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The Fertility Rebound: Evidence from 15 European Countries

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Contents

Abstract

The relation between population growth and income was intensively first examined by Thomas R. Malthus. Malthus argued that the standard of living has a positive effect on the growth rate of population. Since then, a lot of studies have endeavored to detect and explain the link between fertility and socio-economic development. Empirical studies suggest that economic growth, which experienced most of the European countries since 1960, is associated with declining fertility rates. The well-established negative association of fertility with economic and social development was questioned by the pioneer study of Myrskyla et al.(2009). In their influential work, the authors claim that advances in socio-economic development can reverse the fertility rates and thus the development-fertility relation becomes J-shaped. In this study, focusing on the wealthiest countries of Europe for the period 1960-2013, we demonstrate the reversal in the aforementioned relation and moreover we stress the role of the increasing old reproductive-age in the fertility rebound. We present evidence, by calculating the age specific rates (ASFRs) for the cohort ages between 15-29 and 30-49, that the older age drives the fertility rebound. We also examine the factors behind GDP per capita that are responsible for the observed fertility trends as well as the source of the observed non-linearity.

1. Introduction

"*Fertility has been a central topic of research within the discipline of demography, but has also achieved considerable interest within sociology, anthropology, economics, medicine and psychology*"[1].This statement indicates the complexity and arduousness of investigating the topic of human fertility. In this study, we exclude factors from other disciplines and we attempt an empirical analysis focusing strictly to the economic perspective.

In 1798, the English scholar Thomas R. Malthus published "An Essay on the Principle of Population" in which he expresses his view that economic advances lead to population growth. Indeed, as living standards rose, mortality fell due to improvements in food and sanitation, implying increase in life expectancy (decrease of mortality rate) and subsequently to population. In addition to this, fertility increased until the second half of the 19th century, reinforcing this increment to population growth. Nevertheless, this effect was temporary and Malthus seemed for a while right. In the next stage, as income continued to rise, fertility rates declined rapidly in Europe around the turn of the century. This transition, from high fertility and mortality rates to low, constitutes the phenomenon of the First Demographic Transition (FDT)[2], which occurred in Western countries from the 18th and 19th centuries onward and during the second half of the 20thcentury in much of the rest of the world.

The rapid increase of Total fertility rate (TFR) for most of the European countries after World War II, followed by a sharply reduce which produced several concerns at policy makers. In 2000, a total of 15 mostly advanced countries in Europe experienced a TFR below the replacement level[3] (roughly 1.6). These concerns have begun to attract in recent years greater attention. The ageing of population reduces the labor force and thus fewer and fewer workers will be available to produce the output that is consumed by all the individuals in the economy. Moreover, concerns rise with the "pay-as-you-go" pensions and social systems in general[4], as well as a worry about a decline in asset values when the elderly liquidate their assets to finance their consumption in old age[5]. Nevertheless, Ronald Lee et al. (2014) conclude that fertility below replacement level, even as low as 1.6 births per woman could imply higher standards of living.

In recent years, a reversal of fertility trends has been observed, which can be seen as a positive change, in the sense that increasing pace of population aging may attenuate. Myrskyla et al. (2009) find a relation between fertility and human development index (HDI) which can be represented by an inverse J-shaped curve. This finding implies that there is a threshold in HDI after which more advances in development can cause a reversal to fertility rates. Myrskyla et al. apply longitudinal data techniques for a sample of 37

[1]Billari et al. (2013).
[2]Lesthaeghe (2010).
[3] Replacement level: TFR=2.1.
[4]Gertler (1999), Bloom et al. (2007).
[5]Mankiw & Weil (1989).

countries from 1975 to 2005 and found that this reversal occurs when HDI is roughly 0.86. Furuoka (2009) criticizes the inverse J-shaped relationship between TFR and HDI by applying Hansen's threshold regression method. Furuoka splits his data according to HDI threshold, which he estimates at 0.777, and find no support to the reversal. Furthermore, Harttgen and Vollmer (2012) note some vulnerability to Myrksyla's et al. study. They indicate that data was largely constructed in favor of their hypothesis and using the new HDI revised by the United Nations Development Programme (UNDP) find little support that decreases in fertility rates link to improvements in development. In contrary, Greulich and Thevenon (2011) find an inverse J-shaped association between GDP per capita (major component of HDI) and fertility. In our empirical analysis, using GDP per capita, we also find support to the inversed J-shaped curve.

During the last decades, a postponement to mean age at first birth has occurred in the wealthiest countries of Europe. The mean age at first birth between nine advanced countries in Europe in 1960 was 28.02 and changed to 30.21 in 2009[6]. The postponement of childbearing has caused problems since TFR reduces as postponement increases indicating a false value. When the postponement comes to an end, TFR increases. This phenomenon has been suggested as a major factor of fertility rebound and Demographers have argued that the declines in TFR throughout the developed world is partly an artifact of cross sectional measurement when births are being delayed to older ages (Bongaarts, 2001). For this reason, many studies use the tempo adjusted fertility rate, which captures this postponement, or the cohort fertility rate (CFR) which represents the complete fertility as a cohort of women passed through their childbearing years. Hence, two major factors constitute human fertility measurement: tempo (the timing of birth) and quantum (the total number of children). Despite the problems that TFR introduces in empirical analysis, it remains the most commonly used measure of fertility[7].

But what causes the postponement of childbearing? Youth unemployment seems as a major constraint in family formation[8].Uncertainty which arises from unemployment postpones the decision for childbearing and childrearing until finding a better or more stable job. Evidences also indicate male unemployment as a more decisive reason for postponement than female. Another reason is associated with the education enrollment of women which has significantly increased in the last decades at the most developed European countries. Other causes that drive the fertility postponement are related with social factors (i.e. Rise of individualism).

[6]Result by own computation for a restricted sample. Countries: Austria, Finland, France, Germany, Iceland, Netherlands, Sweden, Switzerland, UK.
[7]Bongaarts&Fineey (1998).
[8]Letablier et al. (2013).

1.1 Fertility and Economic Development in Theory

Becker (1960) introduces the so called “new home economic theory”. Becker argues that there are two opposite effects which impact on fertility: the income and the substitution effect. These two effects collide each other and the final result is ambiguous. As income per capita rises, the costs for childrearing reduce implying an increase in the demand for children (income effect). On the other hand, a decrease in demand for children can occur when income per capita rises. This impact implemented by introducing the quality - quantity trade-off and the opportunity costs - which mainly women face. Initially, an increment in income per capita causes a rise in fertility, and then as income per capita continues to rise, households find it optimal to provide better education (quality) to their offsprings at the expense of their total number (quantity). This higher education leads to economic growth and returns of human capital continue to raise making investment on human capital attractive. Hence, households decide to have fewer but more educated children, causing a decrease on fertility. Becker named this mechanism as the quality - quantity trade off. Jones et al. (2008) indicate that advances in economic development also can cause a rise in education costs that make the quality - quantity effect stronger.

Another major factor that explains the declining fertility with advances in economic development is the opportunity cost of having children that women face in the process of economic growth. The opportunity cost derived from the increases of women’s wages which come from the educational achievements. Increasing earnings induce women to participate in the labor market and thus substitute work for children - especially in the absence of the appropriate family policies which allow combining work and family life. The loss of the wage when women decide to stay at home rearing their children is the so called opportunity cost. The higher the wage the more this cost arises. Day (2004) claims that this cost can be weakened by substituting parental care with purchased services. As economic development process continues, disposable income is high enough so that the above trade-off is no longer a constraint and fertility begins to rise once more. Consequently, in the long run, the relation between fertility and socio-economic development can be represented by an N-shaped curve[9].

1.2 Fertility and Economic Development in Empirical Analysis

Empirical research also endeavors to unveil and depict the truth relationship between fertility and development. Butz and Ward (1979) find pro-cyclical fertility rates until 1960s and countercyclical from 1960 to the late of 1970, as economic growth continued, implying an inverted U-shaped relationship. The authors predict that this countercyclical behavior would continue along economic growth. Mocan (1990) provides further evidence

[9]Varvarigos (2013) argues that the dynamics of fertility can be represented by an N-shaped curve.

of the countercyclical fertility patterns, but other studies propose different estimates that do not confirm the negative relation between fertility and economic development[10]

Family policy and its effect on fertility have drawn the attention of empirical analysis. Billari et al. (2013) applying logistic regression models for twenty European countries suggest that first order births are not so responsive to policy and environmental changes compared to higher order births. Luci and Thévenon (2011) argue that fertility trends are crucially dependent on family policy that allow women to combine work and family life, and indicate that fertility rates are substantially higher in countries where women have a larger access to the labor market. Moreover, Gauthier and Hatzius (1997) find a positive effect (limited magnitude) of cash benefits in the form of family allowances on fertility rates and Cohen et al. (2013) support that government policies which affect income should not be expected to have a meaningful impact on fertility.

Education is another broad channel through which economic development affects fertility. Becker et al. (2010) using a dataset of more than 330 county-level observations in Prussia in the mid-nineteenth century find a trade-off between quantity and quality which led to the main German demographic transition. The authors show that the education levels in 1849 are a strong predictor of the strength of the fertility transition for the time period 1880-1905 indicating a negative effect of education on fertility. In contrast, Testa (2014), applying ordinal regression models, suggests that the share of highly educated women in European countries is positively associated with women's lifetime fertility intentions. In addition to this, Moshe Hazan and Hosny Zoabi (2014) find a U-shaped relation between fertility and women's education in the USA for the time interval 2001-2011. Furthermore, Klaus Prettner (2012) applying longitudinal analysis for 118 countries for the time frame 1980-2005 in five year steps, finds that the quality-quantity trade-off represents a statistically significant and economically important force that mitigates the negative impact of demographic change. These results strengthen the idea that education is perhaps the main component of HDI that leads to the reverse of the fertility trends.

This study, using data that spans the period 1960-2013 and applying Longitudinal analysis as well as system GMM, attempts to find out the factor behind the GDP per capita, as well as the age cohort, which drives the fertility rebound. We decompose GDP per capita in its components and calculate the ASFRs. Afterwards, we split each component of GDP per capita into his male and female dimension, which allow us to assess and compare each gender's contribution to the reversal.

The study is constructed as follows: chapter 2 presents a part of the literature review summarized in tables, in chapter 3 we discuss about the data, in chapter 4 we reference to the methodology. The results and some comments from the empirical analysis are displayed in chapter 5, and finally, in chapter 6 we make a conclusion.

[10]McDonald (1983), Macunovich (1995).

2. Literature Review

In this chapter, we present a large part of the literature review concerning the topic of fertility and economic development. With some exceptions, most of the papers we present have been recently written. Moreover, due to the nature of our paper, which is an empirical analysis, we have mainly included empirical papers in our tables, although we make a reference to some theoretical.

We should recognize that the most influential paper is that of Myrskyla's et.al. (2009) who were the first to highlight the new association between socioeconomic development and fertility. Thereafter, a lot of papers have been written trying to get into more details and discover what hides behind this behavior.

For every paper, we display the title, the author of the paper, the methodology that has been adopted, the source of the data as well as the main conclusions. Apparently, at the theoretical papers we restrict our reference to the title, author and conclusions. This is an easy way for the reader to have a glimpse and better understanding of the past papers related to our topic.

Below, at the following tables we present the empirical and continue with the theoretical papers.

Empirical Papers

	Title	Author	Methodology	Data	Conclusions
(1)	Development and fertility in Brazil: Fertility reversion for more developed municipalities?	Salvato et al. [2013].	Hansen’s (2000) econometric methodology.	In this paper are downloaded data from the Demographic and Health Surveys, PNDS 2006 and Amorin and Bonifacio (2010).	The empirical findings support the hypothesis that higher human development (and economic development) is related to lower fertility levels. The results show no evidence to support the existence of an inverse J-shaped development-fertility.
(2)	Gender, time-use and fertility recovery in industrialized countries.	Manglano et al. [2014].	Plot analysis.	The data used for this paper come from the Multinational Time Use Study (MTUS 2012). They used time diary data from the past decades to explore fertility trends in eight industrialized countries.	This paper suggests that there is a threshold level of domestic gender equity that needs to be crossed to trigger a process of fertility recovery in industrialized nations.

	Title	Author	Methodology	Data	Conclusions
(3)	Labor market uncertainties for the young workforce in France and Germany: Implications for family formation and fertility.	Letablier, M.T. & Salles, A. [2011].	Plot analysis.	The data come from the European Community Household Panel(ECHP), OECD family data base (2011),Population policy acceptance study(PPAS), INED and INSEE, third wave of the European Social Survey(2006-2007), Max Planck Institute for Demographic Research, Rostock.	This paper suggests that both the macroeconomic data and the qualitative survey conducted in France and Germany reveal remarkable differences in the way that economic insecurity affects fertility intentions and realizations in the two countries. Despite high youth unemployment and a depressed economic climate in recent years, fertility in France is among the highest in Europe. By contrast, while the crisis in Germany was short-lived, and its youth unemployment rate is much lower than that of France, its total fertility rate is well below that of France and most other countries of Europe.
(4)	Revisiting demographic transition: Correlation and causation in the rate of development and fertility decline.	O'Sullivan, J. [2013].	Plot analysis.	The Data were taken from the UN Population Division (2011a), World Bank (2012) and Population Reference Bureau (2012).	The negative relationship between TFR and GDP p.c. tends to be concave for those countries that have achieved relatively low fertility. This indicates that population growth is an economic burden, and its alleviation stimulates development.

	Title	Author	Methodology	Data	Conclusions
(5)	On the positive correlation between education and fertility intentions in Europe: Individual and country level evidence.	Testa, M. R. [2014].	Ordinal Regression Models.	The data come from Eurobarometer surveys, Eurostat database, Labor Force Survey, OECD family database(2012), United Nation Development Program.	The analysis has revealed that the share of highly educated women in a European country is positively associated with women's lifetime fertility intentions.
(6)	Why demographic suicide? The puzzles of European fertility.	Pritchett, L. & Viarengo, M. [2013].	Plot analysis.	The data used, come from OECD family database 2011, Social Policy Division, Directorate of Employment, Labor and Social Affairs.	This paper concludes that as income expands from initially very low levels, people consume more calories; then as incomes increase further, food expenditures continue to rise but mostly by consuming a higher-quality bundle of food, which has a higher cost per calorie. At even higher levels of income, total calories consumed stop rising, and may even start falling, even as total expenditures on food continue to rise. So "food consumption" as measured in calories might fall even though food is a good thing, but "food expenditures" continue to rise because cost per calorie rises. In a similar manner, TFR might fall but demand for children—properly measured—is really rising with income.

	Title	Author	Methodology	Data	Conclusions
(7)	A reversal in the relationship of human development with fertility?	Harttgen, K. & Vollmer, S. [2012].	Panel data regression analysis.	A sample of 158 countries with five year data from 1980 to 2000 and annual data from 2000 to 2009.The data come from International Human Development Indicators database (UNDP 2011), TFR data were taken from World Development Indicators(WDI).	The analysis does not change the fact that we observe an increase in the TFR in developed countries in recent years. However we find little support in the data that this increase is causally linked with overall advances in development.
(8)	Demographic relevancy of increased use of assisted reproduction in European counties.	Burcin et al. [2014].	Plot analysis.	Available data on ART use in Europe has been collected by the European IVF monitoring (EIM) Consortium for the European Society of Human Reproduction and Embryology (ESHIRE). Total fertility rates have been collected by the Eurostat database.	In most countries the increase in the proportion of ART births was in relation to the increase in TFR. Findings for some European countries suggest that increased ART use may have a demographic relevancy when women take advantage of it earlier than later in life.
(9)	Recent rises in cohort fertility in the industrialized world: Using Bayesian Methods to extrapolate trends while preserving cohort features.	Goldstein et al. [2010].	The methods used are the extrapolatory trend method and the parametric methods.	This analysis relies mainly on data from Eurostat and national statistical agencies.	In this paper, findings suggest that cohort fertility has stopped its long-term secular decline in the majority of low fertility countries around the world. In some cases, there is a clear suggestion of increase.

