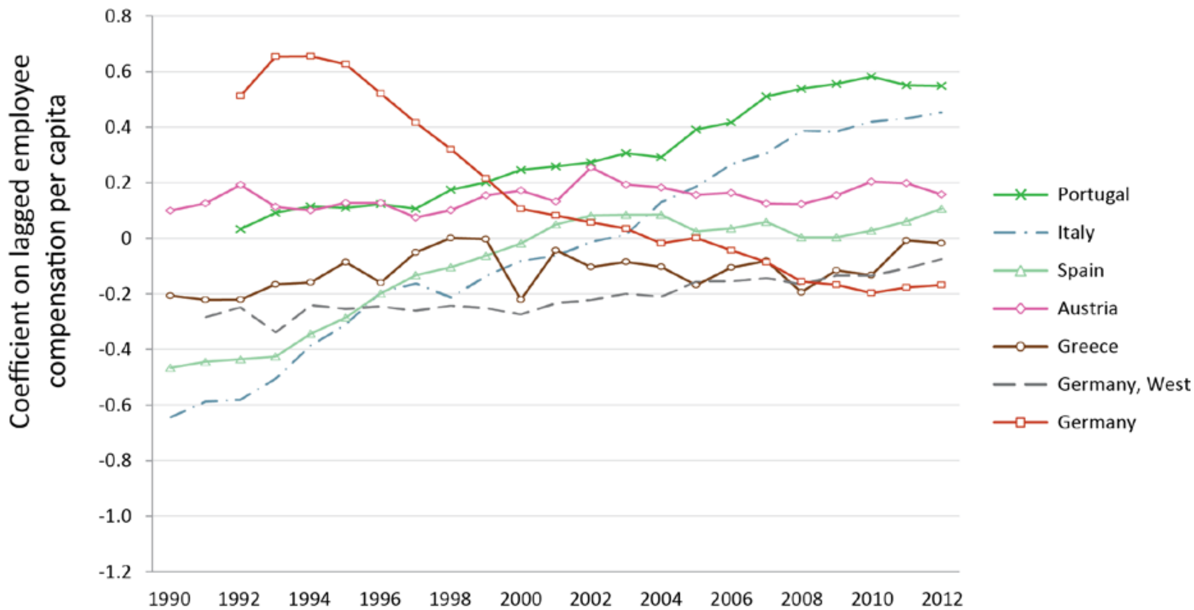
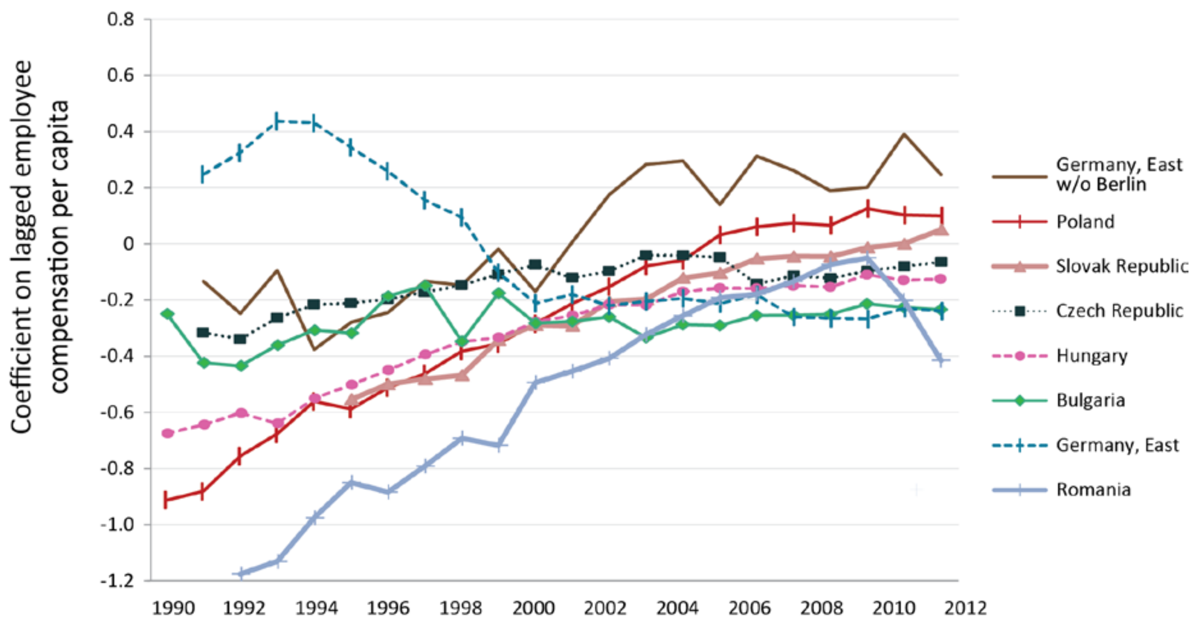


