A Changing Relationship between Fertility and Economic Development at the Sub-national Regional Level? Theoretical Considerations and Empirical Evidence from 258 European regions

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Abstract

Recently presented evidence for nation states suggests that the long-standing negative relationship between socioeconomic development and fertility tends to turn positive at high levels of development. This article introduces the sub-national regional dimension to this debate. It focuses on Europe, which comprises a number of highly developed countries with comparatively high fertility rates. In the theoretical section, we revisit considerations how modernization processes in the 19th and 20th centuries led to a negative association between economic and fertility outcomes across sub-national regions of developed countries. This is followed by the discussion of important recent trends, which offer possible reasons underlying a potential reversal of the fertility-economic development relationship at the sub-national regional level. We then investigate empirically whether this convex relationship between regional fertility and economic development is detectable within European countries. Using a country-by-year fixed effects model, we find evidence for an inverse J-shaped relationship between fertility and per capita income occurring in nearly every country for which evidence exists in Europe. However, there does not seem to be a single inversion point general across areas. In addition, inclusion of regional fixed effects controls for much of the estimated convexity. This suggests that those factors controlled for by the regional fixed effects, but for which income per capita might be a proxy, are important in determining fertility differences across regions. These could include regional level differences in childcare policies, female labour force participation, culture, or other factors.

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

As the economic development of an area increases, the fertility of that area tends to decline. This had been an accepted demographic observation over most of the 20th century. However, this observation has been recently challenged. This began with the Myrskylä, Kohler, and Billari (2009) paper which indicated that at high levels of socioeconomic development, as measured by the Human Development Index, the relationship between development and fertility tends to change from negative to positive. Luci-Greulich and Thevenon (2014) analyse the association between GDP per capita and fertility and find a similar J-shaped association. Luci-Greulich and Thevenon attribute the new patterns in the fertility-development association to the changing relationship between female employment and fertility; Myrskylä et al. (2011) show that positive association is driven by older-age fertility and emerges only in counties with comparatively high gender equality.

This study is interested in whether this change in the association also emerges at the sub-national regional level. If so, this would imply that highly developed countries not only experience fertility increases, but that within these countries the most developed regions are taking the lead in these processes. Additionally, with most countries exhibiting relatively high levels of internal regional homogeneity in cultures and family policies, the presence or absence of an effect could shed light on whether it is income levels themselves which are important, or other aspects of highly developed areas related to income.[1] On the other hand, an absence of a positive regional-level relationship between fertility and income could indicate that it is not income per capita that drives fertility decline (or increase), but other potential factors such as female labour force participation, rising educational levels, greater degrees of urbanization, or other factors for which income per capita might serve as a proxy. Additionally, utilization of the regional perspective allows identification of the most developed regions of a country, as these might already be on an upward fertility trajectory while the national numbers still report a decline. Regional evidence on the potentially inverse J-shaped association between fertility and

[1] When we refer in this paper to income or per capita income, we refer to the regional Gross Domestic Product by capita. Limitations of this measure are discussed in the data section.

income could therefore deliver further support that at high levels of development, a substantive change is occurring in how fertility and economic development are related.

This paper has two primary goals. The first is to present theoretical considerations related to the association of fertility and economic trends at the subnational regional level and important processes that might have shaped this relationship over the last two centuries. We will show that in the 19th and 20th centuries a number of processes supported the emergence of a negative association between fertility and economic trends. We will then turn to a number of more recent development trends which might have the potential to contribute to a turn-around of this association to positive values. Our second aim is to explore empirically the potential reversal in the income-fertility relationship at the subnational regional level by analysing data from 21 European countries between 1990 and 2011.[2] We focus on Europe since prior evidence (Myrskylä et al. 2009; Myrskylä et al. 2011; Luci-Greulich and Thevenon 2014) has shown that most of the countries which have experienced the fertility-income relationship reversal are European countries. In addition, the quality of the European data and that it comes at the regional level allows us to control for those time-varying country, and time-constant region-level effects that can confound estimates of relationships.

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

2.1 Long-Term Development Trends

In this section we first discuss how a number of societal modernization processes of the 19th and 20th centuries fostered in Europe at the sub-national regional level a negative ecological association between economic development and fertility levels. We then turn to a number of rather recent trends that for Europe could potentially contribute to a reversal towards a positive relationship at the sub-national regional level. For these theoretical considerations it is

[2] These countries are Belgium, Bulgaria, Czech Republic, Denmark, Germany, Greece, Spain, France, Italy, Hungary, The Netherlands, Austria, Poland, Portugal, Romania, Slovak Republic, Finland, Sweden, Norway, and the United Kingdom. Countries part of Europe but which are omitted due having less than four NUTS-1-regions are Estonia, Croatia, Cyprus, Ireland, Latvia, Lithuania, Luxembourg, Malta, and Slovenia. Switzerland is also left out due to incomplete regional income information.

important to point out that in most countries we find across the sub-national regions a positive relationship between per capita income levels and the degree of urbanisation.[3] Thus, urban-rural or respectively centre-periphery differences will be of interest in our theoretical considerations as well.

Europe's distant past was likely generally characterized by a sort of Malthusian-cycle boom and bust, where increases in wages generated increases in fertility (Guinnane 2011). Starting around the early 1800s however, this relationship began to break down so that higher levels of income no longer translated to higher levels of fertility (Skirrbek 2008, Dribe and Scalone 2014). This was true both for urban and rural areas (Klüsener et al. 2013). From a variety of cultural, economic, and industrial reasons, a negative ecological association between economic development and fertility levels arose and persisted through the 20th century. However, the public and private provision of different services may be mitigating the costs and opportunity costs driving the negative relationship between fertility and income. For instance, increases in income and female labour force participation during industrialization increased the opportunity costs related to childbearing. But as additional income increases and further participation of females in the labour market led towards the expansion of policies related to childcare and work-family balance in countries, the strength of the negative relationship between income and fertility has perhaps been lessened.

Taking an economic perspective, the negative relationship between income and fertility documented through the 19th and 20th centuries is puzzling in that it suggests children are an inferior good. This puzzle was arguably theoretically solved with the recognition that potential parents face a trade-off in increasing the output of children, or the quality of those children. The quantity-quality framework for analysing fertility decisions, for which a formal approach

[3] Capital regions and centres of economic activity are commonly characterized by high degrees of urbanization, as access to political institutions and economic opportunities has made these regions attractive destinations for migrants over the last centuries. The only larger exception to this general observation are countries that comprise early industrialized areas whose focus had been on economic sectors which have lost relevance over the last 50 years (e.g. coal mining, steel industry). Examples constitute the German Ruhr Area, the English North-East, Central Belgium, Polish Upper Silesia and the Ukrainian Donbas.

began with Becker (1960), held that individuals and couples with better access to resources can invest in either the quantity of children or in their quality. Although there is limited evidence with regards to this quantity-quality trade-off in high fertility contexts, modernization has tended to intensify relationships between parental investment and child success, favouring quality over quantity (Lawson and Mace 2011).