	Title	Author	Methodology	Data	Conclusions
(10)	The importance of economic development related to fertility in OECD countries.	Luci, A. & Thévenon, O. [2010].	System GMM, instrumental variables (IV), fixed effects model (FE).	The data come from the OECD data sets.	The estimates suggest that total fertility rate reach their low point at 1.56 children per woman. The rebound occurs at GDP p.c. levels of around 34000 US $ (in PPP). This finding is robust even when controlling for the postponement of birth.
(11)	Looking for a J-shaped development fertility relationship: Do advances in development really reverse fertility declines?	Furuoka, F. [2009].	Threshold regression analysis.	The data used are from United Nations Development Program's Human Development Report (UNDP-2009).	This paper concludes that in the group of countries with a relatively high human development index, higher HDI level tended to be associated with lower fertility rates, albeit the relationship was weak.
(12)	The end of "Lowest-Low" Fertility?	Goldstein et al. [2009].	Panel data regression analysis.	Tsimbos (2008) for Greece, ISTAT (2009b) for Italy, and author's computations based on INE (2009a and 2009b) for Spain, labor force survey data.	This article suggests that the widespread decline of TFRs to very low levels that began in many parts of Europe and East Asia in the early 1990s is nearly over, at least in Europe.

	Title	Author	Methodology	Data	Conclusions
(13)	Changing fertility rates in developed countries. The impact of labor market institutions.	Adsera, A. [2004].	Panel regression analysis.	OECD labor force statistics, OECD Social Expenditure Database, World Bank economic indicators, International Labor Organization, Barro-Lee data set, United Nations database.	Using a panel of 23 OECD nations for the last 35 years, this study has shown that the flexibility of the market to accommodate women's exit and entry decisions and the penalty that particular market arrangements impose on truncated careers -through forgone experience, delayed wage growth and increased risk of unemployment- are key to explaining those trends. Further, the structure of the labor market affects not only the size of the opportunity cost of child bearing but also how it varies with age at childbirth and labor market attachment.
(14)	The unfolding Story of the second demographic transition.	Lesthaeghe, R. [2010].	Plot analysis.	European fertility and family surveys (FFS), European Values Studies (EVS) and CIA data base.	This study supports that it will remain difficult to separate the effects of structural factors and ideational factors on marriage postponement and low fertility. Nevertheless, it is widely acknowledged that mass media are producing a "world culture" in which individual autonomy and self-actualization have a prominent, if not dominant place, and that these provide both motivations and justifications for the onset of the SDT. Political, religious, and ideological backlashes are of course always possible (e.g., Christian and Muslim fundamentalist reactions), but to this point such reactions have not been sufficient to cause a decisive retreat from SDT values in countries with democratic governance.

	Title	Author	Methodology	Data	Conclusions
(15)	Revising the proximate determinants of fertility framework: What have we learned in the past 20 years?	Stover, J. [1998].	Plot analysis.	Data collected by the DHS and WFS database.	New definitions should be used in the three following cases: (1) When a considerable amount of sexual activity takes place outside of marriage. In this case, a substantial amount of childbearing occurs outside of marriage and the revised definitions will be needed to account for it. (2) When the prevalence of sexually transmitted diseases is high. In this case, the revised definition of infecundity will be required to correctly assess the effect of temporary or secondary sterility on fertility. (3) When a considerable proportion of men or women have chosen to be sterilized.
(16)	Does economic development explain the fertility rebound in OECD countries?	Luci, A. & Thévenon, O. [2011].	Plot analysis.	OECD family database.	This article notes that TFR has increased much more quickly in countries with encourage women's labor market participation, and the opportunity to reconcile work and family rebound in a context of high female employment.

	Title	Author	Methodology	Data	Conclusions
(17)	New cohort fertility forecasts for the developed world.	Goldstein et al. [2012].	This paper uses a new method which is based on limited extrapolation of age specific trends and allows the age specific trend observed over the last 5 years to continue for another 5 years.	The data come from the HFD database, Eurostat database, World Economic Forum, World Bank, United Nations Development indicators database.	The evaluation of forecast uncertainty suggested that it is relatively small, with an average expected forecast error of less than +/-0.03 children per woman for the 1975 cohort, and less than +/-0.06 children for the 1979 cohort. Income p.c. and general human development index were both positively correlated with cohort fertility.
(18)	Do highly educated women choose smaller families?	Hazan, M. & Zoabi, H.[2014].	This paper uses the hybrid fertility rate in order to circumvent the problem which arises from the relationship between total fertility rate and educational attainment.	American Community Survey, U.S. Census, American Time Use Survey.	This article presents new evidence that between 2001 and 2011, the cross sectional relationship between fertility and women's education in the U.S.A is U-shaped.
(19)	The impact of family policy and packages on fertility trends in developed countries.	Luci, A. & Thévenon, O. [2011].	Pooled Ordinary Least Squares (OLS) regression, 2SLS, GMM estimation, FE model estimation.	OECD family database.	Overall, the results of this paper confirm that fertility trends depend crucially on the opportunities for mothers to combine work and family life. Family policy packages appear as important factors to explain why fertility rates are currently and sustainably higher in countries where women have a larger access to the labor market. The different policy instruments (paid leave, childcare services and financial transfers) are found to have a cumulative influence, suggesting that a continuum of support for working parents during early childhood is likely to facilitate parents' choice to have children.

	Title	Author	Methodology	Data	Conclusions
(20)	More schooling, more children, compulsory schooling reforms and fertility in Europe.	Winter-Ebmer et al. [2011].	Panel Data, 2SLS.	The data come from the Survey on Health, Ageing and Retirement in Europe and the English Longitudinal Study of Ageing, Human life table Databases.	This paper presents evidence that additional schooling leads to i) a higher probability to get married, ii) a lower divorce/separation rate and iii) a potential partner who is better educated and, thus, more inclined to have (or approve of) children himself.
(21)	Policies, Institutions and fertility rates: a Panel Data analysis for OECD countries.	D' Addio, A. C. & Mira d'Ecole, M. [2005].	Panel Data analysis.	In this paper, the data which were used come from different waves of the World Values Survey.	The results of the regression analysis, which makes use of longitudinal data for 16 OECD countries and different econometric approaches to verify the robustness of the key results, confirms that a range of policies influence childbearing decisions. These include transfers to families that reduce the direct cost of children, as well as provisions that allow mothers to better reconcile their family and career responsibilities.
(22)	Does welfare reform affect fertility? Evidence from the U.K.	Brewer et al. [2010].	Panel Data analysis.	The Data come from the Family Resources Survey (FRS) and Family Expenditure Survey (FES).	They also find evidence of an increase in births coinciding with the reforms among the group most affected, adding to the existing literature that fertility responds to financial incentives. Finally, they confirm previous findings that effects vary by birth order; the authors find a bigger response for first births than for subsequent births.

	Title	Author	Methodology	Data	Conclusions
(23)	China's Below-Replacement Fertility: Recent Trends and Future Prospects.	Hayford et al. [2009].	Poisson Regression.	State Family Planning Commission (SFPC) of the Chinese government: the 1997 National Population and Reproductive Health Survey (NPRHS) and the 2001 National Family Planning and Reproductive Health Survey (NFPRHS).	The total fertility rate is in the range of 1.4 to 1.6, and our adjustments for fertility postponement suggest that completed fertility for cohorts now in their childbearing years will be roughly 10–15 percent higher than these estimates imply. Continued socioeconomic development is likely to play an increasingly important role both in reducing fertility intentions in China and in reducing achieved fertility relative to intentions.
(24)	Family benefits and fertility: An econometric analysis.	Gauthier, A.H. & Hatzius, J.[1997].	First-difference GMM estimator.	OECD, Commission of the European Communities, Council of Europe, United States Social Security Administration.	The results suggest that cash benefits in the form of family allowances are positively related to fertility. The effect is however of a limited magnitude. However, maternity leave (duration and benefits) did not appear to be significantly related to fertility.
(25)	The long-run determinants of fertility: One century of Demographic change1900–1999.	Vollmer et al. [2012].	Panel cointegration techniques, Dynamic ordinary least squares (DOLS) estimator, FIML estimator of Johansen's (1988), Fully Modified Ordinary Least Squares (FMOLS) estimator of Phillips and Hansen (2010).	Data collected by Reher (2004), Maddison (2003), Morrisson and Murtin (2009).	Given the available data from the last century our analysis has shown that (1) declining mortality leads to declining fertility, that (2) growth of income per capita leads to declining fertility, that (3) declining mortality per se is insufficient to explain the secular decline of population growth over the last century.

	Title	Author	Methodology	Data	Conclusions
(26)	Business cycles and fertility dynamics in the U.S.A.	Mocan, H.N. [1990].	Multivariate VAR analysis, impulse response function, E-G Cointegration.	National Center for Health Statistics Monthly Vital Statistics Report, Vital Statistics of the U. S., Department of Health, Education and Welfare, Statistical Abstract of the United States and the Citibase.	Focusing on pairwise relations between fertility and unemployment generates a procyclical picture, whether one uses a regression analysis or deviations from trend terms as was the case in previous studies, or a VAR, as has been done in this study. This finding, however, is spurious due to the omitted variables. Inclusion of other relevant variables like the divorce rate and the proportion of young marriages yield the opposite outcome: the countercyclicality of fertility.
(27)	Financial incentives and fertility.	Cohen et al. [2013].	Panel Data analysis.	Israel's Central Bureau of Statistics (ICBS).	The results suggest that policies that change the price of a marginal child can be an effective instrument for governments that seek to influence the fertility rate. In contrast, government policies that affect income should not be expected to have a meaningful impact on fertility.
(28)	Advances in Development reverse Fertility declines.	Myrskyla et al.[2009]	Plot analysis	The data come from the United Nations Development Programme (UNDP).	Author's findings support the view that progress in development contributes to lower fertility levels in countries with low to moderately high HDI levels. Moreover, countries remaining at intermediate development levels are likely to face a decline in population size because these countries have attained low TFR levels and they do not yet—and may not in the foreseeable future—benefit from the reversal of the development–fertility relationship.

	Title	Author	Methodology	Data	Conclusions
(29)	High Development and Fertility: Fertility at older reproductive ages and gender equality explain the positive link.	Billari et al. [2011].	Longitudinal regression approach.	The Data come from World Bank Development Indicators Database, United Nations World Fertility Patterns, Human Fertility Database, Eurostat, individual researchers and national statistical offices, United Nations Development Programme (UNDP).	These results extend and provide additional support for the finding that increases in development are an important driving factor of fertility reversals in developed countries. In particular, the results suggest that development contributes to fertility beyond tempo effects, and that gender equality is crucial for countries wishing to reap the fertility benefits of development.
(30)	Criminality and fertility among Danish immigrant populations.	Kirkegaard, O. W. E. [2014].	OLS estimator.	STRAFNA1 (Denmark's Statistics), International Monetary Fund, United Nations Office.	The author showed that criminality is surprisingly predictable at the group level using only three variables: belief in Islam in home country, height, and either IQ or GDP. Height turned out to be a useful predictor for crime, but only in multiple regressions.
(31)	Fertility, income inequality, and labor productivity.	Guest, R. & Swifty, R. [2008].	Vector Error Correction Model (VECM).	World Income Inequality Database.	There is evidence of a long run relationship between fertility and productivity for Australia and the UK to which both variables adjust, and a relationship between productivity and inequality in the USA in the long run that also influences fertility. Productivity is affected by both fertility and inequality in the short run in all three countries.

	Title	Author	Methodology	Data	Conclusions
(32)	Demographic explanation for the recent rise in European fertility: Analysis based on the tempo and parity-adjusted total fertility.	Bongaarts, J. & Sobotka, T.[2012].	Simulation procedure analysis.	Eurostat , Council of Europe and national statistical offices.	To assess the importance of diminishing tempo effect for explaining the recent rise in period total fertility rates across Europe we made extensive use of a new indicator of period fertility, termed tempo and parity-adjusted total fertility (TFRP*). This indicator, which was first proposed by Bongaarts and Feeney and developed independently in a similar form by Yamaguchi and Beppu (2004), is based on a table computation using hazard rates with births of different birth order treated as separate (disconnected) events.
(33)	Fertility choice and economic growth: Empirical evidence from the U.S.A.	Hondroyiannis, G. & Papapetrou, E.[1999].	Johansen Cointegration, VAR analysis.	The Data come from the International Monetary Fund and Labor Force Statistics.	These empirical results appear to be consistent with the theoretical analysis of Barro and Becker (1989), suggesting that fertility should be considered an endogenous variable to the labor market, the capital markets, and the growth process. In particular, wage, interest rate, and output shocks are responsible for the variations of the fertility rate. Furthermore, the results suggest that an increase in fertility growth is responsible for higher economic growth only in the long run.

	Title	Author	Methodology	Data	Conclusions
(34)	County-level IQ and fertility rates: A partial test of differential-K theory.	Boutwell et al. [2013].	OLS.	National Longitudinal Study of Adolescent Health, 1990 US census.	Counties with higher IQs, on average, reported lower overall fertility rates and increased levels of parental investment. Second, the association between IQ and life-history outcomes (i.e., parental investment and fertility rates) remained statistically significant even after controlling for potential mediator variables.
(35)	Declining fertility and economic Well-Being: Do education and health ride to the rescue?	Prettner, K.[2012].	Panel Data Analysis.	The Data come from World Bank, International Institute for Applied Systems Analysis (IIASA) and the Vienna Institute of Demography (VID).	Putting the theory to the test on the macro level, we found that the quantity-quality trade-off indeed represents a statistically significant and economically important force that mitigates the negative impact of demographic change.
(36)	Fertility, income distribution, and economic growth: Theory and cross-country evidence.	Galor, O. & Zang, H. [1999].	WLS and OLS.	The Data collected by World Development Report, Penn World Table 5 (Mark 5) provided by Summers and Heston (1991), World Population Prospects 1988, Human Development Report 1991 and 1985/86,	The authors suggests that in countries which are identical in all respects except for the average family size and the distribution of income, the larger the family size (given income distribution) and the more equally income is distributed (given the family size) the higher the growth rate and the steady-state level of per-capita (per-worker) output. The combined effect of family size and income distribution is more powerful than the separate effects in explaining why some countries have performed better than the other countries.

	Title	Author	Methodology	Data	Conclusions
(37)	The Role of social security in household decisions: VAR estimates of saving and fertility behaviorin Germany.	Cigno et al. [2000].	Cointegration technique.		Old-age security per se (i.e., apart from any intergenerational transfer caused by deficit-financing) has a positive effect on aggregate household saving, and a negative effect on fertility. They also find that child benefits encourage fertility, but that their effect is weak.
(38)	Postponement and recuperation of Belgian fertility: How are they related to rising female educational attainment?	Neels, K. & De Wachter, D. [2010].	Plot analysis.	Belgian censuses of 1991 and 2001.	The hypothesis voiced by Frejka and Sardon (2006) that continuous postponement of first births can lead to a decline in fertility because there is less time remaining for second- and higher-order births is not substantiated by this study.
(39)	The trade-off between fertility and education: Evidence from before the demographic transition.	Becker et al. [2010].	OLS, IV.	The source of the 1849 census data is the Prussian Statistical Office, which published the data in the period 1851–1855 under the title “Tabellen und amtliche Nachrichten über den Preussischen Staat für das Jahr 1849”, data from Preussische Statistik.	This paper further contributes to the literature by establishing the two-way causation between the two components of the child Q–Q trade-off in the sense that exogenous variation in one component leads to changes in the other component. Furthermore, we show that education levels in 1849 are a strong predictor of the strength of the fertility transition between 1880 and 1905.