Figure 1b – Cross-sectional coefficients for Western European countries, Center and South



Notes: West Germany does not include West Berlin, which as part of the city of Berlin is included in East Germany presented in Figure 2

Figure 2 – Cross-sectional coefficients for Eastern European countries



Notes: East Germany includes West Berlin as part of the city of Berlin

Table 1 – Country list and summary statistics

Country	Regions	Regions used	Years	GDP per capita	Compensation per capita	Average TFR
	(1)	(2)	(3)	(4)	(5)	(6)
Austria	9	9	23	€ 24,487.32	€ 12,456.61	1.42
Belgium	11	11	23	€ 23,564.41	€ 10,627.23	1.71
Bulgaria	6	6	21	€ 2,622.27	€ 1,028.61	1.44
Czech Republic	8	8	21	€ 9,078.58	€ 3,727.56	1.35
Denmark	5	5	23	€ 31,206.40	€ 16,733.45	1.81
Finland	5	4	22	€ 22,001.40	€ 11,086.00	1.86
France	22	22	23	€ 21,397.92	€ 12,806.17	1.81
Germany, East	8	7	23	€ 17,751.04	€ 9,791.50	1.19
Germany, West	30	30	22	€ 26,249.12	€ 13,979.76	1.38
Greece	13	13	23	€ 13,447.50	€ 4,178.09	1.39
Hungary	7	7	21	€ 6,675.82	€ 3,087.56	1.43
Italy	21	21	23	€ 21,261.79	€ 8,999.68	1.29
Netherlands	12	12	23	€ 25,764.33	€ 12,762.68	1.71
Norway	7	7	23	€ 40,192.85	€ 18,588.07	1.87
Poland	16	16	21	€ 5,191.97	€ 2,012.18	1.47
Portugal	7	5	22	€ 11,992.39	€ 5,640.97	1.43
Romania	8	8	20	€ 3,358.05	€ 1,326.95	1.33
Slovak Republic	4	4	17	€ 7,430.96	€ 2,906.70	1.32
Spain	19	16	23	€ 17,025.08	€ 7,397.85	1.25
Sweden	8	8	23	€ 26,261.84	€ 14,552.26	1.81
United Kingdom	37	37	22	€ 23,414.15	€ 12,566.50	1.77

Notes: Finnish, Spanish, German, and Portuguese regions are excluded because they are non-mainland regions and/or are different culturally and politically. For Finland, these regions include the Åland islands; for Spain, the North African exclaves of Ceuta and Melilla and the Canary Islands in the Atlantic; for Germany, Berlin; and for Portugal, the Acores and Madeira, which also constitute island regions in the Atlantic.