The underlying mechanisms driving this change are varied and we discuss them only briefly. For a more detailed overview we refer the interested reader to Oppenheim Mason (1997), as well as Cleland and Wilson (1987) for a critique of economic explanations. When infant and child mortality risks are high, the chance of survival until adulthood, and thus the incentive to invest in any single offspring, is low. If a couple's goal is the propagation of their heritage or the guarantee of children to support them in their old age, a preferred strategy may be to invest in the quantity of children, thus increasing the probability that a sufficient number survive childhood. This strategy likely loses its preferred position when the chances that a child reaches adulthood approach 100%, a process on which parents can have some influence through observing hygienic rules and better nutrition. In such contexts, it might be rational to invest in the quality of children over quantity. This process can be enhanced by increased social mobility opportunities, which have mostly emerged in centres of economic activities (Lipset and Bendix 1991: 217). Given this, the move from investments in quantity to investments in quality is likely most present in highly developed areas. This potentially contributed to the negative association between economic development and fertility across sub-national regions of countries.

A related process was the rising costs and opportunity costs of children. Increases in housing and other living costs were usually characterized by a centre-periphery gradient with urban centres experiencing the highest increases. And the extension of schooling contributed to higher costs of children as it increased the time period in which children were dependent on the economic support of their parents. Here, rural areas were likely to be less affected, as summer school vacations were often scheduled in such a way that children could still help in harvest work. With the onset of industrialization, and opportunities for women to find work,

the opportunity costs of children were also increasing. According to the German census, in 1875, the workforce of the German textile and clothing factories was nearly half female (Kocka 1990). In Britain, these figures were about 40 percent (Blythell 1993). Increasing opportunities in the workforce and a limited availability of land led to both delays in the timing of marriage and a reduction of fertility within marriage (Guinnane 2011).

With the societal modernisation in the 19th and 20th centuries, Europe also witnessed substantial changes in the spatial organization of the economic sphere. These had particularly strong consequences for women and would-be mothers (Hayford 1974). In pre-modern societies, most individuals were engaged in economic activities near their place of residence. Peasants usually lived close to their fields, as proto-industrial types of work such as weaving or craftsmanship were often carried out in the context of the household. Industrialization and the expansion of the service sector created many employment opportunities in factories and commercial zones, which required employees to be away from home for a substantial part of the day. For women who traditionally played an important role in taking care of the offspring, taking up an economic activity outside home substantially limited the time resources available for children. This engagement in economic activities outside the household is likely positively related to growing economic gains available through such strategies. As was also the case for the quantity-quality trade-off, this was likely relatively stronger in urban areas. Rural areas likely experienced this spatial re-organisation of economic activities to a much lower degree and at a later stage (Dart 2006). These processes reduced investments in the quantity of children, particularly in the rapidly developing urban contexts, thus fostering a negative association between economic development and fertility levels at the sub-national regional level. It is therefore not surprising that urban, economic centres were leaders of the fertility decline, while peripheral areas followed with some delay (Basten et. al 2011; Klüsener and Goldstein 2013).

More recent developments may be contributing towards a lessening or reversal of this relationship between fertility and income. This inverse J-shaped relationship, which has been identified at the cross-country level, may also be present at the sub-national level. We consider

three main dimensions which may have contributed towards a lessening and perhaps positive turn of the fertility-income relationship. The first looks at the growth of European welfare states, both in their size and influence. Given this, these governments were able to target issues such as fertility through designed policy. This policy began as a sort of transfer payment system, but has since evolved to try to reduce the opportunity cost of time related to bearing children. The second looks at the issue of migration, both within and across countries. Selective migration over the course of generations has possibly affected human capital and partner markets in peripheral areas, thereby contributing towards lower fertility in these areas. And the arrival of foreign immigrants who often choose to settle down in highly developed areas has potentially bolstered the fertility rates in these areas, although this has been the case for long periods of time. Lastly, we consider whether changes in the spatial organization of the economic sphere and a greater allowance for working at home may contribute towards changing fertility patterns.

We base our analysis of the contribution of state regulation and welfare state support on the "regulation theory" as outlined by Baldwin et al. (2012) and the "Multiple Equilibrium Theory" described by Esping-Andersen et al. (2013). Parallel to rapid economic developments, the 19th and 20th centuries in Europe were also witness to the rise of the nation states (Watkins 1991). The governments of these nation states accumulated substantial resources through taxation, which could then be guided in the development of welfare support systems. Likely a result of their response to the numerous crises and the resulting ratchet effect of Big Government, these governments grew not only in their size, but also in their reach and influence regarding the lives of their residents. As many governments saw the sinking fertility rates as a development challenge, many implemented policies aimed at improving the situations for families with children (Lorimer 1945).

In the first part of the 20th century, these pro-family policies mostly focused on child benefits or tax deductions (Population and Policy Database 2014). Across regions within the same country, the real value of these lump-sum child benefits, which were imperfectly adjusted for cost-of-living, if at all, was likely highest for inhabitants of less developed areas. Thus, these

policies may have intensified the negative relationship between economic development and fertility levels within countries. However, over the last few decades, the focus of family policy reforms has shifted to extending parental leave schemes and (full-time) child care (PPD 2014). Rather than transfer payments, these instruments are aimed to decreasing the opportunity cost of childcare. These opportunity costs are particularly high for couples where both partners have acquired substantial human capital and have high earning capacities. The policies aimed at opportunity costs would then most affect fertility rates in regions with higher levels of income.

Related to parental leave is the access to childcare outside the home. Non-household childcare is a possible substitute for remaining at home, and the recent shifts in family policies towards assuring available childcare should disproportionately affect urban fertility. These policies allow dual-earner couples to have larger families without necessarily the time-tradeoff that would otherwise occur without such services. Policies present in Belgium are an example of this, as it is one of the leading countries in improving access to childcare and displays little differences in fertility by social status (Klüsener et al. 2013b). Additionally, Belgium has experienced a comparatively high cohort fertility of 1.9 for the cohorts born around 1960, despite being densely populated and highly developed. It is likely that the Belgian policy context plays an important role in this.

The second important trend is related to selective migration and developmental challenges in peripheral areas, which may also foster a positive association between income and fertility across sub-national regions. Innovations in agricultural production in the last 150 years substantially increased yields while reducing the labour required. As urban centres offered greater returns to skilled individuals, the rural-urban migration processes were likely to be characterised by selectivity in terms of human capital. The selective migration of highly skilled individuals has for many European countries been occurring for several generations. These long term selection effects might create development challenges in less-developed areas, with negative effects on available human capital, partner markets and fertility levels.