	Title	Author	Methodology	Data	Conclusions
(40)	Social interactions and contemporary fertility transitions.	Bongaarts, J. & Watkins, S.C. [1996].	Plot analysis.	The Data come from UNDP.	The authors conclude, that development alone is insufficient to account for observed variations in the timing of the onset of transitions or in variations in their pace that social interaction should be taken into account.
(41)	The increasing importance of economic conditions on fertility.	Örsal, D. & Goldstein, J. R. [2010].	Panel Data analysis.	The Data is collected by OECD Database.	The authors find that the effects of the economic variables on fertility are pro-cyclical, in other words in good economic conditions fertility increases, whereas bad economic conditions lead to a decline in fertility. While they find evidence for the increasing importance of the female unemployment rate over time, they do not detect a change in the influence of the male unemployment rate. Finally, they show that the good and bad economic conditions do not only affect the timing of the childbearing, but they also have a quantum effect.
(42)	The Fertility-Development relationship in the United States: New evidence from threshold regression analysis.	Furuoka, F. [2010].	Threshold regression analysis, OLS.	Data on total fertility rates were obtained from the World Bank (2010). Data on per capita GDP were obtained from CICUP (2010).	As a conclusion, the findings of the present study suggest a possibility that advances in a country's economic development are able to reverse the declining fertility rate provided that income level in the country reaches a certain threshold. For example, a number of European countries and some Asian countries have a high per capita income but do not experience a reverse in the fertility rates. This is due to a complexity of the development-fertility relationship and the existence of numerous other factors that can affect the relationship between economic development and human fertility.

	Title	Author	Methodology	Data	Conclusions
(43)	The fertility transition in the U.S.A.: Schooling or income?	Hansen et al. [2014].	Panel Data Analysis, GMM estimator.	Data from Tamura (2012).	While the initial results from OLS estimations suggest that the rise of schooling and income both are related to the observed decrease in US fertility during the period 1840-1980, allowing for mean-reverting dynamics and persistent effects in fertility, which may be endogenous to income and schooling, demonstrates the primacy of the development in schooling over income in the fertility transition.
(44)	The end of the fertility transition in the developed world.	Bongaarts, J. [2002].	Estimation methods of various fertility rates.	Council of Europe (2000); Sato (2001); Bongaarts and Feeney 1998, US DHHS (1997) , United Nations Economic Commission for Europe, Sardon (2000, 2001).	The present analysis has demonstrated that observed period fertility measures such as the TFR are temporarily depressed by a rise in the mean age at childbearing in most of these countries. This postponement effect has been present in many developed countries since the 1970s and could continue for years into the future. But once this rise ends- as it eventually must- the corresponding fertility-depressing effect stops, thus putting upward pressure on period fertility.
(45)	Demographic Transitions: analyzing the effects of mortality on fertility.	Angeles, L. [2008].	Panel Data Analysis, GMM estimator.	United Nations Database.	This paper contributes to the ongoing research effort improving our understanding of demographic transitions. Gross fertility reacts to mortality changes with a lag of about 10 years, the effects continue to be felt after 20 years. Only education has an effect of similar magnitude in some regressions. The importance of post-childhood mortality rates points towards the existence of a quantity-quality tradeoff effect of mortality.

	Title	Author	Methodology	Data	Conclusions
(46)	Gender equality and fertility: Which equality matters?	Neyer et al. [2012].	OLS	European Generations and Gender Surveys , National Institutes of Statistics.	Overall, the results cannot be reconciled with any notion of a simple, uniform, and unidirectional relationship between gender equality and fertility intentions.
(47)	IQ and fertility: A cross-national study.	Shatz, S. M. [2008].	Pearson correlations.	United States Central Intelligence Agency (CIA).	There are a variety of possible speculative explanations, all of which are in need of further empirical testing. One possible explanation is that the IQ–fertility relationship is mediated by a third variable, that variable being economics. National IQ scores are associated with a country's economic status.
(48)	The Biocultural Origins of Human Capital Formation.	Galor, O.& Klemp, M. [2014].	Cubic spline regression, OLS regressions models.	The data is based on the demographic history of Quebec, using the reconstructed genealogy based on the entire parish registers of Quebec, covering 471,412 individuals from the beginning of the French colonization in the 17th century to the turn of the 19th century.	This research explores the biocultural origins of human capital formation. It presents the first evidence that moderate fecundity was conducive for long-run reproductive success within the human species. Using the time interval between the date of marriage and the first live birth as a measure of reproductive capacity, the research establishes that while a higher fecundity is associated with a larger number of children, an intermediate level maximizes long-run reproductive success.

	Title	Author	Methodology	Data	Conclusions
(49)	Do family support environments influence fertility? Evidence from 20 European countries.	Billari et al. [2013].	Multilevel, logistic regression models, where individual respondents (leve1) are nested with countries(level 2).Three level approach in which individual fertility intentions and births were modeled as a function of national and within- country, regional support environments.	The data come from the second and fourth wave of the European Social Survey (ESS),collected between 2004 and 2005 and between 2008 and 2008-2009.	This paper provides support for the idea that higher order births are likely to be more responsive to policy and environmental changes compared with first births.
(50)	Does economic advancement “cause” a re-increase in fertility? An empirical analysis for OECD countries (1960-2007).	Luci, A. & Thévenon, O. [2014].	Pooled OLS, 2SLS, BE, RE, FDE, CCE and System GMM.	The data come from the Human Fertility Database (HFD), OECD family data base and Bongaarts and Feeny Human Fertility Database, for 30 OECD countries that spans the years 1960-2007.	Paper’s findings suggests that further economic development is likely to induce fertility re-increase in the richest societies, but this increase will be small if driven by increase in GDP p.c. only.
(51)	Fertility rebound and economic growth. New evidence for 18 countries over the period 1970-2011.	Dominiak et al. [2014].	Longitudinal data analysis assuming non-linearity between examined variables. Pooled OLS.	The data used for this paper are exclusively derived from World Development Indicators database 2013.	This paper concludes that many developed countries do not experience the fertility rebound, which suggests that economic growth does not drive exclusively demographic changes, and fertility rebounds across countries are only partly explained by growth in living standards, while the rest of it is hugely attributed to institutional, social and state policy context.

THEORITICAL PAPERS

	Title	Author	Conclusions
(1)	Gender wages, house prices and fertility.	Creina, D. [2013].	The analysis predicts the following: firstly, for given house prices, fertility increases with female relative wages if housing comprises a sufficiently large share of childrearing. Secondly, if the user cost of housing land falls with rising house prices, then fertility rises. Thirdly, for endogenous house prices, fertility unambiguously declines with female relative wages and growth in the working age population.
(2)	Skill composition, fertility and economic growth.	Creina, D. [2013].	The analysis predicts that as an economy grows, overall fertility initially declines with rising skill intensity of the workforce and then may recover with rising wages of a skilled workforce.
(3)	Evolution, fertility and the ageing population.	Collins, J. & Richards, O. [2013].	This article suggests that government policies may accelerate or mitigate the selection of high fertility genotypes because different genotypes may respond differently to government incentives. By ignoring the evolutionary underpinnings of fertility, policy makers risk underestimating future fertility rates and population growth.
(4)	Bio-social determinants of fertility.	Kohler et al. [2005].	This study demonstrates convincingly that fertility contains genetic variance; that is, differences between humans in their genetic make-up, affects their fertility outcomes and fertility related behaviors.
(5)	Why is fertility lower in wealthier countries? The role of relaxed fertility-selection.	Aarssen, L.W. [2005].	This paper suggests that the potential role of evolution is different-that selection against innate behaviors promoting low fertility will continue to be relaxed in wealthier countries. If the latter is true, then low fertility in humans (provided it is not lower than replacement level) is neither an aberration nor maladaptive, as long as the society in question supports female empowerment and sustains high economic prosperity.

	Title	Author	Conclusions
(6)	On the quantum and tempo of fertility.	Bongaarts, J. & G. Feeney [1998].	The method proposed in this article, has been shown both by theoretical argument and by empirical example to be an effective solution to the problem of adjusting total fertility rates for distortions attributable to changes in the tempo of childbearing.
(7)	A Theory of Demographic Transition and Fertility Rebound in the Process of Economic Development.	Varvarigos, D. [2013].	In this article, the theory that is presented formalizes just one of a variety of possible explanations behind the fertility rebound in developed economies – the outcome that is ultimately responsible for the emergence of N-shaped fertility dynamics.
(8)	From Malthusian stagnation to modern growth.	Galor, O. & Weil, D. N. [1999].	This paper concludes by stressing the desirability of building unified models of population and development which address not only the demographic transition that occurred in the developed countries over the last century and is currently taking place in much of the rest of the world, but also the Malthusian Regime that characterized so much of human history, as well as the period of rising population growth and output per capita that followed it.

3. Data Discussion

3.1 GDP per capita

We aim to determine the driving factors-composing GDP per capita- of the fertility rebound which is more notable-mainly-in highly developed countries and therefore, we concentrate on the wealthiest countries of Europe. The countries that have been selected are: Austria, Belgium, Denmark, Finland, France, Germany, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Sweden, Switzerland and United Kingdom. The criterion for the selection was the level of GDP per capita[11] in 2013. According to Eurostat, GDP per capita in PPS - index (EU28=100) - of these countries range from 99 (Italy) to 257 (Luxembourg). However, data for GDP per capita which we use in our empirical framework derived from the Louis Fred Database in constant 2005 us dollars[12]. It spans the period from 1960 to 2013 for all countries of our selection, except three of them. GDP per capita is not available for Germany, Ireland and Switzerland for the time interval between 1960 and 1970. Consequently, we estimate the impact of GDP per capita on TFR for two different time intervals and country samples. Trend in GDP per capita at the selected countries is onward sloping as figures3.1 and 3.2 illustrate.

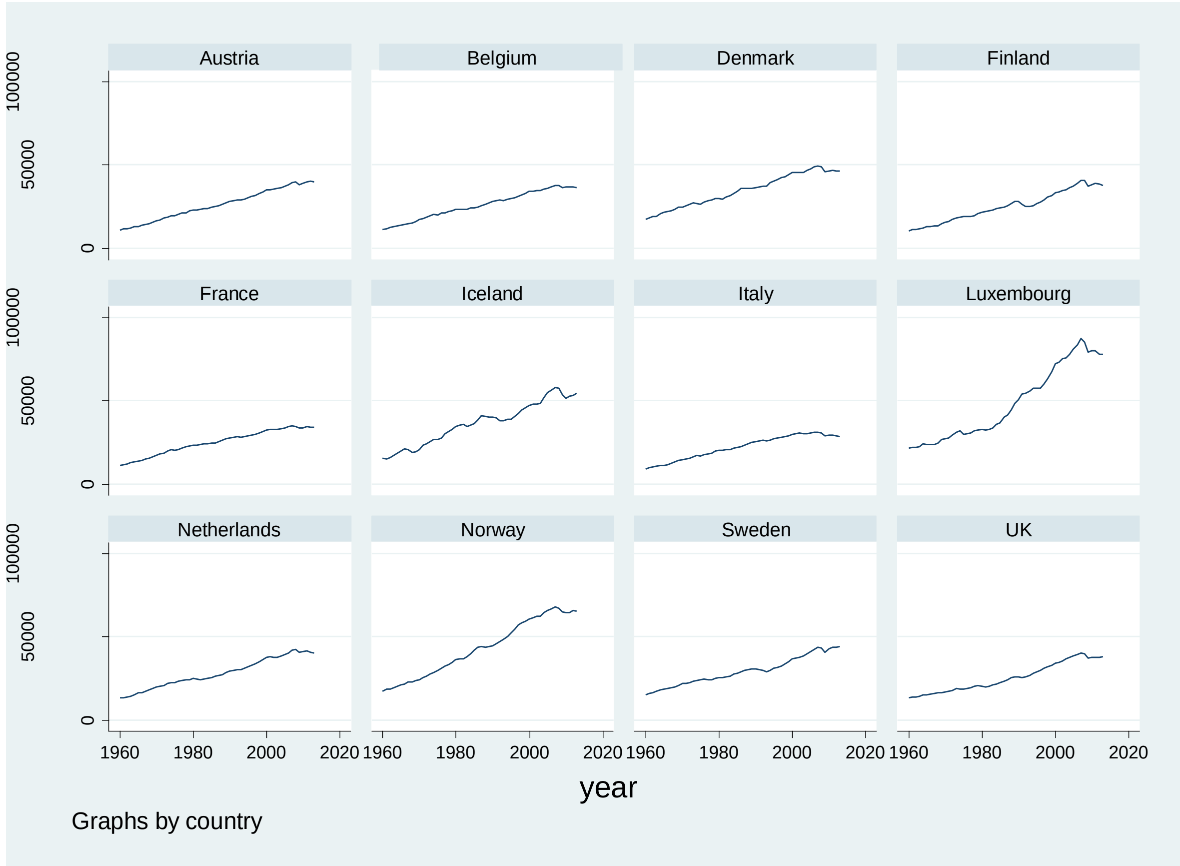

Figure 3.1: GDP per capita for period 1960-2013.

[11] GDP per capita remains the most usual measure of economic development.
[12] Eurostat data as well as Louis Fred indicates the same sample of countries according to our criterion.

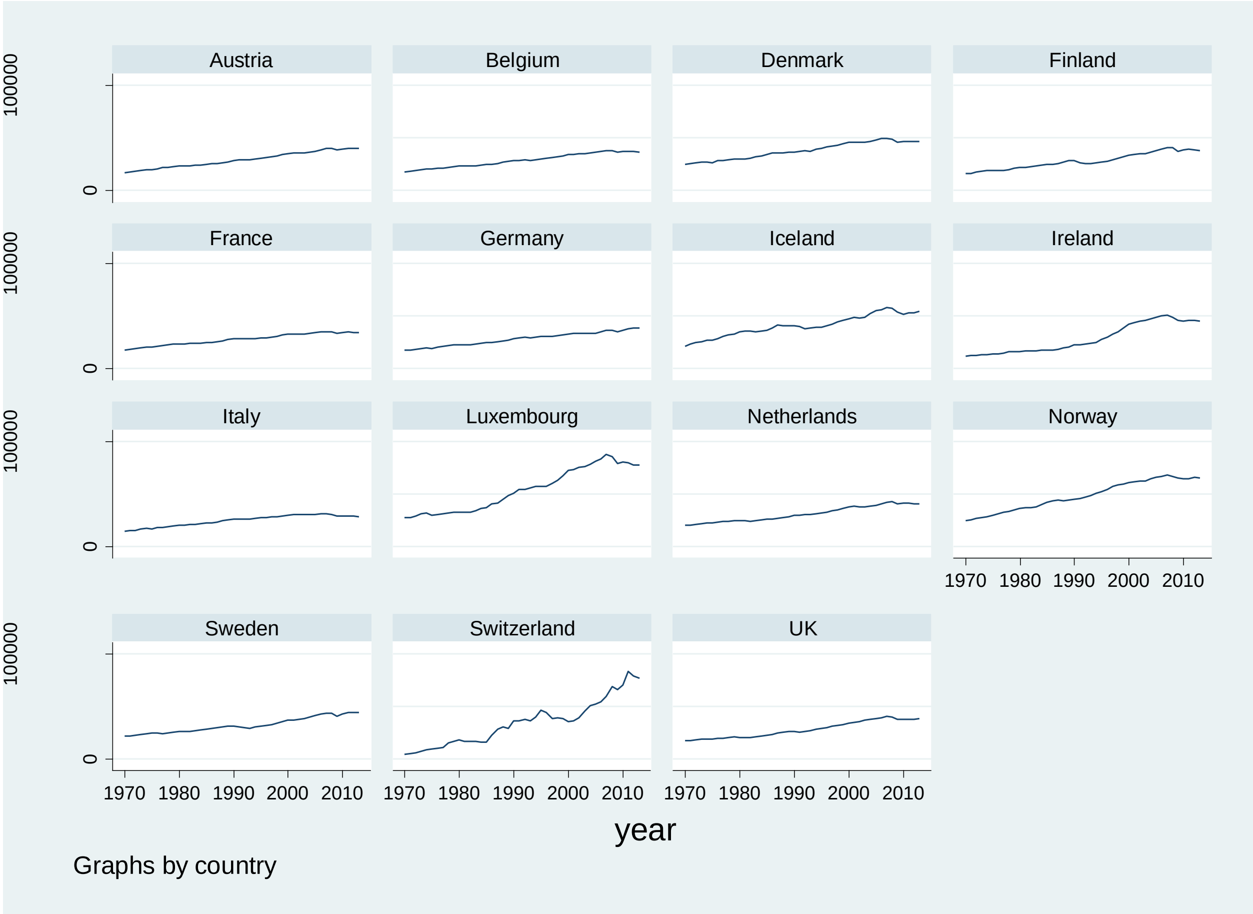

Figure 3.2: GDP per capita for period 1970-2013.