Table 2 – Country-by-year fixed effects, Total Fertility Rate (TFR)

Dependent variable: TFR	Full sample	Western Europe	Eastern Europe
Independent variables	(1)	(2)	(3)
Prior year ln(compensation per capita)	-1.255	-0.884	-2.271
	(0.089)**	(0.224)**	(0.184)**
Prior year ln(compensation per capita) squared	0.064	0.044	0.129
	(0.005)**	(0.012)**	(0.011)**
Constant	7.675	5.957	11.230
	(0.403)**	(1.047)**	(0.745)
Inversion point	18,826.89 €	23,655.79 €	6,680.33 €
Regional Fixed Effects	N	N	N
Country-year interacted fixed effects	Y	Y	Y
Observations	5,703	4,522	1,181
Regions	256	200	56
Adj. R-squared	0.825	0.804	0.835

Notes:
Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1
Compensation is defined as the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period. This consists of wages and salaries, and of employers' social contributions.

Table 3 – Country-by-year fixed effects, Tempo-Adjusted TFR

Dependent variable: Estimated TFR*	Full sample	Western Europe	Eastern Europe
Independent variables	(1)	(2)	(3)
Prior year ln(compensation per capita)	-1.120 (0.097)**	-2.089 (0.2623)**	-1.754 (0.222)**
Prior year ln(compensation per capita) squared	0.059 (0.005)**	0.109 (0.014)**	0.102 (0.014)**
Constant	7.131 (0.451)**	11.755 (1.235)**	8.875 (0.885)**
Inversion point	13,074.76 €	14,288.60 €	5,324.44 €
Regional Fixed Effects	N	N	N
Country-year interacted fixed effects	Y	Y	Y
Observations	5,205	4,116	1,089
Regions	256	200	56
Adj. R-squared	0.769	0.762	0.764

Notes:
Robust standard errors in parentheses
** p<0.01, * p<0.05, + p<0.1
Compensation is defined as the total remuneration, in cash or in kind, payable by an employer to an employee in return for work done by the latter during the accounting period. This consists of wages and salaries, and of employers' social contributions.
Estimated TFR* is an estimated version of the tempo-adjusted total fertility rate based on the average age of childbearing.

Appendix 1 – Documentation of Demographic Data

The demographic data on the births by five-year age groups and the females by five-year age groups have mainly been obtained from the Eurostat web database (final datasets were last updated as of April 14, 2015 (population data) and April 29, 2015 (birth data). This table provides information on temporal coverage and on the alternative sources from which we obtained data to complement and correct the data that are available through Eurostat. For the documentation of the economic data from Cambridge Econometrics, see: http://www.eui.eu/Research/Library/ResearchGuides/Economics/Statistics/DataPortal/ERD.aspx		
Countries	Years	Notes
Austria	1990-2012	-
Belgium	1990-2012	-
Bulgaria	1990-2012	-
Czech Republic	1992-2012	-
Denmark	1990-2012	For the Danish NUTS 2 regions newly formed in 2007, Eurostat provides only population data dating back to 1990, and no birth data. These birth data have been derived based on municipality-level data from the Statbank of Statistics Denmark.
France	1990-2012	-
Finland	1990-2012	In the Eurostat data for the births in 1996 the age of the mother seems to have been derived based on a different standard than for the rest of the series. This was confirmed by a comparison of the data with time series data available in the StatFin database of Statistics Finland. Thus, we replaced the 1996 birth data with data directly obtained from the StatFin database.
Germany (West/East)	1991-2012	For the period 1991-1999, the data were derived from individual-level counts obtained from the birth register (FDZ 2015) since this allowed to gain information on the age of mother which is quite comparable with the standards in the Eurostat database. Birth register data are missing for the regions of Mecklenburg-Vorpommern between 1991 and 1994 and Saarland in 1991. In these cases we derived data from published statistics in which the age of the mother had been derived quite roughly by subtracting the