Migrant effects do not only exist in internal migration patterns, as international immigrants tend to settle in high developed areas as they usually offer the most opportunities.

This inflow of international migrants into urban areas can have important effects on fertility levels, particularly in low fertility contexts (Billari and Dalla-Zuanna 2011). Not only can these immigrant groups have different parity levels, but many migrants postpone fertility events until they reach their migration destination (Wilson 2013). Processes of selective migration and developmental challenges or peripheral regions are of particular relevance for low fertility contexts. If these processes contribute to a positive association between economic development and fertility, it might happen far below replacement level.

In addition to changes in public policy and the effects of internal and external migration, changes in the spatial organization of the economic sphere may also be contributing to alter the relationship between income and fertility. With the Internet and associated technologies, individuals are more able to work at home and create flexible working arrangements than in the periods before. Teleworking, flex-place, flex-time, or any other of the myriad different working arrangements helps to free employees from the obligation to be present at a regular work place for all their work hours. Just as industrialization changed the spatial organization of economic activities in the 19th and 20th centuries, technological advancements that allow more flexible working arrangements may be changing the spatial organization of economic activities in the 21st. In this process, work, at least to some extent, is coming home, and residential households are regaining importance as places for generating income through economic activities. Flexible working arrangements offer dual-career couples new options in combining child rearing obligations with career plans. This might also have positive effects on fertility decisions, as intentions seem to be influenced by the amount of subjective work control a person is able to achieve (Begall and Mills 2011). Although the share of employees able to make use of such flexible opportunities is in most countries still low, these opportunities are greater than previously.

The relationship between flexible work arrangements and urbanization is not completely clear, but should favour denser cities. An argument against could be that if employees obtain complete flexibility over the work place arrangements, weak location factors such as climate, environmental conditions or cultural richness of an area might gain relevance

for housing relocation decisions. These areas might not necessarily be the most developed ones. However, if jobs remain relatively location dependent, the density and economic centrality of places would still be important. In addition, as knowledge continues to grow in importance as an economic production factor, spatial proximity and resulting frequent direct social interaction will continue to be important (Bathelt et al. 2004). Thus, unless further technical developments allow individuals to interact through the Internet as they do in reality, many individuals will continue to benefit from economic centrality and agglomeration effects. We therefore expect populations in more urban and economically advanced areas to have higher gains from the emergence of flexibility in working options to invest in children.

Overall, it seems that a number of important development trends are occurring which might, in Europe, foster a situation in which highly developed economic areas offer better contextual opportunities for the decision to have a(nother) child compared to more peripheral areas. Certainly, the relationship of these development trends to fertility levels also depends on the social norms and culture prevailing among individuals living in these areas. But these can be subject to change, with social interaction and influence potentially playing an important role (Fent 2013). Related to this, many European areas are currently experiencing re-urbanisation processes after decades of suburbanisation (Haase et al. 2010). This might contribute to decreases in long-standing spatial segregations with low-childbearing populations being concentrated in the core cities and people with higher childbearing intentions situated in suburban contexts (Haase et al. 2010).

2.2 The "Noise" of Small Transitions within Big Transitions

The ideas outlined above are long-term transition processes operating in the dimension of decades or longer. However, next to these big developments there are relatively smaller transitions happening, which may challenge attempts to capture the effects of such long-term trends. Two smaller transitions relevant to this study are the postponement of births to higher ages and the transition processes in Eastern Europe as a result of the collapse of communism.

A central critique on research findings pointing to a turn-around in the relationship between period fertility rates and income is that the models are mostly capturing postponement effects. Period fertility rates can be for some time depressed as a result of females postponing their births to higher ages, and when fertility postponement slows down, period fertility may increase (Goldstein et al. 2009; Bongaarts and Sobotka 2013). However, recent evidence on cohort fertility suggests that at least a part of the fertility increases are not due to such a tempo-effect, but instead due to true increases in the quantum of fertility. Indeed, there are signs that cohort fertility rates are turning from a negative to a positive trend in high developed countries (Myrskylä et al. 2013; Schmertmann et al. 2014).

Related to the collapse of communism, our study covers the period from 1990 until 2011, which was for the Central Eastern and Eastern European societies a period of transition. This was often from a dictatorship and command economy to more democratic forms of government and more liberal economies. The economies of these countries entered this process with local companies often having limited competitiveness on global markets. The difficulty in competing with international imports, and the huge economic transition which followed, resulted in the former communist countries to experience economic crises of differing levels. This period of economic transition also had consequences for fertility behaviour (Sobotka 2003).

The transition affected urban and rural areas differently. In the initial period of the process, regions with higher levels of development often had no particular advantage over other areas. For countries affected most severely by the crises, urban areas were even worse off. Inhabitants in these areas lacked access to food while at the same time faced substantial increases in the cost of living (Macours and Swinnen 2008). Rural inhabitants in these countries could at least ensure access to basic essentials, so were able to better cope. However, the situation changed substantially as the transition progressed. Capital areas and urban centres with economic potential were a target of foreign investment and trade, and so were often the first regions to recover. Smaller or more rural areas experienced the return to growth much later. Thus, we might expect the most developed centres to be leaders in both the initial

fertility decline, as well as the eventual fertility recovery. Since the period 1990-2011 would primarily be capturing both these periods, it will be important to see if there is an indication of an initial dip and then a recovery for these areas. This could occur even if the development processes causing that pattern do not fit well into the more general societal transition discussed above.

3 Data

In order to investigate the regional relationship between income and fertility, we rely on data compiled by the Cambridge Econometrics data firm. This data was collected primarily from Eurostat, which annually provides official statistics for nearly every country part of the European Union. By using official statistical data, we limit ourselves to aggregate data and exclude a variety of potentially relevant information that could be had from survey data such as the Generations and Gender Survey or Understanding Britain. However, the statistical data chosen has the advantage of being broadly available for more countries, and less prone to selectivity, as surveys are usually faced by low and potentially selective response rates in big urban centres (Stoop 2012).

The countries in the dataset are divided into sub-national regions using the NUTS classification system of the European Union. This classification distinguishes three different geographic hierarchies based off of comparable population sizes, while taking existing administrative divisions into account whenever possible. NUTS-1 represents the largest, and represents regional divisions between 3 and 7 million persons. NUTS-2 offers a finer level of detail, as it separates areas into those with populations between 800,000 and 3 million. NUTS-3 offers the finest level of detail and represents areas between 150,000 and 800,000. This project utilizes the data available at the NUTS-2 level, as this is the lowest level of division as which the required fertility and economic data is available.[4]

[4] The NUTS system of classification does have its limitations, as it is neither clear-cut nor does it necessarily reflect long-standing administrative definitions within countries. For one example, in 2007 the population

Table 1 gives the set of countries to be used in the Section 4 analysis. This list does not represent the total number of countries for which data is available through Eurostat, as this project limits itself to those countries with at least four regions. We will be estimating the relationship between fertility, income, and income squared using the variation within countries, so at least three different regions are necessary for an estimate. This necessarily excludes countries with only a single NUTS-2 region (Cyprus, Estonia, Lithuania, Luxembourg, Latvia, Malta, and Slovenia). 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 of having at least four regions, but is not included as we were not able to obtain regional GDP trend data. The Column (1) of Table 1 gives the number of regions present for each of the other countries included, while the Column (2) displays the regions used from each of the different countries. Column (3) gives the number of years for which data is available for each of those regions.