3.2 Fertility rates

Total fertility rate (TFR) is the average number of children a woman would bear if she experienced current age specific fertility rates throughout her reproductive life span. Hence, it is a hypothetical measure when age specific rates are averages for five year age bands.

TFRs come from Human Fertility Database (HFD) and cover the period 1960-2013[13]. Data on age specific fertility rates is limited; it is disposable for ten out of fifteen countries that we selected[14] and span the years 1970-2009. We have already mentioned that TFR is a biased measure of fertility when postponement occurs, nevertheless, due to lack of data on adjusted measures of fertility, we make use of it. However, we can partially control for this bias by using the fertility rate of the age cohort 30-49 ($ASFR_{30-49}$).

In order to calculate the aggregated ASFRsfor the ages 15-29 and 30-49, we make use of the single year ASFRs that human fertility database provides. The one year age groups

[13] Linear interpolation method used to fill in the missed values of TFR for Luxembourg in 1961 and 1963.
[14] Austria, Finland, France, Germany, Iceland, Netherlands, Norway, Sweden, Switzerland, UK.

are estimated by using the calibrated spline estimator which introduces more uncertainty into our estimates[15]. Hence, we estimate the ASFRs according to the following types:

$$ASFR_{15-29} = \sum_{i=15}^{29} \mathrm{ASFR}_{\mathrm{i,year}} \quad , \qquad\qquad \mathrm{ASFR}_{30-49} = \sum_{\mathrm{i}=30}^{49} \mathrm{ASFR}_{\mathrm{i,year}}$$

Trends in TFRs and ASFRs are illustrated below in figures 3.3, 3.4, 3.5 and 3.6.[16]

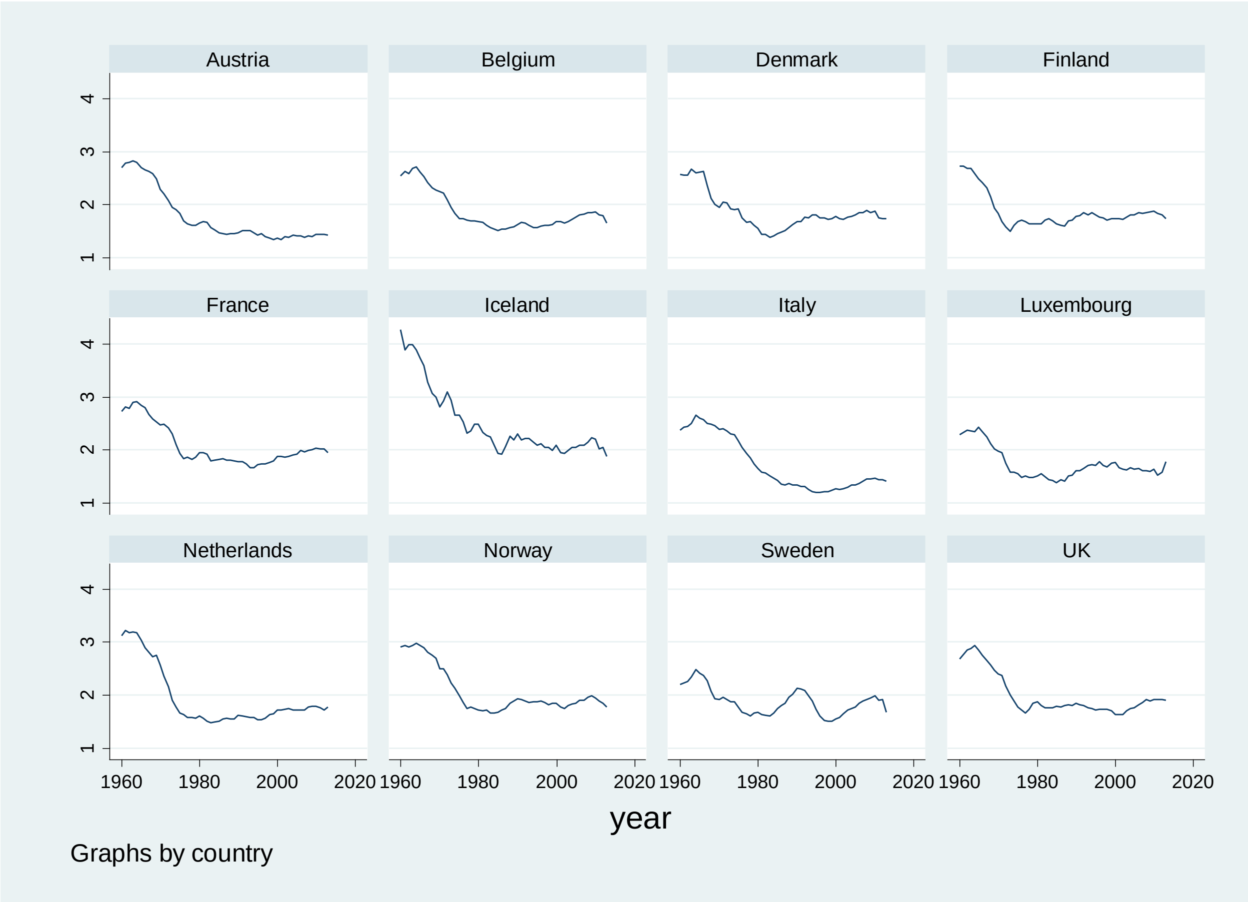

Figure 3.3: TFR for period 1960-2013.

[15] Methods Protocol for the Human Fertility Collection (2014), p. 9.
[16] In Appendix, we plot the relationships between all the fertility variables-GDP per capita and its components and we discuss about in chapter 5.

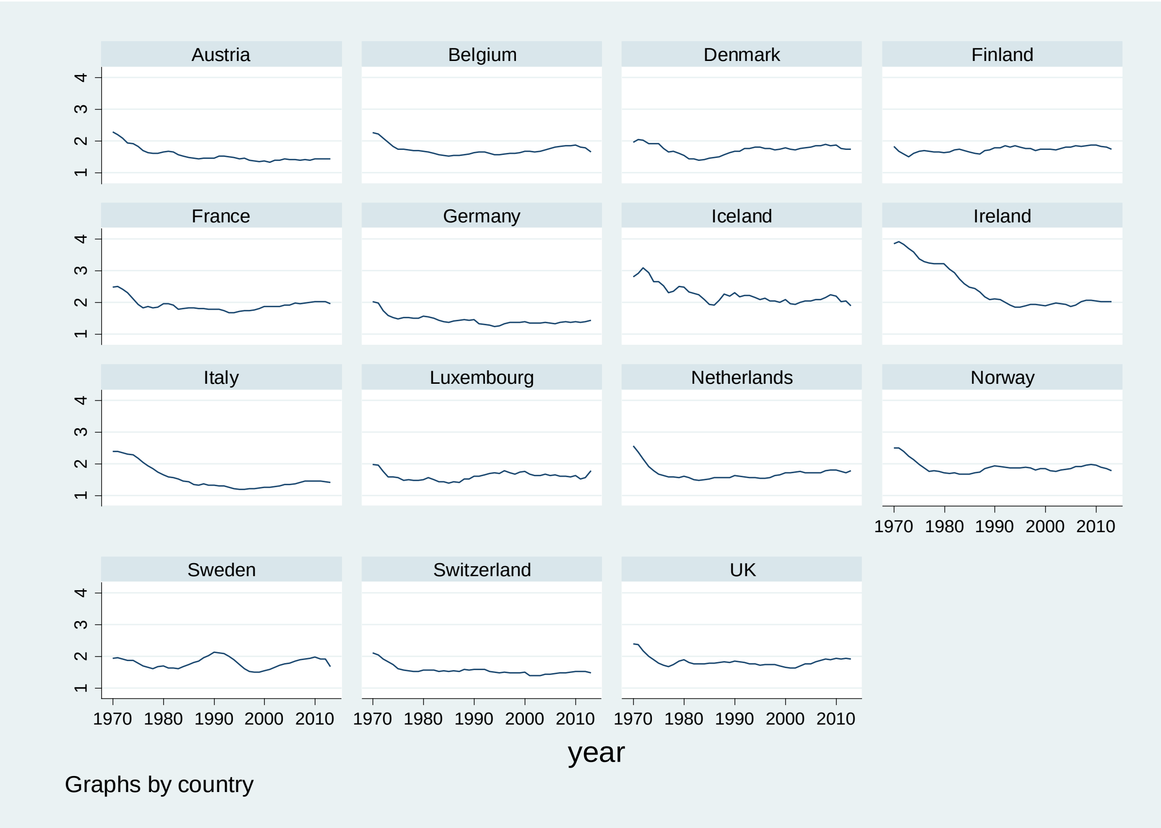

Figure 3.4: TFR for period 1970-2013.

Figure 3.5: $ASFR_{15\text{-}29}$ for period 1970-2009.

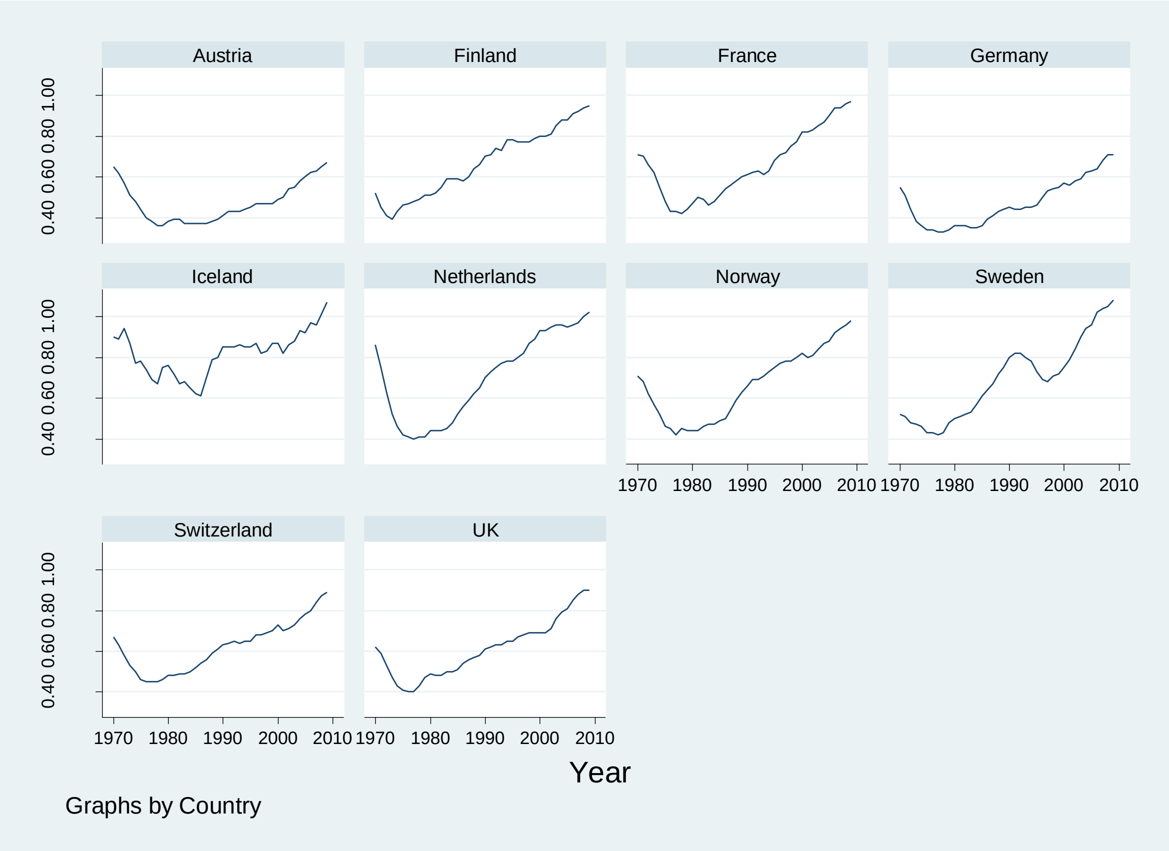

Figure 3.6: ASFR$_{30-49}$ for period 1970-2009.

Figures 3.3 show us the sharply decline and the slightly rebound that occurs after 2000. According to the 3.5 and 3.6 figures, we conclude that the age cohort between 30 and 49 drives the reversal, and it is notable that this reversal occurs at late 1970s - early 1980s, unlike to the 15-29 cohort which indicates a decrease to the pace of reduction, but no sign of reversal.

3.3 Labor Productivity

Data on labor productivity come from OECD database and spans the time interval between 1970 and 2013[17]. Figure 3.7 indicates the upward trend in labor productivity in all countries and the graphs in Appendix show the relationship between labor productivity and the fertility rates. We should emphasize that a U-shaped curve exists between TFR and labor productivity, in additon ASFRs and labor productivity correlation seems to be non linear, in particular, a concave impact with ASFR$_{15-29}$ and a convex one with ASFR$_{30-49}$. No wonder if we consider that higher labor productivity entails higher wages which

[17] Missing values for Austria and Germany for periods 1970-1975 and 1970-1990 respectively.

increases the opportunity cost especially for women, because female labor is more complimentary with capital than is male labor[18].