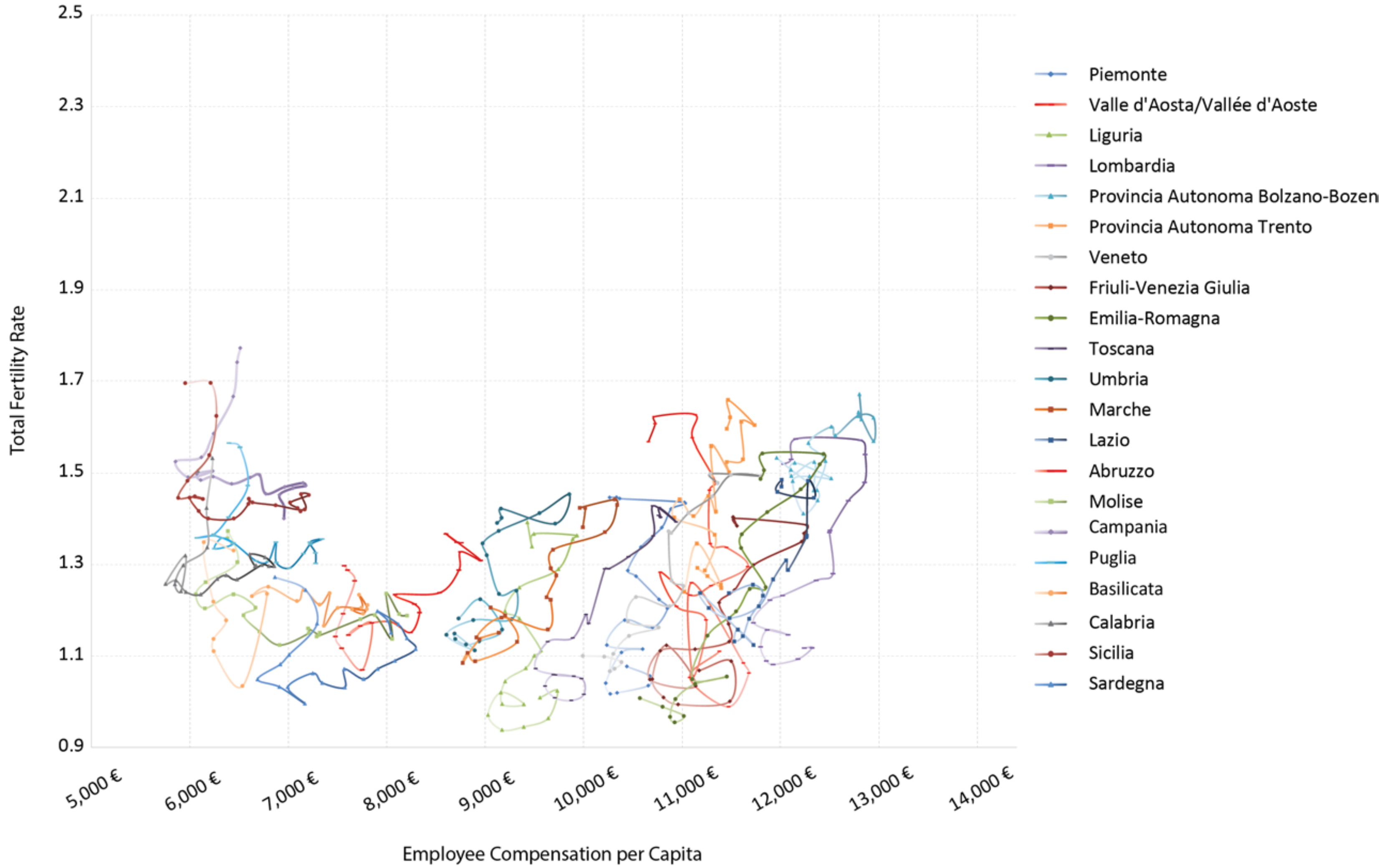
		birth year of the child from the birth year of the mother. Economic data from Cambridge Econometrics for the regions Chemnitz and Leipzig are based on an old regional classification where the district of Döbeln is included in Leipzig, not Chemnitz. As such we derived the demographic data based on this old set-up. However, for the years 2011 and 2012 we only were able to obtain fertility data for the new set-up. But this should not have an effect on our estimates as the regions Chemnitz and Leipzig had in this period very similar fertility trends and levels.
Greece	1990-2012	-
Hungary	1990-2012	-
Italy	1990-2012	Emilia Romagna and Marche exchanged seven municipalities in 2009 and as such Eurostat provides no time series before 2000. We were not able to reconstruct the data for the 1990s based on the current regional boundaries, but since the administrative reform affected only small parts of the population (less than 0.5% of that of Emilia Romagna and 1.2% of that of Marche), making a small change in the regional set-up of these two regions between 1999 and 2000 should not significantly affect any estimates. For the 1990s, we obtained the data for these two regions from a database by ISTAT, which provides regional fertility rates by single ages. For Lazio, the age-specific fertility rates derived from Eurostat for 1998 deviated strongly from the time trend and the initially published Italian statistics. Data for Lazio for 1998 were replaced by data from ISTAT.
The Netherlands	1990-2012	For the period 1990-2000 Eurostat does not provide regional data for the Netherlands. These data were derived directly from Statistics Netherlands.
Norway	1990-2012	-
Poland	1991-2012	-
Portugal	1990-2012	-