Finland, Spain, and Portugal all have 1 or 2 regions that will be excluded as we proceed. The Swedish-speaking Aaland islands in Finland, Regio de Canarias and Ciudad Autonoma de Ceuta in Spain, and Regio Autonoma des Acores and Região Autónoma da Madeira in Portugal are all omitted since they are isolated regions with very small population sizes but granted NUTS-2 regional status due to their location or, in the case of the Finnish Aaland islands, their substantial autonomy. We chose to exclude them from the analysis since they were substantially different from the rest of the other regions within these countries. In addition, income information for Romania and Slovak Republic is not available prior to 1996 or 1997.

The columns (4) and (5) of Table 1 list the average per capita GDP and average compensation per capita for each of the different countries. We would like to emphasize that this is not average per capita income for, say, Belgium during this time period, but rather the average income across the Belgian regions during this time period. Per capita GDP is defined as Total Gross Value Added plus taxes less subsidies on products, and divided by the region's

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size of the 292 NUTS 2 regions (excluding Turkey) ranged from 26,923 to 11.6 million, with 24 percent of the regions having populations below the 800,000 threshold used to differentiate between NUTS 2 and NUTS 3 regions.

population. Compensation per capita is 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. Since the NUTS classification system attempts to balance population across areas, these per capita income averages should be close to the country-level averages. The income information for each of these areas was adjusted to 2005 Euros using GDP deflators from the OECD and World Bank.[5] The Russian and Ukrainian data were obtained from their national statistical offices and adjusted to euros using historical currency conversion rates from the European Central Bank and the World Bank. These nominal denominations were then adjusted to 2005 euros using country-level GDP deflators.

Combining the income averages with their and standard deviations (not shown) gives the well-known observation that there is not only great variation in per capita incomes across European countries, but also variation in the income dispersion within those countries. Countries such as the Netherlands and Sweden have coefficients of variation around about .2, while places such as Bulgaria have coefficients of variation closer to 1. For Bulgaria and Romania, these large coefficients of variation can be attributed to the inflationary period around 1997, while for places such as the United Kingdom (cov of about 0.42), it is more the case that there were persistent differences between the regions.

Column (6) presents the regional-level average of the total fertility rate for each of the different countries. There is also a large amount of variation in fertility rates across countries, but it is not immediately clear whether these regional averages between 1990 and 2011 suggest a positive, negative, or convex fertility-income relationship. They clearly show the low fertility rates for the eastern European areas (as well as the lower income levels present in these regions), but other than that do not show a clear relationship. This could, however, be due to their being averaged over a period of about 20 years. We will look closer at these aspects in the following section in which we present the models and results of the econometric analyses.

[5] Whenever possible, the GDP deflators from the OECD were used. Bulgaria, Romania, and Ukraine were not listed in the OECD datasets, and so their GDP deflators were obtained from the World Bank.

4 Econometric analyses

4.1 Cross-Sectional Comparisons

As a first step of analysis, we perform cross-sectional regressions on a by-country annual basis. Thus, for each year and for each country, we regress regional total fertility rates on the lag of adjusted regional employee compensation per capita. Since for most countries there are a total 22 years of data, we generally end up with 22 different cross-sectional correlations for the regional data. This allows tracking of the relationship between income and fertility for each of the different countries over two decades.

Figures 1 through 3 plot the country-specific cross-sectional correlations for countries part of Western Europe (North and West, Figure 1; Centre and South, Figure 2) and Eastern Europe (Figure 3).[6] Beginning with Figure 1, there is not a completely consistent fertility-income relationship from the regional correlations across Northern and Western European countries. Finland, the Netherlands, and Denmark exhibited a consistently negative relationship throughout the entirety of the study period. There appears to be a slight lessening of the negative relationship for the Netherlands and Denmark, however for Finland the relationship was stable. Belgium looked very much like these first three countries until about 1999, at which point the fertility income relationship became less and less negative, and eventually positive in 2008. France had a consistently positive relationship between fertility and income at the regional level. On average, those regions with higher per capita income were also those regions with higher rates of fertility. Sweden had a big change in the relationship during the early 1990s, resulting in a more positive relationship between income and fertility. This then gradually increased throughout the study period. In general, most of the countries in Figure 1 experienced positive change in their relationship between fertility and income. In 1991, only

[6] Those countries part of Western Europe include Belgium, Germany, Greece, Spain, France, Italy, Netherlands, Austria, Portugal, Sweden, the UK, Finland, Norway, and Denmark. Those part of Eastern Europe include Bulgaria, the Czech Republic, Hungary, Poland, Romania, and the Slovak Republic.

France was estimated with a positive coefficient, while by 2011 Sweden, Norway, and Belgium had joined it, and Denmark and the Netherlands seemed to be on their way there.

Figure 2 displays these relationships for countries in the centre and South of Europe. Two things jump out from this figure. The first of which is the big change in the fertility-income relationship for Germany, which became very positive and then gradually more negative. Limiting to only regions in West Germany, the picture is less dramatic, with a negative fertility-income relationship becoming gradually less negative. The second thing to jump out of the figure is the consistent pattern of a negative relationship between income and fertility becoming less negative, and for most countries, eventually positive. During the early 1990s, wealthy regions in Portugal, Italy, Spain, and Greece were all experiencing relatively lower fertility, but this had reversed by 2011. The only set of regions without a positive fertility-income relationship in the centre or South of Europe by 2011 was West Germany, and this area seems to be traveling in that direction. Austria was consistently positive throughout the study period.

For some of these countries, the probable mechanism contributing to these stable or changing relationships is relatively straightforward to parse out. In addition, across many, if not all of these countries, it is likely related to the costs and opportunity costs of child bearing faced by women participating in the labour market outlined in Section 2. The importance of these factors has in fact been identified by previous researchers in explaining the fertility reversal across countries (Myrskyla et. al 2009 and Luci-Greulich & Thevenon 2014). For example, the positive correlation between fertility and income identified during the 1990s for Germany as a whole is a result of the least developed regions being those that were formerly East Germany. These areas were affected by the economic post-communist transition crises and exhibited poor economic performance with high levels of unemployment, which in combination with postponement effects, resulted in very low fertility rates (Goldstein and Kreyenfeld 2011). As the income differences in the formerly East German regions became less stark, and as the opportunities for younger women expanded in these areas, fertility has begun to rebound. Also

better access to childcare in East compared to West Germany might have contributed to the East now exhibiting higher fertility levels (Goldstein and Kreyenfeld 2011).