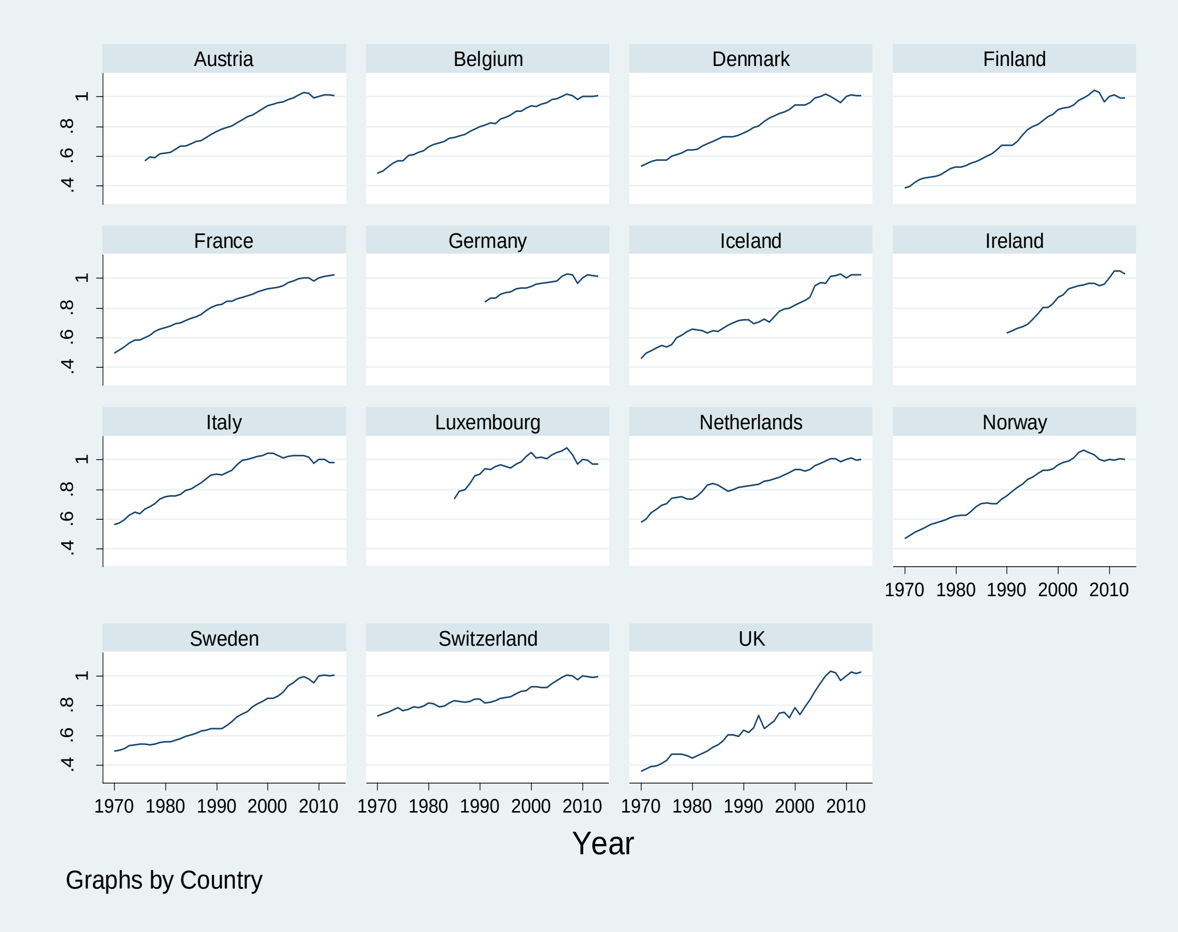

Figure 3.7: Labor Productivity for period 1970-2009.

We also constructed the indexes for the gender component of labor productivity. To achieve this, we used the definition of labor productivity:

$$\text{Labor Productivity} = \frac{\text{GDP}_{\text{total}}}{\text{Sum of Working Hours}}$$

But instead of sum of working hours, we used the geometric mean of three variables:

$$\sqrt[3]{\alpha * \beta * \gamma}$$

where, α: weekly working hours male/female,

β: labor force participation rate male/female,

γ: active population rate male/female.

[18]Guest & Swifty (2008).

The geometric mean takes regard of the interaction between these three variables; therefore it is more accurate than the arithmetic mean. Figures 3.8 and 3.9 depict the trend of the constructed indexes. In both indexes, a slightly increase is present.

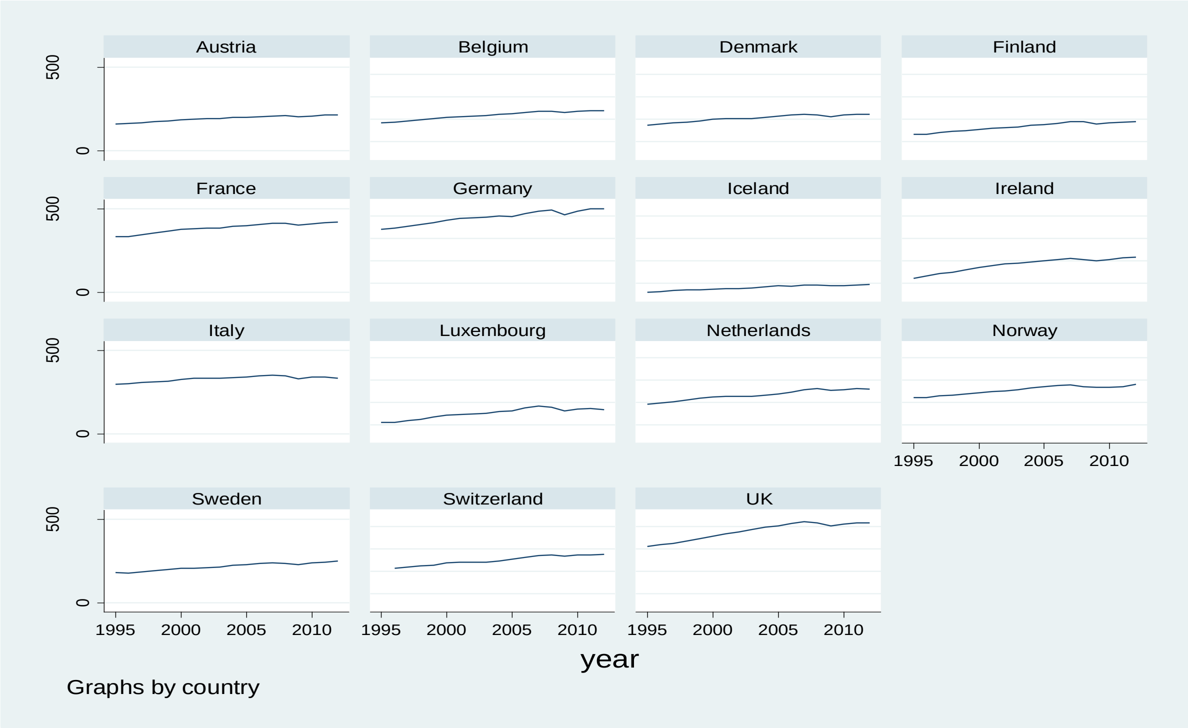

Figure 3.8: Labor Productivity for men for period 1995-2012.

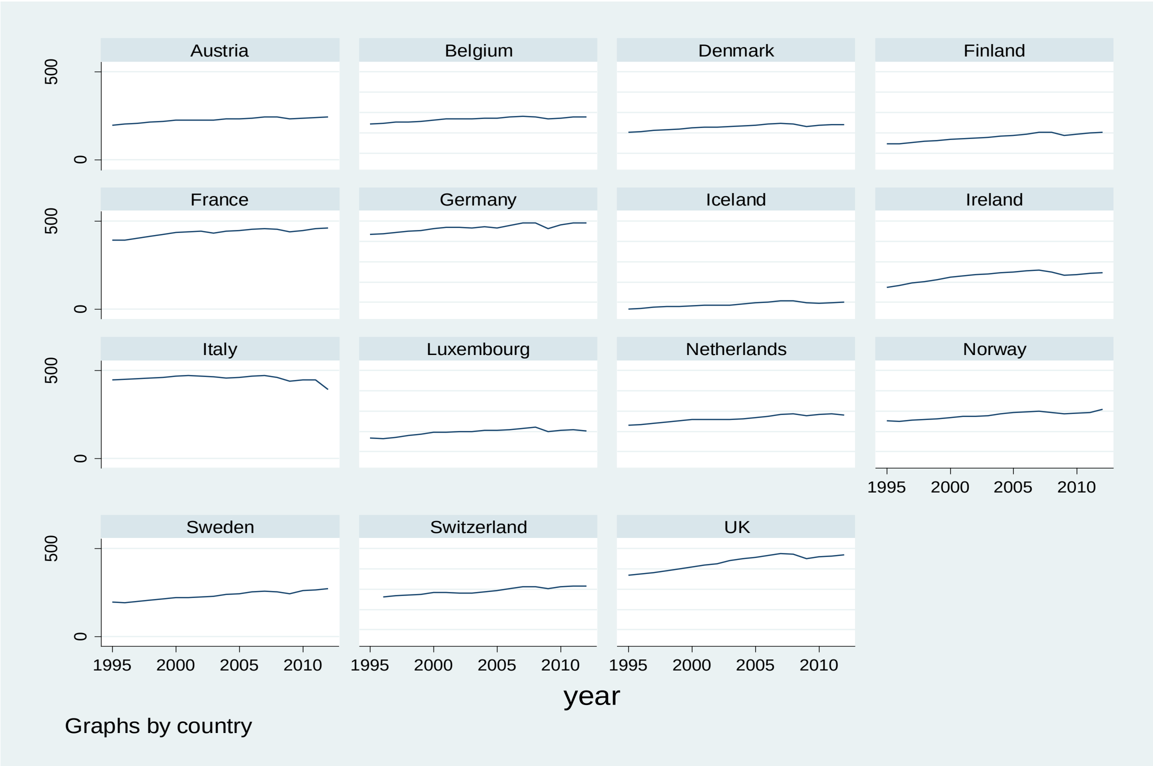

Figure 3.9: Labor Productivity for women for period 1995-2012.

Due to restriction in data, our sample for the male/female labor productivity spans the period 1995-2012 for TFR, and 1995-2009 for ASFRs. Data on GDP_{total} (constant prices 2005 US $) as well as labor force participation rate derived from World Bank, and weekly working hours derived from ILO.

3.4 Average Working Hours

Another component of GDP per capita is the average working hours[19].Data come from OECD database as average annually hours actually worked per worker and span the time period 1995-2013. In order to find out the correlation between the various fertility rates that we use and the gender components of working hours, we constructed two more variables: weekly hours worked per female and weekly hours worked per male.

$$\text{Weekly hours worked per male/female} = \frac{\text{weekly hours worked male/female}}{\text{active population male/female}}$$

To construct these variables, we downloaded the weekly hours worked for male/female, from International Labor Organization (ILO), and the active population of male/female from Eurostat. In the next figures we observe trends of these three measures.

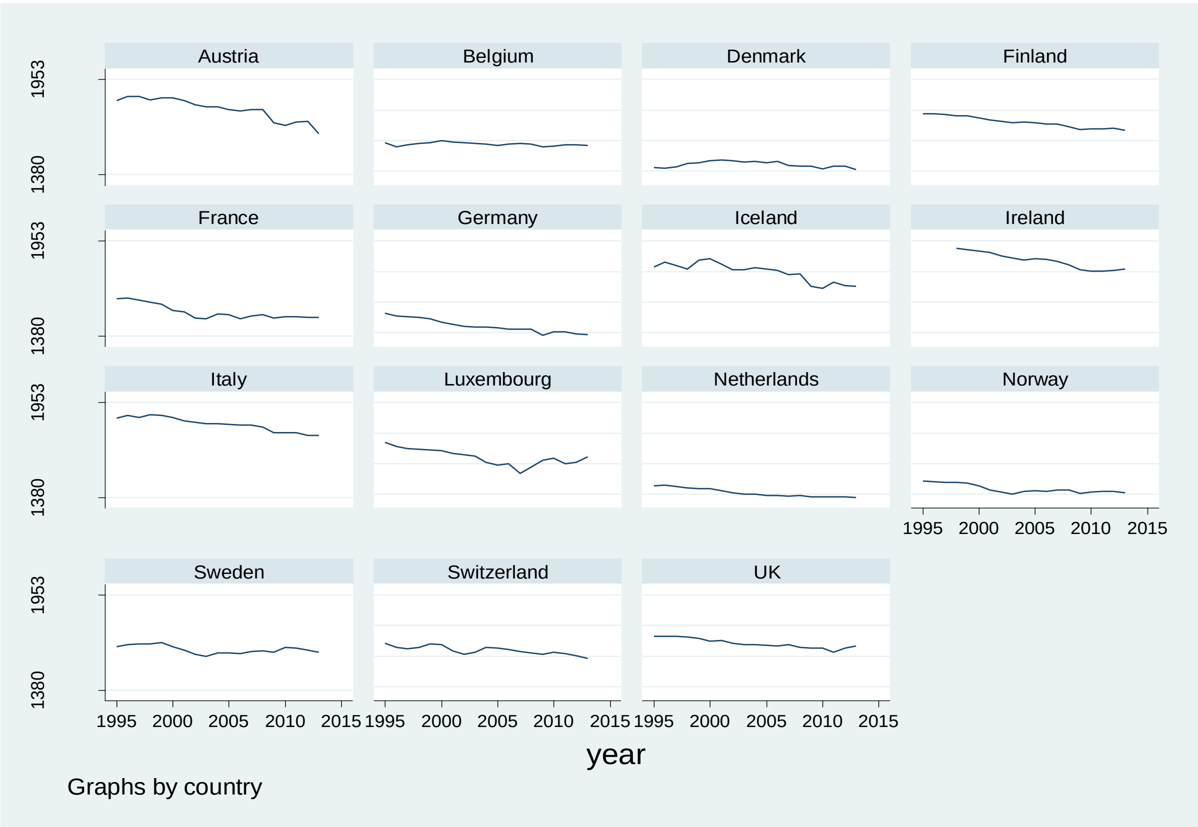

Figure 3.10:Average Working Hours per person for period 1995-2013.

[19]The effect on fertility rates can be ambiguous. This indicator increases when sum of working hours increases, this raise could occur for two reasons: raise in sum of working hours without reduce of unemployment (possible decline of fertility) or in tandem with decrease in unemployment (possible increase of fertility).

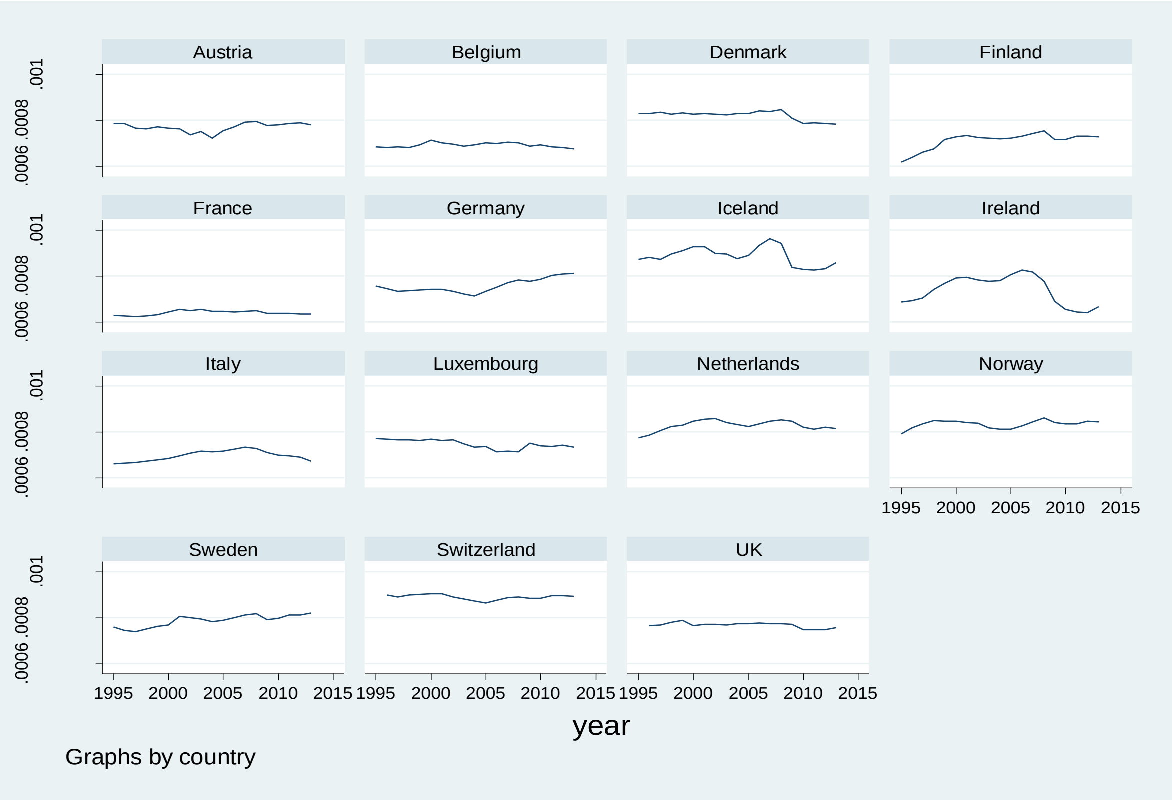

Figure 3.11: Average Working Hours per male for period 1995-2013.