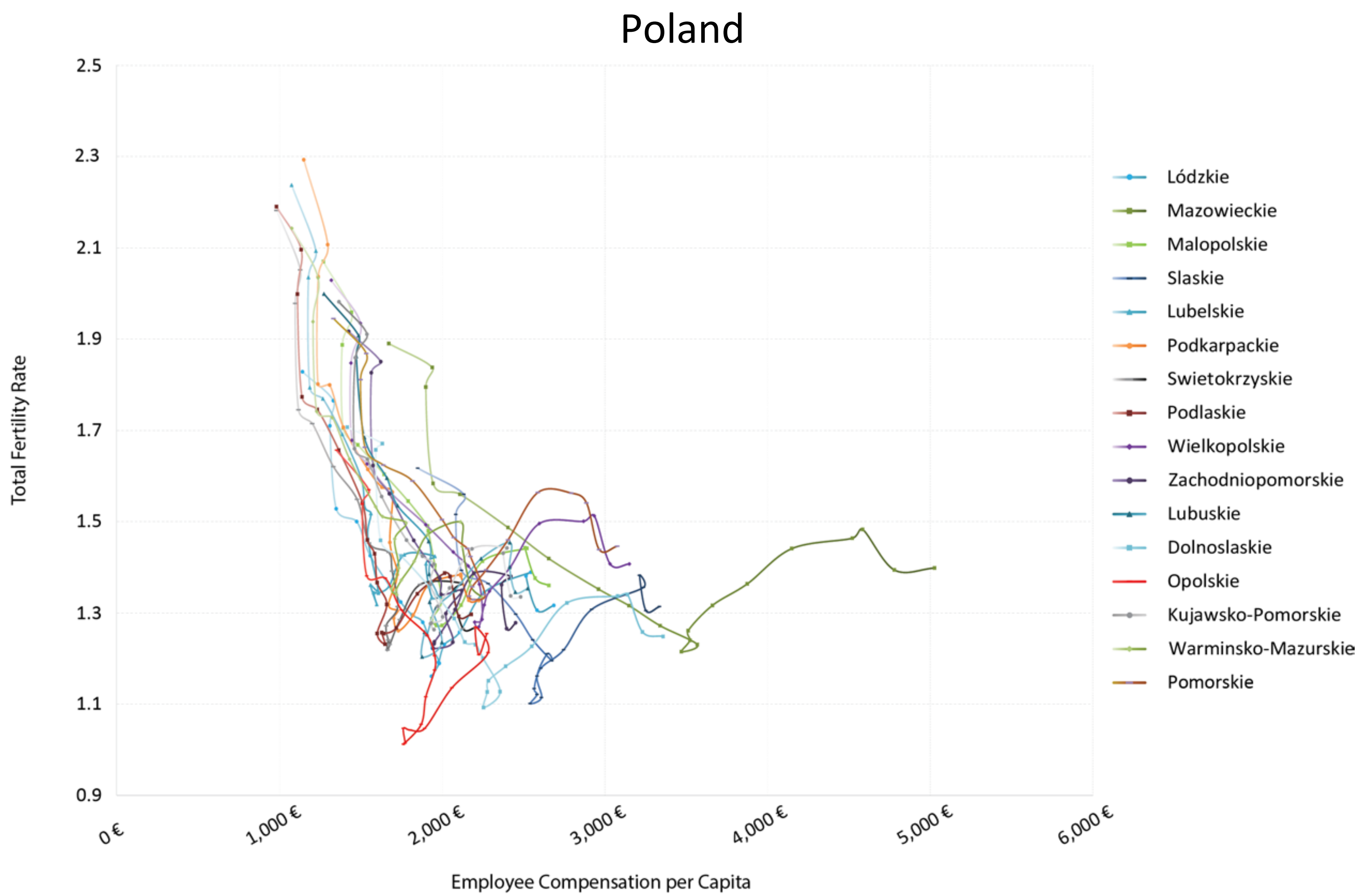
Romania	1993-2012	For the births in 1998, 2000, and 2010 the age of the mother seems to have been derived based on a different standard than for the rest of the series. This was confirmed by a comparison with the time series data available in the TEMPO Online database of Statistics Romania. Thus, we replaced the birth data for these three years with the data directly obtained from Statistics Romania. Eurostat only has regional data from 1997 onward, while the TEMPO Online database of Statistics Romania contains a series from 1993 onward which we included in the analysis.
Slovak Republic	1996-2012	-
Spain	1990-2012	-
Sweden	1990-2012	-
United Kingdom	1991-2012	Eurostat does not provide regional UK data prior to 2000. Data for the 1990s were derived from local population statistics obtained from the UK data archive. Economic data from Cambridge Econometrics for the regions Cheshire and Merseyside are based on an old regional classification where the city of Halton is included in Cheshire, not Merseyside. As such the demographic data are derived based on this set-up. For Scotland there is a break in the regional definition in 2000, and it was not possible to obtain data for the previous period based on the current regional division. The changes were a movement of the islands of North Ayrshire from the region Islands and Highlands to Southwest Scotland and a movement of Helensburgh and Lomond from Southwest Scotland to the Islands and Highlands. This procedure is followed for both the birth and the population counts. Among the two NUTS 2 regions in Wales, up to 1994 the births for a number of small hamlets and settlements are assigned to the wrong NUTS 2 region, while the population at risk is assigned correctly. This should