Countries for which the wealthy regions are persistently the wealthiest, and continue to provide substantially greater opportunities for women of child-bearing age, would be more likely to show a more stable positive relationship in their correlations over time. Austria could be seen as an example of such a persistent and positive relationship. Peripheral rural regions such as Burgenland with relatively low levels of per capita income also had the lowest fertility rates during the period of our study. Although there was growth in per capita income across all of the different Austrian regions between 1990 and 2011 the relative differences in income between regions remained relatively constant. It is, however, relevant to point out that this positive income-fertility relationship is observed far below replacement levels. Calculations by Zeman (2010) also provide support for our theoretical argument that at these low fertility levels, regional variation in migrant share can play an important role. From Zeman (2010), migrants contributed in Vienna app. 0.3 to the Total Fertility Rate of the city while the net contribution in other regions than the capital city was just 0.12.

Taking Italy as a counter example, although the wealthiest regions in 1990 were also the wealthiest in 2011 (and likewise for the least developed), there was considerably more movement in the ordinal rankings during the 15 year time period. This might be related to the distinct demographic differences between the wealthier North and the Southern part of the country. Northern Italy experienced fertility decreases due to postponement effects earlier compared to Southern Italy, while more recently postponement effects seem to be particularly focused on the South. This may provide a clue as to why Italy seems to have experienced such a profound reversal in its income-fertility relationship. In addition, international migration being focused on Northern Italy might play a role.

Figure 3 presents the same information for Eastern Europe. Like those countries part of Central and Southern Europe, the Eastern European countries display a strikingly consistent relationship. For each of the different countries surveyed at the beginning of the panel, those regions which were on average wealthier also had significantly lower fertility rates. In the case

of Romania and Poland, this negative correlation between income and fertility was especially strong. For Romania in 1997, this correlation suggests an unrealistic relationship of a one percent decline in per capita GDP being associated with 1.04 increase of an area's TFR. This was largely driven by two regions. The capital region Bucurest-Ilfov in the South-East, and the region Nord-Est at the border of Moldova, had total fertility rates of about 0.9 and 1.7 and per capita income levels of about 4,300 € and 2,253 €, respectively. However, even after omitting these regions, a strong negative relationship remains. As was the case for all of the Eastern European countries surveyed, this negative relationship lessened throughout the 1990s and 2000s, so that by 2011 most of these countries had fertility-income correlations around zero. Poland and former East Germany are only former Eastern bloc areas to so far experience a positive relationship between income and fertility across its different regions. For Poland, this is possibly a result of the distinctive differences between Western and Northern Poland, and Southern and Eastern Poland; a story similar to that of Italy.

Taken as a whole, Figures 1 through 3 suggest that the relationship between income and fertility at the regional level is a country-specific relationship. Given that the Eastern European countries are all recovering from the legacies of Communism, and the fertility decline that followed the collapse of that system (Goldstein, Sobotka, and Jasilioniene 2009), the observed pattern is consistent with the role of smaller transitions affecting the observed trend pattern.

These figures also suggest there is a profound difference in the relationship between fertility and income within countries as compared to the relationship between fertility and income across countries. Focusing on Austria, if it is taken as a whole, it is country with low fertility and high per capita income. This is consistent with the narrative regarding negative-fertility income relationships. If we track this relationship over time, it is also consistent with the idea that this relationship is reversing at high levels of development. As per capita income levels for Austria have grown past about 28,000 euros per person, its TFR has begun to rebound (albeit at very low fertility levels).[7] However, comparing those regions within Austria, it has consistently been the case over the past 15 years that the wealthiest regions have also been

[7] See Basten et al. 2011 for a long-term view of regional fertility trends in Austria.

those with higher levels of fertility. Additionally, this relationship has appeared remarkably stable.

Relative to countries, regions are much less likely to differ in family policy legislation, access to birth control, and other factors traditionally identified as the mechanisms causing the fertility-income relationship across countries. Although regions can still differ in important and relevant ways, the differences at the country-level and relative similarities across regions within the same country perhaps explains the diversity of relationships evident in Figures 1 through 3.

4.2. Country-by-year fixed effects

Figures 1 through 3 display estimates from pooling regional data within the different countries, and present it on a country-by-country basis. Using a country-by-year fixed effects model, we can determine what the overall effect is for the set of Western European countries and for the set of Eastern European countries. Analysing the regional data with a country-by-year fixed effects model to determine the effect of income per capita on fertility at the country level essentially takes the annual estimate from each of the different countries in figures 1 through 3 and takes a weighted average of them to create an overall estimate of the relationship between fertility and income per capita.

Although the above description paints a basic model which assumes within-country regions are identical in those factors related to both fertility and income, it controls for potentially confounding unobserved effects at the country level. These can include factors such as family and child care policies, the level of female education or labour force participation, or tempo-effects in fertility. These can also differ at the regional level as well, however the extent to which they do will be much less than is case across countries. This is particularly true for Europe, as institutions that promote a work-family life balance and female educational enrolment are generally administered at the national level (PPD 2014). This panel model controls for country-level differences and country-specific period effects in fertility. These country-specific period effects are not just linear trends and account for period shocks that

could be driven by a recession or policies implemented at the national level. Within this model, a country's total fertility rate is considered a function of logged income per capita and its squared term. Depending on the specification, income per capita can mean either employee compensation per capita or per capita GDP.

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

In equation 1, $TFR_{t,c,r}$ is total fertility rate at time t, in country c, and in region r. The first term, $\chi_c * \lambda_t$, controls for the country-by-year fixed effects. Income per capita is represented by "*inc*" and appears in both the linear and squared terms. The error term $\varepsilon_{t,c,r}$ is assumed with conditional mean zero. We estimate this model separately for those countries part of Western Europe as well as for those countries part of Eastern Europe. These estimates are presented in Table 2, as well as the associated level of per capita income at which the results indicate any sort of a fertility reversal.

The results from Equation 1 indicate in point estimate form what was present visually in figures 1 through 3. From column 1, the estimates from the Western European countries indicate that at low levels of per capita income, there exists a negative relationship between per capita GDP and fertility, that this begins to lessen as per capita GDP increases, and that at about 34,000 2005 euros this relationship reverses into a positive one. This is generally consistent with the Myrskyla et. al (2009) and Luci-Greulich and Thevenon (2014) findings. For Eastern European countries, the story is generally the same, but with a lower level of per capita GDP associated with the point at which the income-fertility relationship starts to turn around.