Figure 3.12: Average Working Hours per female for period 1995-2013.

In figure 3.10 we see that the trend is decreasing but as we decompose it into its gender dimensions (figures 3.11 and 3.12), we observe a clear uptrend in case of women and a stationary or decreasing pace in case of men. It is expected such a result since the last decades women have largely penetrated into the labor market and thus increased their working hours.

3.5 Employment ratio

The last component in which we decompose GDP per capita in our analysis is the employment ratio, which we constructed it dividing the active population by the total, and spans the time period 1995-2013.

$$\text{Employment ratio} = \frac{\text{active population}}{\text{total population}}$$

We also created the male and female component[20] of employment ratio in order to find out which of the two gender components is more accurate to explain fertility rates. We constructed the employment ratio variables using again data from Eurostat. The next graphs show us the trends in the employment ratio variables.

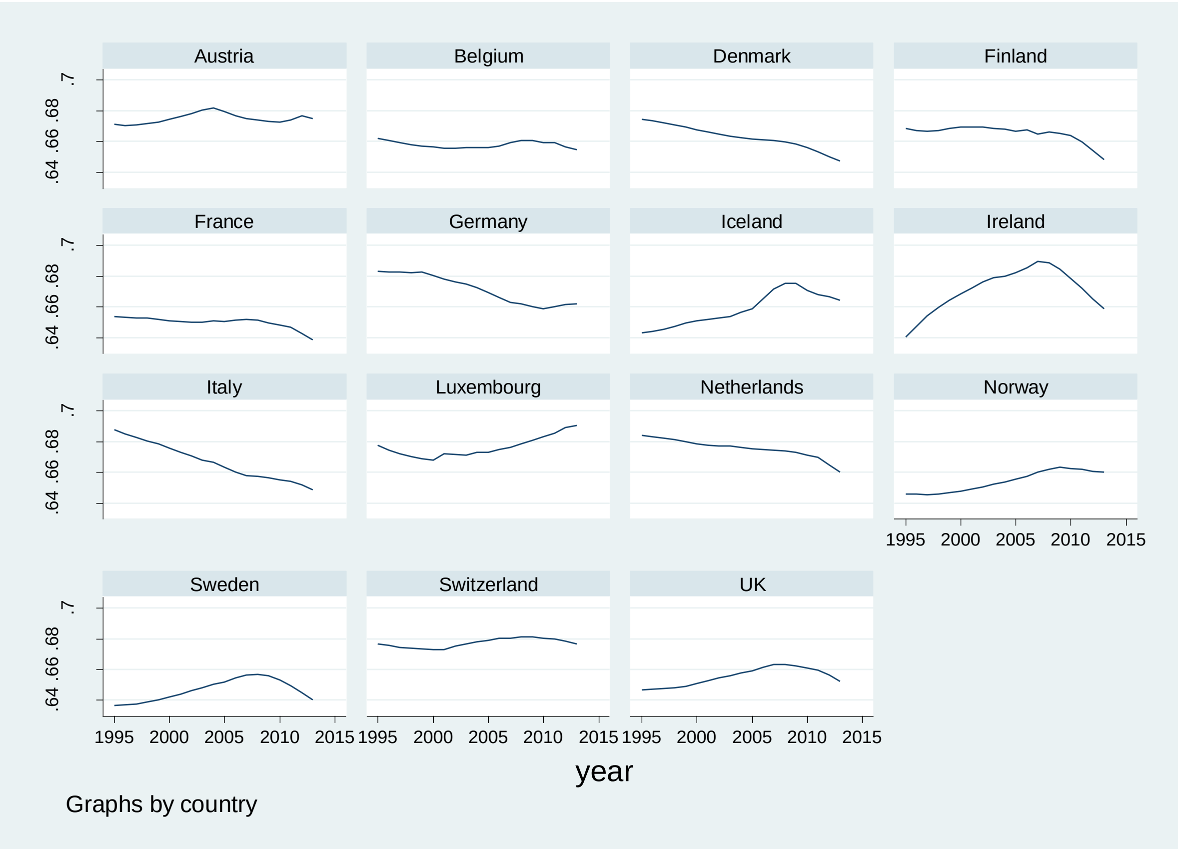

Figure 3.13: Employment Ratio for period 1995-2013.

[20] $\text{Employment ratio male/female} = \frac{\text{active population male/female}}{\text{total population male/female}}$

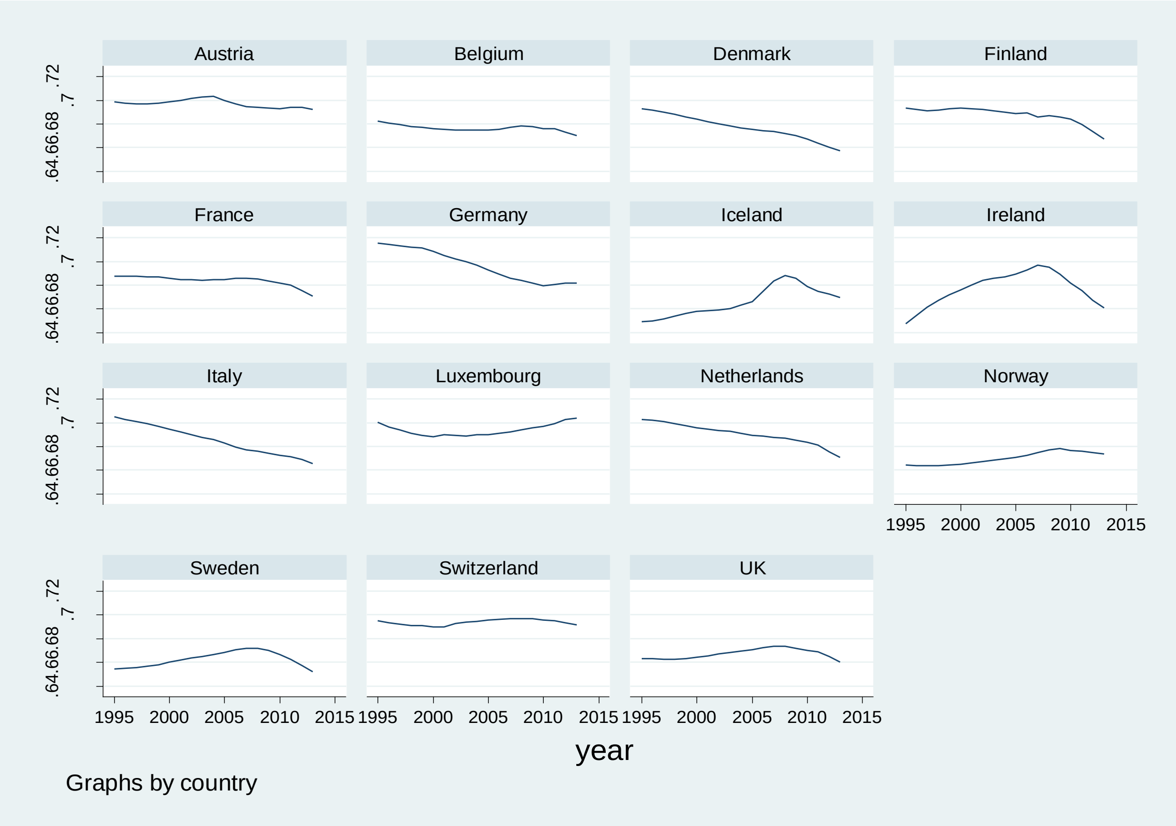

Figure 3.14: Employment Ratio Male for period 1995-2013.

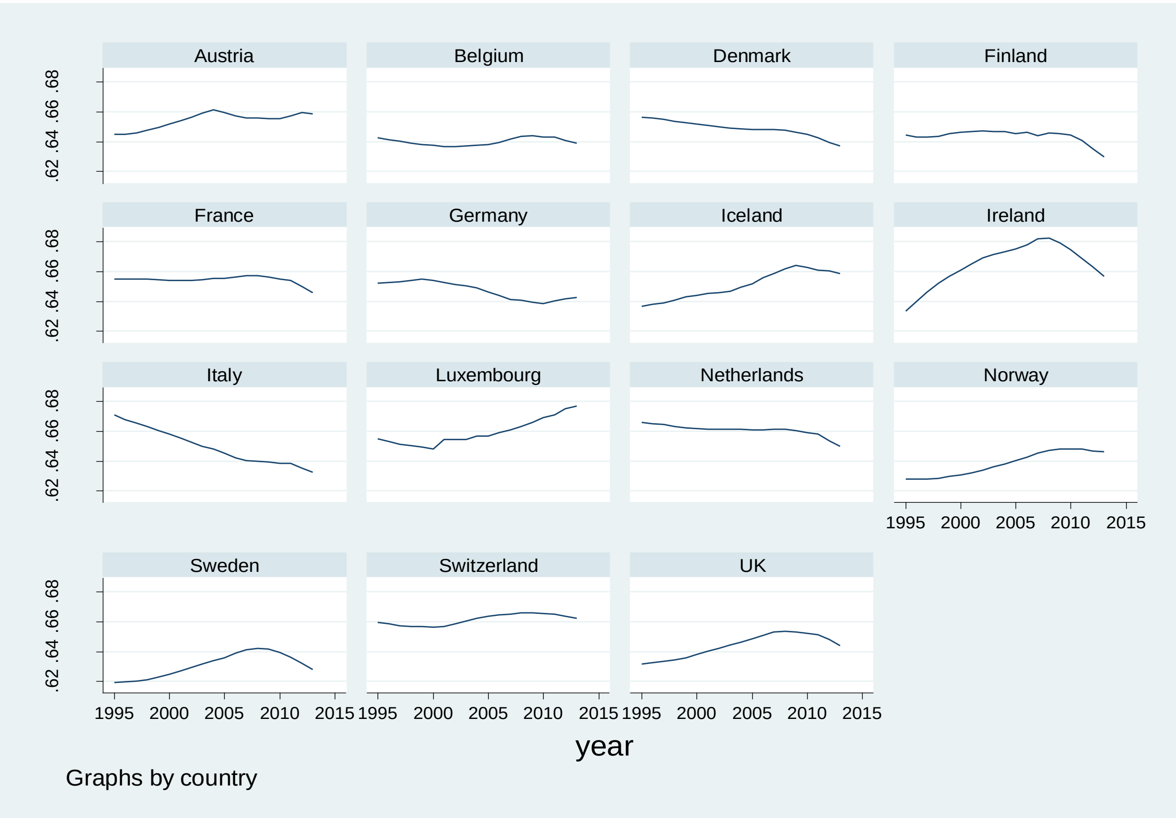

Figure 3.15: Employment Ratio Female for period 1995-2013.

As we see in the next figures, we do not notice any clear trend in all of the countries under examination. We observe that some countries present a concave curve like Ireland, UK, Sweden, and some others have a downward sloping curve like Italy, Netherlands, Denmark, and Finland. Luxembourg is an exception to these clusters, as the trend is upward and obviously this occurs due to the female component (figure 3.15).

Coming to the end of data discussion, we present the descriptive statistics for all the variables that we make use in Table 1 as well as their source in Table 2.

Table 3.1: Descriptive statistics.

Variable	Time Period	Number of obs/tions	Mean	Std. Deviation	Min	Max
TFR	1960-2013	648	1.936	0.471	1.190	4.266
$ASFR_{15-29}$	1970-2009	400	1.123	0.273	0.6	2.15
$ASFR_{30-49}$	1970-2009	400	0.637	0.181	0.33	1.08
GDPpc	1960-2013	648	30688.66	13821.84	9009.41	87716.73
GDPpc	1970-2013	660	33185.46	13724.91	3713.562	87716.73
Labor Productivity	1970-2013	598	0.806	0.174	0.361	1.078
Labor Productivity Male	1995-2012	269	242.39	91.86	61.58	431.07
Labor Productivity Female	1995-2012	269	284.39	110.76	67.95	492.88
Average working hours	1995-2013	282	1624.446	150.990	1380	1953
Weekly hours worked per Male	1995-2013	283	0.00077	0.000075	0.00062	0.00096
Weekly hours worked per Female	1995-2013	284	0.00063	0.00010	0.00036	0.00082
Employment Ratio	1995-2013	285	0.665	0.012	0.637	0.690
Employment Ratio Male	1995-2013	285	0.682	0.014	0.647	0.716
Employment Ratio Female	1995-2013	285	0.649	0.012	0.619	0.682

Table 3.2: Descriptive statistics (definitions and sources).

Variable	**Definition**	**Calculation**	**Source**
TFR	Total fertility rate is the average number of children a woman would bear if she experienced current age specific fertility rates throughout her reproductive life span.	TFR=$\sum ASFR$	Human Fertility Database.
ASFR	The age specific fertility rate measures the annual number of births to women of a specified age or age group per 1000 women in that age group.	$ASFR_{15-29} = \sum_{i=15}^{29} \mathrm{ASFR}_{\mathrm{i,year}}$ $ASFR_{30-49} = \sum_{i=30}^{49} \mathrm{ASFR}_{\mathrm{i,year}}$	Human Fertility Database.
GDPpc	A measure of the total output of a country that takes the real gross domestic product (GDP) and divides it by the number of people in the country (in constant 2005 US $).	$\mathrm{GDPpc} = \frac{\text{Real GDP}}{\text{Total population}}$	Louis Fred Database.
Labor productivity female/male	Labor productivity measures the amount of real GDP produced by an hour of labor.	$\text{Labor productivity} = \frac{\text{Real GDP}}{\text{Sum of working hours female/male}}$	Own calculation.
Average working hours per person	The total number of hours worked over the year divided by the average number of people in employment.	$\text{Av. Work. Hour. per person} = \frac{\text{Total hours worked}}{\text{Employed people}}$	OECD Database
Weekly hours worked per female/male	The total number of weekly hours worked over the year per female/male.	$\text{Week. hours work. per male} = \frac{\text{Week. hours work. female/ male}}{\text{Active population female/male}}$	Own calculation.

Employment ratio female/male	The ratio of the total working age of the labor force currently employed to the total population of a country.	$\text{Employment ratio} = \dfrac{\text{Active population female/male}}{\text{Total population female/male}}$	Own calculation.
Labor force participation rate female/male	The labor force participation rate refers to the number of people who are either employed or are actively looking for work.		World Bank.
Active population female/male	The fraction of a population that is either employed or actively seeking employment.		Eurostat.
Total Population female/male	The number of people who leave in a country to a given period.		Eurostat.
Weekly hours worked female/male	Weekly hours actually worked on the basis of the mean number of hours of work per week, and with reference to hours worked in all jobs of employed persons and in all types of working time arrangements.		International Labor Organization.

4. Methodology

4.1 A Short Econometric Reference

In our empirical analysis, we aim to detect the component of GDP per capita and the age cohort that drives the fertility rebound. We also aim to find out the source of the convexity between the fertility trends and economic development. Consequently, for the pair of the variables that we use in our regressions, we take regard of the linear and the quadratic impact of the independent variable (raising the independent variable in square). Before we get in the econometric analysis, we form a diagram with the components that compute GDP per capita.

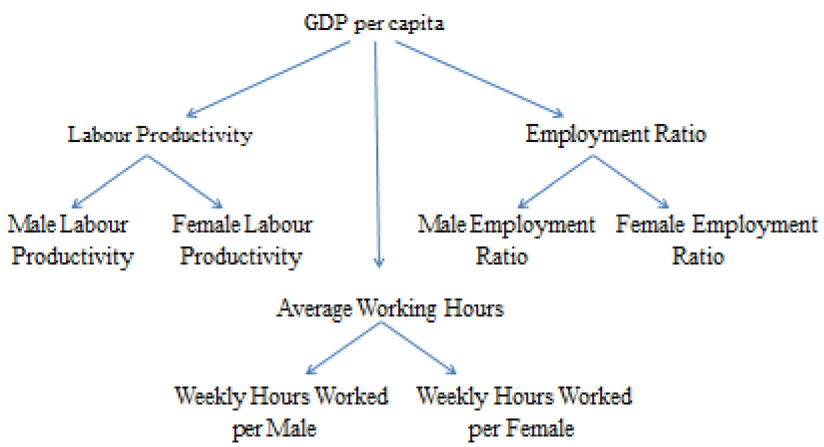

Figure 4.1:GDP per capita and its components.