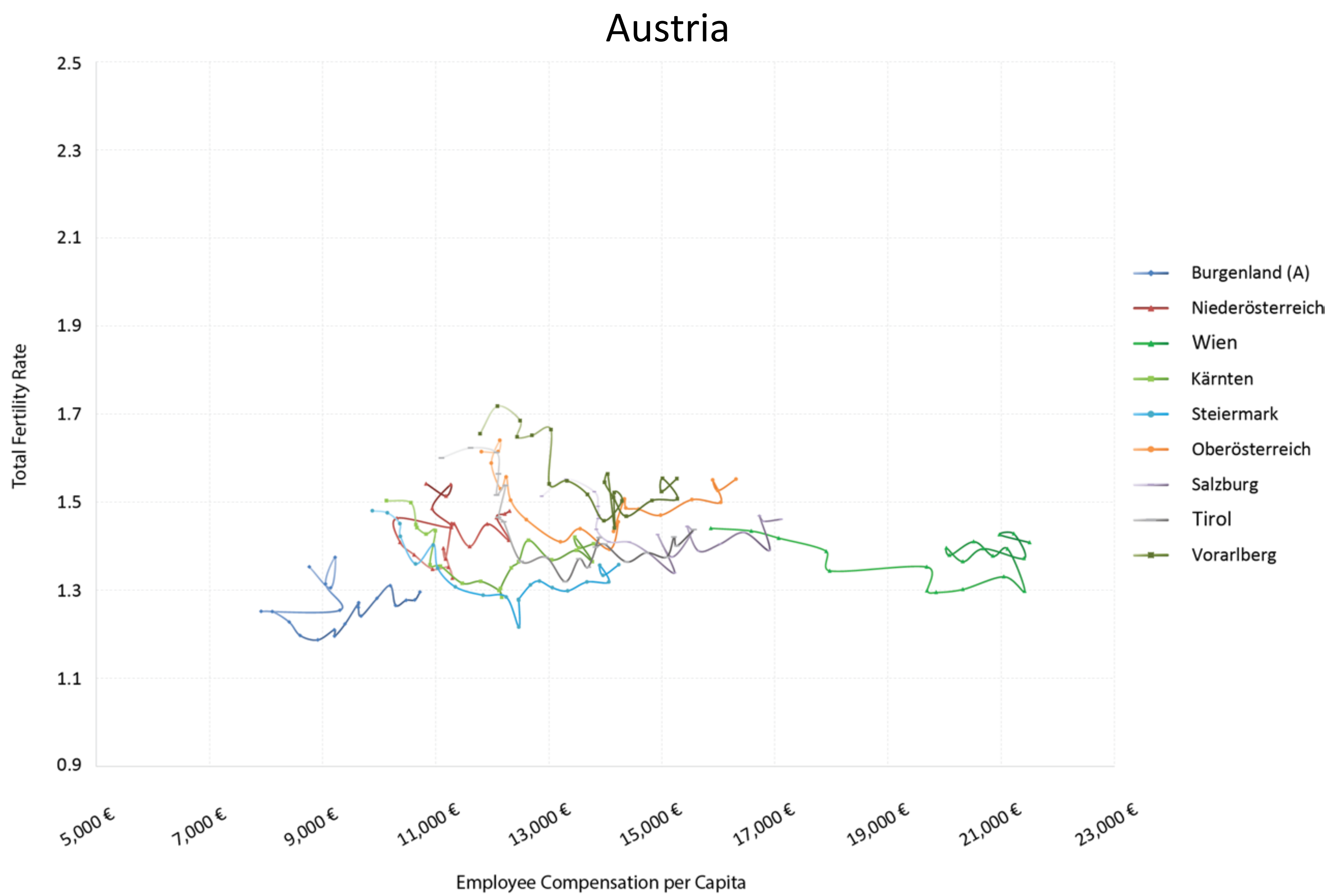
		nevertheless have minor effects as these hamlets are very small relative to the total population of the two NUTS regions of Wales.