The story changes slightly when using per capita employee compensation to measure income per capita. Although the inversion point for the Western European countries is similar, the coefficients are not statistically significant. For Eastern Europe, however, the relationship remains statistically significant.

4.3. Country-by-year and regional fixed effects

In this section, a regional fixed effect is added to equation 1 above. Equation 1 estimated the relationship between fertility and income by assuming regions within the same country were sufficiently similar. Adding a regional fixed to the analysis allows these areas to differ in additional characteristics related to fertility and income that do not differ over time. This may be important if populations differ significantly within countries. For instance, much has been made regarding the cultural differences between the Northern and Southern areas in Italy, and how these differences can explain the differences in income per capita in these areas. And in Germany, East and West Germany have a long history in exhibiting stark differences in family formation strategies which can be traced back over centuries and were further reinforced by the division into two countries between 1945 and 1990 (Klüsener and Goldstein 2014). This within-country variation in the persistence of the past could be the mechanism linking the fertility and income relationship identified in the previous sections. Levels of urbanisation, natural resource endowments, access to coastline or rivers, or the presence of major industry are some of the other ways in which regions within the same country can differ, and each of these different factors which have been clearly linked to economic development could also be related to the fertility of and other demographic characteristics of the population as well. Adding in a regional fixed effect controls for these and any other unobserved characteristics constant through time. Explicitly, the equation estimated is given as follows:

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

In equation (2), all of the variables are the same as in equation (1), but with the inclusion of the regional fixed effects term γ_r. Results from the estimation of equation (2) are given in Table 3.

The results from equation (1) suggested that, depending on how income was measured, areas in Western Europe exhibited a convex relationship between income and fertility. And areas in Eastern Europe demonstrated this convex relationship for both ways of measuring

income. With the inclusion of the regional fixed effect, although the coefficients for Eastern Europe remain statistically significant, the convexity of the relationship is diminished. Controlling for both the country-by-year fixed effects and the regional fixed effects results in a finding where at relatively low levels of per capita income, wealthier regions have higher levels of fertility.

5 Discussion

Recent work has already identified a likely reversal in the relationship between fertility and income across highly developed countries. In the theoretical considerations, we discussed a set of processes that could potentially contribute to a similar reversal at the regional level. Based off of cross-sectional correlations and fixed effects models, such a reversal at the regional level is discovered for most, but not all countries surveyed. Thus, with some exceptions, European countries are, at the regional level, also experiencing a lessening of the negative relationship between fertility and income so often described.

In the empirical sections, we used regional information on fertility and income per capita to estimate the relationship between the two. Figures 1 through 3 suggested there is a great deal of variation in this relationship across countries, which resulted in difficulty precisely identifying an overall effect for the Western European areas. There was a much more consistent story for those countries part of Eastern Europe. Those countries experienced a strong negative association between fertility and income which seemed often to become stronger in the early 1990s before it started lessening in the mid-1990s. Eventually, this lessened to the point where, in 2011, the relationship was either near zero or positive.

Once regional fixed effects were controlled for, the strength of the convexity of this relationship was diminished. We suspect that for those estimates in Section 4.3, the regional fixed effect controls for many of the mechanisms linking fertility decisions and income. This is going to take more work to determine more definitely, however.

Overall, the results found in Section 4 indicate that there is no single "fertility-income" relationship. Some Western European countries deviate from the reversal story. Austria and France had stable positive relationships, while Finland had a stable negative relationship. For some of these areas, we have a good understanding for why we see the relationships we do. For others, more work needs to be done for a fuller understanding. That the Eastern European countries show such a consistent relationship fits with our theoretical considerations. We attribute this to the common shock all of these areas experienced to the economies in the years just prior to the start of the panel, and the previously documented fertility crises there.

We do not find a completely consistent pattern for Western European countries, but it is nevertheless interesting to see that a large number of countries are exhibiting a positive GDP-fertility relationship that appears relatively stable over time. This includes Belgium, Sweden, and Austria, and Norway, and which may be explainable by the processes mentioned in the theoretical considerations. However, there are also a number of countries with strongly negative patterns which do not fit in the picture. These include Denmark, Finland, and the Netherlands; however the relationship for Denmark and the Netherlands shows signs of lessening. This suggests that country specificities have significant influence on this relationship, highlighted by the stark regional contrasts observed in Italy and Germany. Nevertheless, it is interesting to see the number of countries that exhibit a positive relationship has been growing over the last two decades, and that for countries in Western Europe, these constitute the clear majority.