For our empirical framework, we prefer to apply longitudinal or Panel data analysis due to some advantages by which this method can provide us.

Firstly, in Panel analysis we combine time series of cross section observations which produce more informative data, this means that we have more variability and though less collinearity. Secondly, techniques of panel data take into account possible heterogeneity across countries by allowing for individuals (countries in our case)-specific variables, and can also better detect and measure effects that cannot be observed in pure cross-section or pure time-series data.

In Panel data analysis, we can use many estimators depending on the problem we want to overcome. In our analysis, we make use of Fixed Effect (FE) - Random Effect (RE), FE with Discroll–Kraay (D-K) standard errors (s.e.) estimators, as well as the Generalized

Method of Moments (GMM) estimator. Every estimator that we use controls for some of the problems that our sample fronts. We test for A/C applying the Wooldridge test[21] and we see that in most cases, we reject the null hypothesis at 1% implying A/C across the residuals. In addition, we check for H/C and cross sectional dependence (CSD) using the White[22] and Pesaran[23] tests correspondingly. In Tables 4.1-4.6 we present the aforementioned tests; it is clear that our sample encounters in most of the cases all of the problems[24] that we mentioned above. Therefore, we take regard of these problems by using more than one estimator. Furthermore, we suspect multicollinearity (M/C)[25] at the quadratic models because every variable in the R.H.S. is obviously highly correlated with its squared value.

Application of FE estimator is more usual when studying countries; it is more possible to have time-constant unobserved variables which may affect fertility (i.e. country specific characteristics linked to history, geography, population certain attitudes, etc.). However, from econometrical perspective, one could apply the Hausman Test[26] in order to decide whether RE or FE is better fitted. In case the error term ($\varepsilon_{\mathrm{it}}$) is uncorrelated with the time-constant unobserved variable (v_i), which translated to: $\mathrm{cov}(\varepsilon_{\mathrm{it}}, \mathrm{v}_i) = 0$, RE is more accurate. If correlation exists, FE fits better. We apply the Hausman test for all the regression (Table 4.7 and 4.8) in our analysis and we notice that in most of the regressions, FE is superior to RE. Nevertheless, in our estimations we take regard of both estimators and notice no significant differences between them.

FE models do not allow controlling for time specific effects and hence we could use a two way FE model which includes both country and year variables. This procedure would produce a less efficient model due to the number of parameters that must be estimated. We make use of the FE-within transformation[27]model, which demeans data (subtracts the between variation) in order to disappear the unobserved heterogeneity and to control for endogeneity. Additionally, the use of FE with D-K standard errors estimator controls for heteroscedasticity, first order autocorrelation (1^{st} A/C) and cross sectional dependence with MA (q).

Another way to control for endogeneity is the application of GMM estimator which belongs to the instrumental variables (IV) approaches.[28] In order to be accurate, the instruments must be highly correlated with the variable that we suspect for endogeneity, and simultaneously not correlated with the error term of the regression. In the absence of more accurate instrumental variables, lagged- one year lag-values of the independent

[21] Wooldridge test, A/C test for Panel Data, H_0: no first-order autocorrelation.
[22] White test, H/C test for Panel Data, H_0: homoscedasticity.
[23]Pesaran test for cross section dependence, H_0: no cross-sectional dependence.
[24] A/C and H/C cause too high t-statistics.
[25] M/C hampers precise estimations and causes lower t-statistics.
[26]Hausman's test does not work always; moreover, it is based on strong assumptions.
[27]It produces the same coefficients - standard errors as dummy least square variable approach (except R^2).
[28]Variations in TFR or ASFRs affect GDP per capita and its components (inverse causality).

variable (in each case) serve as instrument[29]. Next, we test for the problem of stationarity in the variables that we aim to use, since non-stationarity can cause spurious regressions which drive to misleading results. In Table 4.9, we depict the results from the Pesaran (2007)[30] unit root test with time trend in the first column and without time trend in the second. We observe conflicting results in some cases and moreover most of the variables are non-stationary[31].

Table 4.1: A/C, H/C, Cross Sectional Dependence tests [1].

TFR (linear model)	1st order A/C	H/C	Cross Sectional Dependence
GDPpc (1960-2013)	yes***	yes***	yes***
GDPpc (1970-2013)	yes***	yes***	yes***
Labor Productivity	yes***	yes***	yes***
Labor Productivity Male	yes***	yes**	yes***
Labor Productivity Female	yes***	yes***	yes***
Average Working Hours	yes***	yes***	yes***
Weekly Hours Worked per Male	yes***	yes***	yes***
Weekly Hours Worked per Female	yes***	yes***	yes***
Employment Ratio	yes***	yes***	yes***
Employment Ratio Male	yes***	no	yes***
Employment Ratio Female	yes***	yes***	yes***

*p<0.1; **p<0.05;***p<0.01

[1] *We have adopted the logarithmic transformation for all variables.*

[29] The use of lagged exogenous variable does not rule out the problem of inverse causality; in the case of GDP per capita for instance, it is likely that TFR in 2000 affect GDP per capita in 1997 through birth postponement.

[30] Pesaran (2007) test, H_0: all panels contain unit roots.

[31] We could deal with non-stationary problems by applying First Difference (FD) estimator, but it would produce less efficient estimators.

Table 4.2: A/C, H/C, Cross Sectional Dependence tests.

TFR (quadratic model)	1st order A/C	H/C	Cross Sectional Dependence
GDPpc (1960-2013)	yes***	yes***	yes***
GDPpc (1970-2013)	yes***	yes***	yes***
Labor Productivity	yes***	yes***	yes***
Labor Productivity Male	yes***	yes**	yes***
Labor Productivity Female	yes***	yes***	yes***
Average Working Hours	yes***	yes***	yes***
Weekly Hours Worked per Male	yes***	yes***	yes***
Weekly Hours Worked per Female	yes***	yes*	yes***
Employment Ratio	yes***	yes***	yes***
Employment Ratio Male	yes***	yes**	yes***
Employment Ratio Female	yes***	yes***	yes***

p<0.1; **p<0.05;*p<0.01*

Table 4.3: A/C, H/C, Cross Sectional Dependence tests.

$ASFR_{15\text{-}29}$ (linear model)	1st order A/C	H/C	Cross Sectional Dependence
GDPpc	yes***	yes*	yes***
Labor Productivity	yes***	yes***	no
Labor Productivity Male	yes*	yes***	no
Labor Productivity Female	yes*	yes***	yes***
Average Working Hours	yes**	no	no
Weekly Hours Worked per Male	yes**	yes***	yes***
Weekly Hours Worked per Female	yes**	yes***	no
Employment Ratio	yes**	yes*	yes***
Employment Ratio Male	yes**	No	yes***
Employment Ratio Female	yes**	yes*	yes***

p<0.1; **p<0.05;*p<0.01*

Table 4.4: A/C, H/C, Cross Sectional Dependence tests.

$ASFR_{15\text{-}29}$ (quadratic model)	1st order A/C	H/C	Cross Sectional Dependence
GDPpc	yes***	yes***	yes***
Labor Productivity	yes***	yes***	no
Labor Productivity Male	yes*	yes***	no
Labor Productivity Female	yes**	yes***	yes***
Average Working Hours	yes**	yes*	no
Weekly Hours Worked per Male	yes**	yes***	yes***
Weekly Hours Worked per Female	yes**	yes**	yes**
Employment Ratio	yes**	no	yes***
Employment Ratio Male	yes**	yes**	yes**
Employment Ratio Female	yes**	no	yes***

p<0.1; **p<0.05;*p<0.01*

Table 4.5: A/C, H/C, Cross Sectional Dependence tests.

$ASFR_{30\text{-}49}$ (linear model)	1st order A/C	H/C	Cross Sectional Dependence
GDPpc	yes***	yes***	yes***
Labor Productivity	yes***	yes*	yes***
Labor Productivity Male	yes***	yes***	yes***
Labor Productivity Female	yes***	yes***	yes***
Average Working Hours	yes***	yes***	yes***
Weekly Hours Worked per Male	yes***	yes***	yes***
Weekly Hours Worked per Female	yes***	yes***	yes***
Employment Ratio	yes***	yes***	yes***
Employment Ratio Male	yes***	yes**	yes***
Employment Ratio Female	yes***	yes***	yes***

p<0.1; **p<0.05;*p<0.01*

Table 4.6: A/C, H/C, Cross Sectional Dependence tests.

$ASFR_{30\text{-}49}$ (quadratic model)	1st order A/C	H/C	Cross Sectional Dependence
GDPpc	yes***	yes**	yes***
Labor Productivity	yes***	yes**	yes***
Labor Productivity Male	yes***	yes***	yes***
Labor Productivity Female	yes***	yes***	yes***
Average Working Hours	yes***	yes***	yes***
Weekly Hours Worked per Male	yes***	yes***	yes***
Weekly Hours Worked per Female	yes***	yes***	yes***
Employment Ratio	yes***	yes***	yes***
Employment Ratio Male	yes***	yes***	yes***
Employment Ratio Female	yes***	yes***	yes***

$^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 4.7: Hausman test for linear models.

Hausman Test	Linear Models		
	TFR	$ASFR_{15\text{-}29}$	$ASFR_{30\text{-}49}$
GDP pc (1960-2013)	-	-	RE
GDP pc (1970-2013)	FE*	-	RE
Labor Productivity	FE**	RE	-
Labor Productivity M	RE	-	-
Labor Productivity F	FE*	FE*	FE***
Average Working Hours	FE*	RE	-
Working Hours per M	RE	RE	FE*
Working Hours per F	-	FE*	FE**
Employment Ratio	FE***	FE***	FE***
Employment Ratio M	-	FE***	FE***
Employment Ratio F	RE	FE***	FE***

$^*p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Table 4.8: Hausman test for quadratic models.

Hausman Test	Quadratic Models		
	TFR	$ASFR_{15-29}$	$ASFR_{30-49}$
GDP pc (1960-2013)	-	-	RE
GDP pc (1970-2013)	RE	-	RE
Labor Productivity	FE**	FE***	-
Labor Productivity M	RE	FE***	FE*
Labor Productivity F	RE	RE	FE***
Average Working Hours	RE	RE	-
Working Hours per M	RE	RE	FE*
Working Hours per F	-	FE***	FE***
Employment Ratio	FE***	FE***	FE**
Employment Ratio M	-	FE***	FE**
Employment Ratio F	-	FE***	FE***

*$p<0.1$; **$p<0.05$;***$p<0.01$

Table 4.9: Stationarity tests.

Pesaran (2007) Panel unit root test	Time trend	Without time trend
TFR	stationary**	stationary***
$ASFR_{15-29}$	non-stationary	stationary**
$ASFR_{30-49}$	non-stationary	stationary**
GDPpc (1960-2013)	non-stationary	non-stationary
GDPpc (1970-2013)	non-stationary	non-stationary
Labor Productivity	-	-
Labor Productivity Male	non-stationary	non-stationary
Labor Productivity Female	non-stationary	non-stationary
Average Working Hours	non-stationary	non-stationary
Weekly Hours Worked per Male	non-stationary	non-stationary
Weekly Hours Worked per Female	non-stationary	non-stationary
Employment Ratio	non-stationary	non-stationary
Employment Ratio Male	non-stationary	non-stationary
Employment Ratio Female	non-stationary	non-stationary

*$p<0.1$; **$p<0.05$;***$p<0.01$

4.2 Econometric Methodology

In this section of chapter four, we present the form of the regressions that we are interesting in, and we separate them according to the specific estimator we use.

FE estimator

Linear Model

$Y_{it} = \beta_1 X_{it} + \nu_i + \varepsilon_{it}$

Quadratic Model

$Y_{it} = \beta_1 X_{it} + \beta_2 X_{it}^2 + \nu_i + \varepsilon_{it}$

where Y_{it} represents the endogenous variable which is one of the three fertility measures (TFR, $ASFR_{15\text{-}29}$,$ASFR_{30\text{-}49}$) that we make use,X_{it} is the exogenous variable which consists of the GDP per capita and its components,ν_i is the country-specific time-constant unobserved heterogeneity and ε_{it} is the idiosyncratic error term.

RE estimator

Linear Model

$Y_{it} = \beta_0 + \beta_1 X_{it} + \nu_i + \varepsilon_{it}$

Quadratic Model

$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 X_{it}^2 + \nu_i + \varepsilon_{it}$

In this approach, the endogenous and exogenous variables remain the same. The difference is that we have a constant (β_0) in the regressions, we further assume that ν_i is a random variable and moreover it is uncorrelated with the idiosyncratic error term.

GMM estimator

Linear Model

$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it}$

Instrumental Regression (I.R.): $X_{it} = a_0 + a_1 Z_{it} + u_{it}$, where Z_{it} is the instrumental variable (lags of the exogenousX_{it}).

Quadratic Model

$Y_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 X_{it}^2 + \varepsilon_{it}$

Instrumental Regressions: $X_{it} = \gamma_0 + \gamma_1 Z_{it} + u_{it1}$,

$$X_{it}^2 = \gamma_2 + \gamma_3 Z_{it}^2 + u_{it2}$$

The quadratic model allows for a change in the sign of the effect of an increase in the exogenous variable on fertility levels, which is compatible with a reversal of fertility trends. A positive estimated coefficient β_2 (and statistically significant) would suggest that the correlation between the endogenous and the exogenous variable is first negative up to a certain threshold level of the exogenous and then turns into positive for higher levels of the exogenous. This implies that the exogenous variable has a convex impact on the endogenous. In case we have a negative estimated coefficient β_2, the impact is correspondingly concave.

Below, in Table 4.1, we present the models and the variables that we use in empirical analysis summarized in a table and more analytically in Appendix.

Table 4.1: Models and variables in empirical analysis.

	Linear	**Quadratic**
FE	$Y_{it} = \beta_1 X_{it} + \nu_i + \varepsilon_{it}$	$Y_{it} = \beta_2 X_{it} + \beta_3 X_{it}^2 + \nu_i + \varepsilon_{it}$
RE	$Y_{it} = \beta_0 + \beta_1 X_{it} + \nu_i + \varepsilon_{it}$	$Y_{it} = \beta_2 + \beta_3 X_{it} + \beta_4 X_{it}^2 + \nu_i + \varepsilon_{it}$
GMM	$Y_{it} = \beta_0 + \beta_1 X_{it} + \varepsilon_{it}$ $X_{it} = a_0 + a_1 Z_{it} + u_{it}$	$Y_{it} = \beta_2 + \beta_3 X_{it} + \beta_4 X_{it}^2 + \varepsilon_{it}$ $X_{it} = a_1 + a_2 Z_{it} + u_{it1}$ $X_{it}^2 = a_3 + a_4 Z_{it}^2 + u_{it2}$
	Endogenous Variables	
$\mathbf{Y_{it}}$	$\ln(\mathrm{TFR})_{it}$ $\ln(\mathrm{ASFR}_{15-29})_{it}$ $\ln(\mathrm{ASFR}_{30-49})_{it}$	
	Exogenous Variables	
$\mathbf{X_{it}}$	$\ln(\mathrm{GDP_{pc}})_{it}$ $\ln(\mathrm{Lab.\ Product})_{it}$ $\ln(\mathrm{Lab.\ Product.\ M})_{it}$ $\ln(\mathrm{Lab.\ Product.\ F})_{it}$ $\ln(\mathrm{Av.\ Work.\ Hours})_{it}$ $\ln(\mathrm{Week.\ H.\ Work.\ M})_{it}$ $\ln(\mathrm{Week.\ H.\ Work.\ F})_{it}$ $\ln(\mathrm{Empl.\ Ratio})_{it}$ $\ln(\mathrm{Empl.\ Rat.\ M})_{it}$ $\ln(\mathrm{Empl.\ Rat.\ F})_{it}$	
	Instrumental Variables	
$\mathbf{Z_{it}}$	$\ln(\mathrm{GDP_{pc}})_{it-1}$ $\ln(\mathrm{Lab.\ Product})_{it-1}$ $\ln(\mathrm{Lab.\ Product.\ M})_{it-1}$ $\ln(\mathrm{Lab.\ Product.\ F})_{it-1}$ $\ln(\mathrm{Av.\ Work.\ Hours})_{it-1}$ $\ln(\mathrm{Week.\ H.\ Work.\ M})_{it-1}$ $\ln(\mathrm{Week.\ H.\ Work.\ F})_{it-1}$ $\ln(\mathrm{Empl.\ Ratio})_{it-1}$ $\ln(\mathrm{Empl.\ Rat.\ M})_{it-1}$ $\ln(\mathrm{Empl.\ Rat.\ F})_{it-1}$	

5. ESTIMATION RESULTS

In this chapter we present the results we obtained from our estimates and we discuss about them.