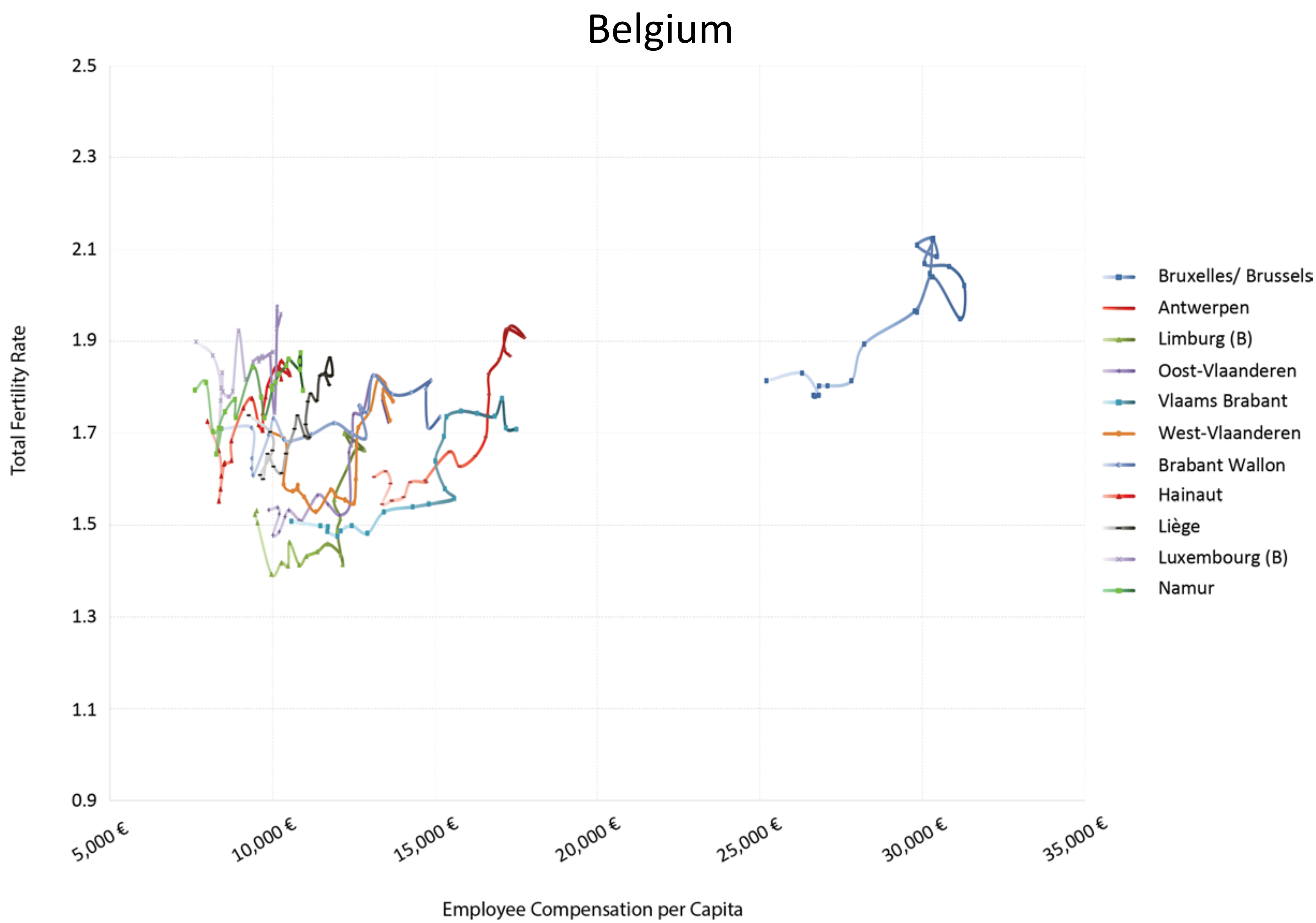
Appendix 2 – Regional trends in selected countries