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

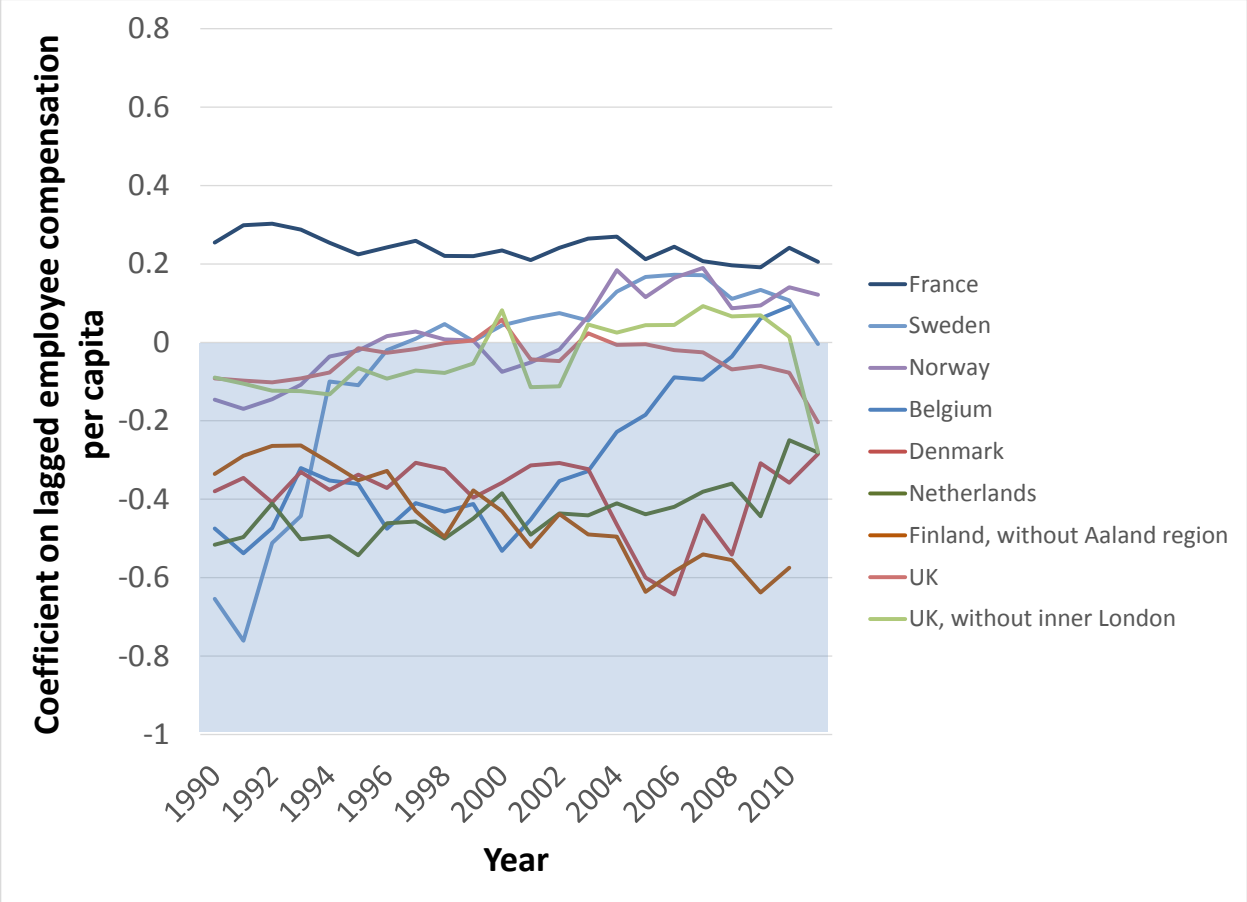

Figure 2 – Cross-sectional coefficients for Western European Countries, Center and South