Italy




Poland
Total Fertility Rate
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
0 €
1,000 €
2,000 €
3,000 €
4,000 €
5,000 €
6,000 €
Employee Compensation per Capita
Lódzkie
Mazowieckie
Malopolskie
Slaskie
Lubelskie
Podkarpackie
Swietokrzyskie
Podlaskie
Wielkopolskie
Zachodniopomorskie
Lubuskie
Dolnoslaskie
Opolskie
Kujawsko-Pomorskie
Warminsko-Mazurskie
Pomorskie


Austria
Total Fertility Rate
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
5,000 €
7,000 €
9,000 €
11,000 €
13,000 €
15,000 €
17,000 €
19,000 €
21,000 €
23,000 €
Employee Compensation per Capita
Burgenland (A)
Niederösterreich
Wien
Kärnten
Steiermark
Oberösterreich
Salzburg
Tirol
Vorarlberg



Belgium
Total Fertility Rate
2.5
2.3
2.1
1.9
1.7
1.5
1.3
1.1
0.9
5,000 €
10,000 €
15,000 €
20,000 €
25,000 €
30,000 €
35,000 €
Employee Compensation per Capita
Bruxelles/ Brussels
Antwerpen
Limburg (B)
Oost-Vlaanderen
Vlaams Brabant
West-Vlaanderen
Brabant Wallon
Hainaut
Liège
Luxembourg (B)
Namur