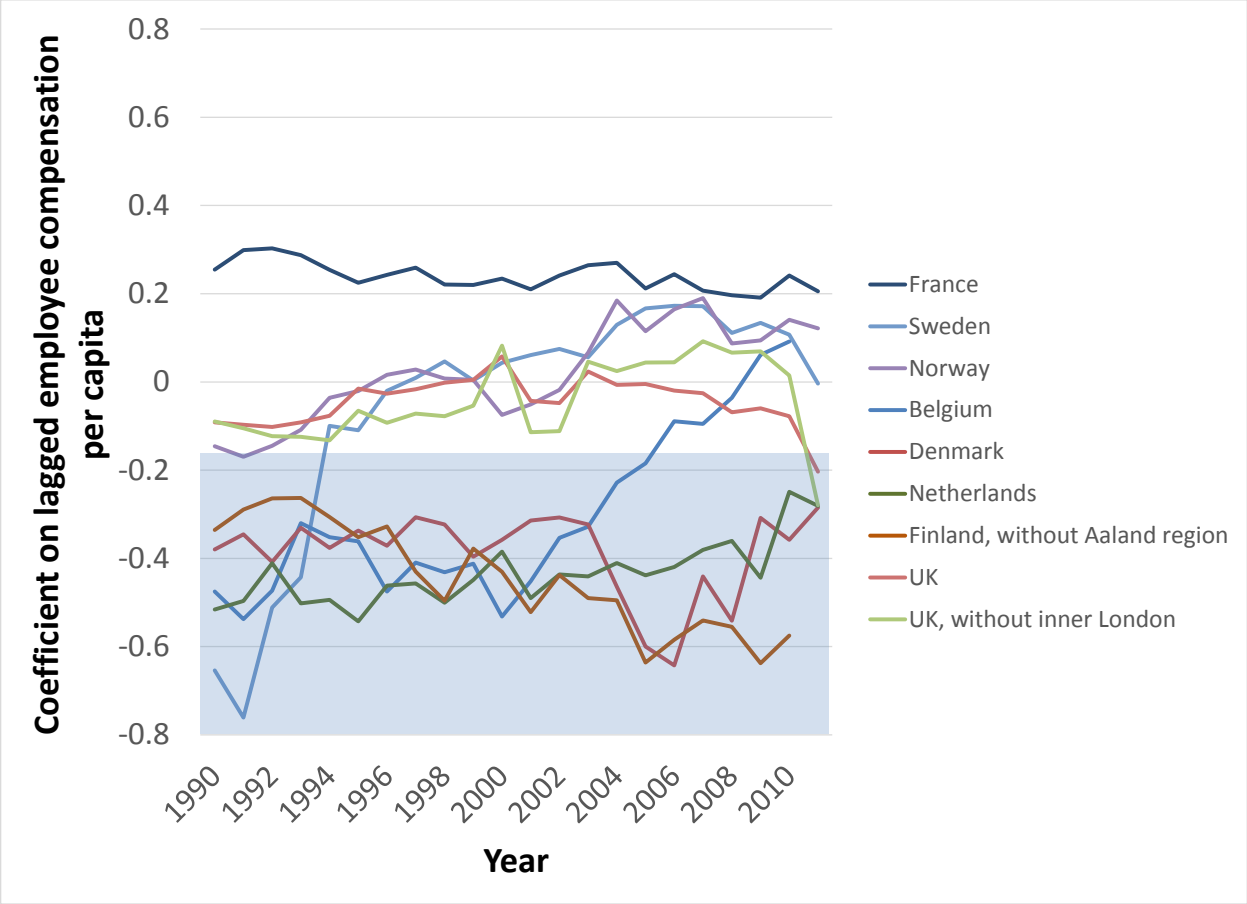

Figure 3 – Cross-sectional coefficients for Eastern European countries

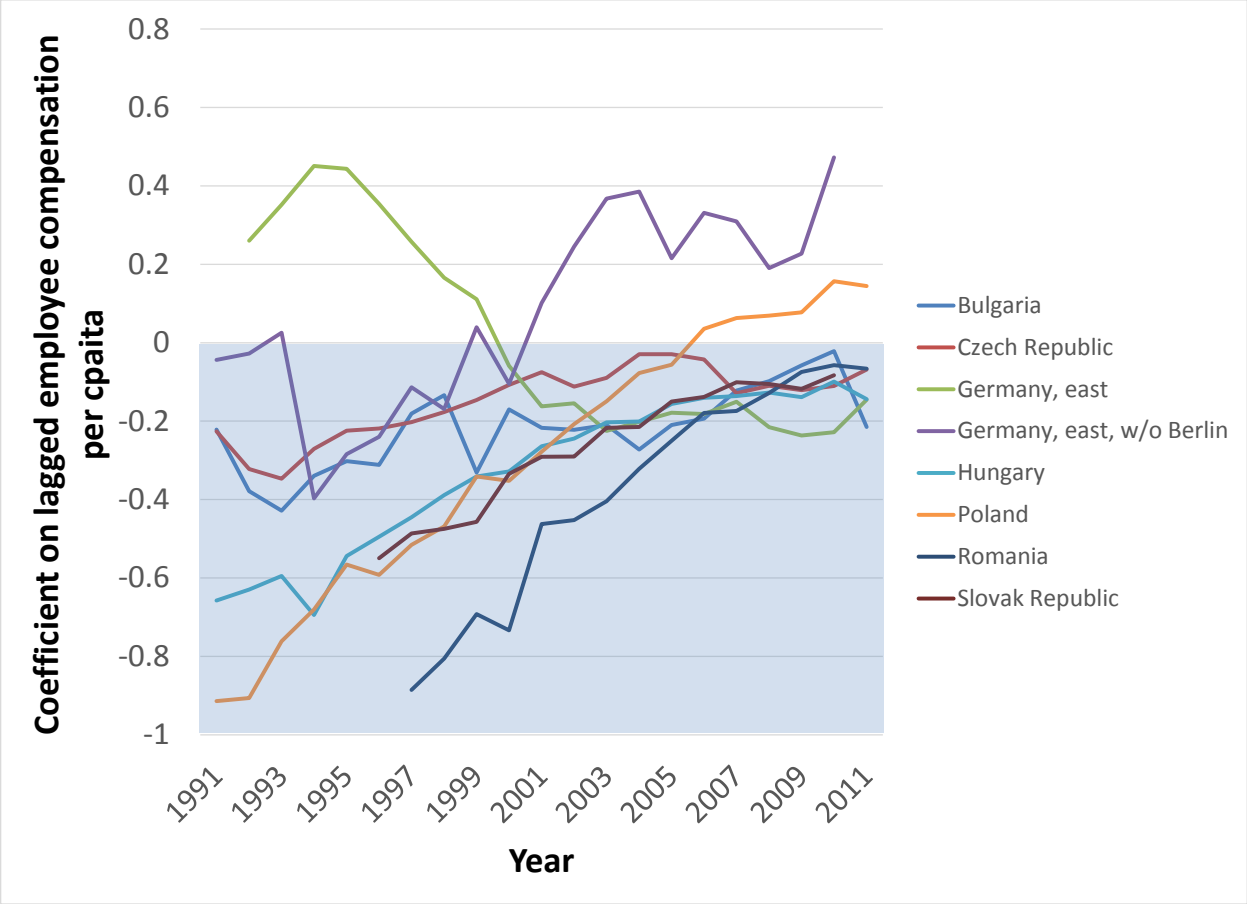

Table 1 – Country list and summary statistics

Country	Regions	Regions used	Years	GDP per capita	Compensation per capita	Average TFR
	(1)	(2)	(3)	(4)	(5)	(6)
Belgium	11	11	21	€ 23,564.41	€ 10,627.23	1.70
Bulgaria	6	6	22	€ 2,622.27	€ 1,028.61	1.39
Czech Republic	8	8	22	€ 9,078.58	€ 3,727.56	1.39
Denmark	5	5	22	€ 31,206.40	€ 16,733.45	1.81
West Germany	30	30	22	€ 26,249.12	€ 13,979.76	1.38
East Germany	8	8	22	€ 18,567.29	€ 10,285.10	1.17
Greece	13	13	22	€ 13,447.50	€ 4,178.09	1.41
Spain	19	17	22	€ 16,837.67	€ 7,402.84	1.29
France	22	22	22	€ 21,397.92	€ 12,806.17	1.80
Italy	21	21	22	€ 21,261.79	€ 8,999.68	1.27
Hungary	7	7	22	€ 6,675.82	€ 3,087.56	1.44
Netherlands	12	12	22	€ 25,764.33	€ 12,762.68	1.71
Austria	9	9	22	€ 24,487.32	€ 12,456.61	1.41
Poland	16	16	22	€ 5,191.97	€ 2,012.18	1.52
Portugal	7	5	22	€ 11,992.39	€ 5,640.97	1.45
Romania	8	8	15	€ 3,358.05	€ 1,326.95	1.28
Slovak Republic	4	4	15	€ 7,430.96	€ 2,906.70	1.28
Finland	5	4	21	€ 22,001.40	€ 11,086.00	1.87
Sweden	8	8	22	€ 26,261.84	€ 14,552.26	1.80
United Kingdom	37	37	22	€ 23,414.15	€ 12,566.50	1.78
Norway	7	7	22	€ 40,192.85	€ 18,588.07	1.88

Notes:

Two regions of Spain are excluded: Ciudad Autónoma de Melilla and Canarias

Two regions of Portugal are excluded: Regio Autonoma des Acores and Região Autónoma da Madeira (PT)

The region of Finland excluded is Aaland

The Finnish, Spanish, and Portuguese regions are excluded because they are non-mainland regions different culturally and politcally

Table 2 – Country-by-year fixed effects

Dependent variable: TFR	Western European Regions	Eastern European Regions	Western European Regions	Eastern European Regions
Variables	(1)	(3)	(3)	(4)
Prior year ln(RGDP)	0.923	-2.4191		
	(0.372)*	(0.2501)**		
Prior year ln(RGDP) squared	-0.044	0.1241		
	(0.0181)*	(0.0139)**		
Prior year ln(compensation			0.059	-1.668
per capita)			-0.233	(0.18909970)**
Prior year ln(compensation			-0.0028	0.0915
per capita) squared			-0.012	(0.0117)**
Constant	-2.907	13.120	1.508	8.895
	(1.914)	(1.1217)**	(1.128)	(0.763)**
Inversion point	34,237.54 €	17,091.85 €	38,140.74 €	9,060.95 €
Regional Fixed Effects	N	N	N	N
Country-year interacted fixed e	Y	Y	Y	Y
Observations	4,569	957	4,548	957
Regions	201	57	201	57
Adj. R-squared	0.753	0.808	0.754	0.803

Robust standard errors in parenthes

*** p<0.01, ** p<0.05, * p<0.1

RGDP refers to Real GDP, which is defined as the value added for productive activities, plus taxes and less subsidies on products

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 & region fixed effects

Dependent variable: TFR	Western European Regions	Eastern European Regions	Western European Regions	Eastern European Regions
Independent variables	(1)	(2)	(3)	(4)
`				
Prior year ln(RGDP per capita)	-0.157	-3.130		
	(1.599)	(0.9001)**		
Prior year ln(RGDP per capita)	0.028	0.191		
	(0.079)	(0.0513)**		
Prior year ln(compensation			-1.875	-2.087
per capita)			(1.218)	(0.7802)*
Prior year ln(compensation			0.119	0.148
per capita) squared			(0.067)+	(0.0479)**
Constant	0.35	14.13	8.77	8.90
	(8.097)	(3.96)**	(5.559)	(3.173)**
Inversion point	16.17 €	3,548.55 €	2,678.34 €	1,169.56 €
Regional Fixed Effects	Y	Y	Y	Y
Country-year interacted fixed effects	Y	Y	Y	Y
Observations	4,569	957	4,548	957
Regions	209	49	208	49
R-squared	0.649	0.949	0.641	0.944

Robust standard errors in parenthes

*** p<0.01, ** p<0.05, * p<0.1

RGDP refers to Real GDP, which is defined as the value added for productive activities, plus taxes and less subsidies on products

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.