5.1 TFR - GDP per Capita and its Components

We start with the results concerning the impact (linear and quadratic) of the GDP per capita on TFR for two different time periods. Table 5.1 shows us that the quadratic form fits better than the linear one because of the higher[32] value of R^2 (in both time periods), implying a non-linear impact of GDP per capita on TFR. We additionally observe that all of the four estimation methods we used are producing almost the same results. The coefficients β_2 (quadratic model 2 - Appendix) have positive signs (in all columns) and they are statistical significance at 1% which suggests that initially, increases in GDP per capita reduces TFR, but from a point on as GDP per capita increases, TFR increases too. Hence, results indicate a convex curve. Figure A.1 (Appendix) also indicates a curve impact. In this case we obtain consensus between plot and regression's results.

In Table 5.2 we present the results from the regression between TFR and each one of the components of GDP per capita. In column (7), in case of the quadratic model, where we take into account H/C, 1st order A/C and CSD, we observe a convex impact of labor productivity on TFR at 5% level, instead of 1% (column 6) and no convex impact when using the GMM estimator (column 8). However, we see that three of the four methods in case of the linear model agree. FE with Discroll-Kraay standard errors shows us no statistical significance for labor productivity. As in case of GDP per capita, the quadratic model fits better according to the value of R^2 - though no large difference - and the statistically significance. Hence, we have not a clear picture concerning the type of the relationship between TFR and labor productivity.

For the next variable, average working hours per person, the results between GMM and FE-RE are conflicting too. Nevertheless, R^2 is the same for both quadratic and linear models. In particular GMM is in favor of a convex impact, while FE and RE support the linear correlation. We mention also that the explanatory power of average working hours per person is slightly larger to that of labor productivity.

In case of the correlation between TFR and the employment ratio, again the results are contradictory. GMM supports the linear process, while the other three methods indicate a non-linear impact at 1%.The difference here in comparison with the preceding two components is the negative value of the $\beta_2$coefficients (quadratic model 16). The negative sign (also statistically significance at 1%) indicates a concave impact of employment ratio on TFR. This means that as employment rate initially increases, TFR also increases (positive correlation) and from a point on the correlation turns into negative. We also have to notice here, that R^2 is by far larger in case of quadratic model. In particular, it turns from 0.0007(linear approach) to 0.121 (quadratic).

[32] The greater the R^2, the greater the variation in the endogenous variable is explained by the exogenous.

Hence, so far, non-linearity in the relationship of TFR-GDPpc seems to arise from two components: labor productivity, and with more statistically accuracy from employment ratio.

Next, we examine the correlation between TFR and female/male dimension of each one component of GDP per capita.

5.2 TFR and Male/Female Components of GDP per Capita

Male Dimension

Initially, we focus on the correlation between TFR and male labor productivity (Table 5.3, columns 1-8).According to the regression's results, all the variables are statistically significance at 1%, moreover, R^2 is 0.329 for the quadratic form and 0.206 for the linear. Therefore, empirical analysis suggests that the impact is non-linear and particularly convex (both $\beta_2$coefficients have a positive sign in 4 and 44 models). Results also confirm the plot in figure A.7.

Weekly hours worked per male show statistical significance at 1% for FE and RE approach but since we control for H/C, 1st order A/C and CSD and then for endogeneity, the statistical significance disappears (linear approach).In addition to this, quadratic forms show no statistical significance and have the same value of R^2. Consequently, we conclude that weekly hours worked per male is not the key variable for the explanation of TFR trends.

The last variable of interest is the male employment ratio where the results are again contradictory for the linear approach. We see that according to FE with Discroll-Kraay standard errors, there is no statistical significance. On the other hand, GMM estimator indicates that coefficient β_1(linear model 57) is statistically significant and negative at 1%. When considering the quadratic form, we have consensus among all the four methods we used. We also notice that the impact is concave and the R^2 is much higher than in the linear form. Hence, employment ratio seems important on explaining the non-linear impact (concave).

Female Dimension

In Table 5.4, we show the results between the female dimension of GDP per capita components and TFR. Female labor productivity cannot explain us the total fertility rate according to the GMM estimator. FE and RE estimators, both present statistically significant coefficients at 1% in linear and quadratic models. R^2 reveals a slight difference between the two models (0.174 for linear and 0.223 for quadratic form). Similarly like labor productivity of men, labor productivity of women has a convex impact.

The weekly working hours per person that women work has - as expected - an important impact on fertility. The first that we observe is the large variance in R^2 between the two forms. When we take into account the quadratic value of the variable, R^2 increases from 0.011 to 0.169. The non-linear impact seems to be concave at 1% (column

15) but GMM estimator shows no statistical significance in this case. The impact of female employment ratio on TFR seems to be non-linear. Firstly, the value of R^2 becomes higher when the squared value of the independent variable is included, and secondly, we observe no statistical significance in the coefficients of the female employment ratio in the linear model. Both results strongly suggest that the impact is once again concave (the coefficient β_2 in model 20 is negative). We should also not overlook that once more, GMM estimator gives no statistical significance results.

Afterwards, we present the estimations concerning the regressions between ASFRs and the independent variables that we use in our analysis. In Table 5.5, we have regressed the $ASFR_{15\text{-}29}$ and $ASFR_{30\text{-}49}$ with GDP per capita and its components. By splitting the TFR into age cohorts, we capture the bias that arises from the postponement in younger ages ($ASFR_{15\text{-}29}$). Economic development affects unemployment (directly) and education (indirectly through human capital returns) which are the two main reasons for birth postponement. Hence, we expect GDP per capita to be more important for earlier ages.

5.3 ASFRs-GDP per Capita and its Components

It is interesting to observe in columns 1 to 16 (Table 5.5) the variation of R^2. According to the results we obtained, it seems that economic development is more significant for the fertility trends at younger ages ($ASFR_{15\text{-}29}$) and his importance reduces by far as we estimate for older age cohorts ($ASFR_{30\text{-}49}$),though it remains at high level (53.6%). This result confirms our assumption that tempo effect reduces significally when taking into account only the older ages. Additionally, there is no significant difference between the explanatory power of the linear and the quadratic form for the ages 15-29, contrary to the ages 30-49 where the quadratic form dominates the linear (columns 7 and 15).We also see that all the coefficients are statistically significant at 1%, except those in column 12. Finally, the impact in case of $ASFR_{15\text{-}29}$ is concave when considering a non-linear relationship (negative coefficient of squared GDPpc) and convex for the older ages (positive coefficient of squared GDPpc).

It is also interesting that taking five year lags in GDP per capita[33]and then regress with $ASFR_{30\text{-}49}$, we find a much higher R^2 and statistically significant coefficients[34] (0.588 for linear and 0.718 for the quadratic form). In contrast, applying the same methods with 5 years lags in GDP per capita and regress it with TFR and $ASFR_{15\text{-}29}$, we obtain lower R^2 which means that past values of GDP per capita are more crucial for the present fertility decisions of the older reproductive ages.

Next, we follow the same steps in our analysis as we did in case of TFR. Thus, we analyze GDP per capita in its components and we attempt to detect the impacts. In

[33] The use of lags in GDP per capita when examine the influence of economic development on fertility trends seems reasonable since the birth of infant is the result of a decision that took place at least 9 months ago. However, our estimation results with lags do not confirm this logical assumption except the case of $ASFR_{30\text{-}49}$.

[34]Table 5.8, compare the results of Table 5.8 with columns 7 and 15 of Table 5.5.

columns 17-32 (Table 5.4), we present the results for labor productivity. The picture in this case is almost the same as with GDP per capita. We have a higher R^2 for the younger ages, but again the explanatory power does not change a lot (even less than GDP per capita) when we take into account the quadratic form. Figure A.5 also illustrates that the correlation is more likely to be linear (negative) rather than non-linear. In case of $ASFR_{30-49}$, the explanatory power of the regression increases from 0.561 (linear-column 23) to 0.667 (column 31) for the quadratic form and thus we conclude that the impact is convex. In comparison to the TFR - labor productivity regression, here we have obtained much higher values of R^2. This result is expected from economic theory. As labor productivity increases, the ratio $\frac{K}{L}$ raises and wages go up as well, this process increases the opportunity cost especially for women, who initially choose to work more and thus fertility decreases.

The second variable we examine is the average working hours. In columns 41 to 46, we observe that in most of the coefficients, standard errors that are large in tandem with a high R^2 (except column 44) making us to suspect that we have a high degree of M/C. We also see that essentially there is no difference between the values of R^2 for both models (linear and quadratic). Hence, we could conclude that there is a linear impact in this case. Figures A.14 and A.15 do not give us any clear information. We should not ignore however, that the average working hours explain much better the behavior at older ages (R^2=0.654) than in younger (R^2=0.142). The latter is expected if we consider that unemployment is a problem mostly in earlier ages[35].

The next variable we examine is the employment ratio. As we see in columns 51 and 59 (Table 5.5), employment ratio explains very little of the variation in $ASFR_{15-29}$ and the results for FE (D-K s.e.) and GMM are conflicting (different signs). So, we cannot be adequately confident whether the impact is concave or convex. In contrast, correlation between employment ratio and $ASFR_{30-49}$ is better fitted. Quadratic form explains better the behavior in fertility trends (R^2=0.368 against 0.126 in linear approach), and the impact is concave for all methods. Coefficients are also significant at 1%.

5.4 ASFRs and Male/Female Components of GDP per Capita

Male Dimension

In Table 5.6 we see the results we obtained regressing the male components of GDP per capita with ASFRs. The estimates for labor productivity of men show us that there is no large difference between linear and quadratic form for the younger age cohort according to R^2 (0.336 and 0.342). But it increases significantly in case of older age cohort. Moreover, we observe that the quadratic form fits better (R^2 is 0.809 instead of 0.732) and

[35] Letablier & Salles (2013).

the impact is convex. Hence, we conclude that the male productivity affects much more the fertility rates for the older age cohort[36].

Weekly hours worked per male have also linear impact on fertility and they are more influential to $ASFR_{30-49}$. However, their impact is not considerable large (R^2=0.147). On the other hand, results for the male employment ratio suggest that the impact is non-linear for both age cohorts. The explanatory power is greater in case of $ASFR_{30-49}$ and the coefficients are all statistically significant at 1%, furthermore, the impact is concave in case of the older age cohort, whereas the impact is conflicting for the younger one as we see from the signs (columns 43 and 44).

We deduce from Table 5.6, that labor productivity is the most decisive variable of male dimension components that affect fertility in both age cohorts. Convexity seems to stem from the male labor productivity and finally, in all cases, the three male components of GDP per capita explain better the $ASFR_{30-49}$.

Female Dimension

Table 5.7 displays the results for the female decomposition of GDP per capita. As we see, female labor productivity is more important for the fertility trends at older than younger ages. The impact is non-linear and varies from negative at the 15-29 age cohort to positive at 30-49. In comparison with the male component (columns 3 and 7-Table 5.6), we observe that the explanatory power here is weaker implying that labor productivity of men is a more crucial factor in explaining age cohort fertility trends compare to women. As in case of female labor productivity, weekly hours worked per female have probably a non-linear impact (concave)-compare columns 19 and 26-on $ASFR_{15-29}$, and more obviously a linear (positive) influence on $ASFR_{30-49}$[37]. The explanatory power is also higher in the latter case. Finally, the female employment ratio explains more adequately the fertility trends in the older age cohort and has a concave impact (columns 47 and 48).

5.5 Graphs

In Appendix, we present all the plots we derived between the variables we are interesting in. In figure A.1 we see an inverse J-shaped curve which also confirms the regression results. Splitting TFR in ASFRs, we see two different pictures: a downward (figureA.2) and an upward (figure A.3) sloping curve. According to these plots, fertility rebound seems to occur due to the older age cohort and also at relative low levels of GDP per capita (approximately 20000)[38] while in figure A.1 it shifts to larger values.

[36]Compare with Table 5.5-columns 27 and 31.

[37]We notice here that the effects of female labor productivity and the female working hours are almost the same.

[38]Harttgen & Vollmer (2012) find a low cut-off value (0.56) for HDI where the reversal takes place. HDI is a composite index and one of its three components is GDP per capita-GNI per capita after the revesion of Human Development Report in 2011.

In the next plots, figure A.4 - A.6 present some important shapes. We notice that it is downward sloping in case of $ASFR_{15\text{-}29}$ and U-shaped for the other age cohort which is also in agreement with the regression results. We see further a clear upward trend of $ASFR_{30\text{-}49}$ with labor productivity of men and women (figures A.9 and A.12 correspondingly) and also with weekly hours worked per female. Employment ratio of men in figure A.27 and women in figure A.28 illustrates the concave impact that demonstrates our estimation findings.

5.6 Discussion

To conclude, we obtained that GDP per capita explains adequately (R^2=68.2%) trends in TFR. When decomposing GDP per capita into its three indexes (without gender decomposition), we find that each index contributes approximately at the same percentage and the observable convexity at the TFR - GDPpc relationship seems to arise from labor productivity. Decomposing furthermore each index into the gender dimension, we recognize male labor productivity as the most significant factor (R^2=32.9%) which has a convex impact and then-with the same impact-comes the weekly hours worked per female (R^2=16.9%).

Results are different in case of ASFRs. According to our estimates, the importance of present GDP per capita is more crucial for the decision to fertile in earlier ages. The factor of labor productivity remains the most important of the three, especially for the age cohort 15-29 where it correlates negatively with fertility, in contrast with the older cohort where the influence is convex. It is also interesting to notice the gender decomposition of these three components. Both labor productivity for male and female is more important for $ASFR_{30\text{-}49}$ than $ASFR_{15\text{-}29}$ age cohort, but as we have seen, labor productivity without gender dimension is more predictable for the earlier age cohort which seems contrasting. The next factor that contributes most at both age cohort fertility trends is the weekly hours worked per female variable. It has a positive linear effect in case of $ASFR_{30\text{-}49.}$ It is also interesting that employment ratio female is crucial for the older age fertility trends and becomes almost meaningless to earlier ages.

Hence, our results suggest that labor productivity of men as well as women and the quantity of working hours of women are the most important factors explaining the fertility trends.

Finally, we notice that the value of R^2 is greater in any case of gender component of GDP per capita for $ASFR_{30\text{-}49}$ than it is for$ASFR_{15\text{-}29}$.

At the end of this chapter, we make a summary of the results that yield non-linearity. We see that at table 5.10.

Table 5.10: Summary results*.

Convex impact	R^2_{convex}(%)	Concave impact	$R^2_{concave}$(%)
TFR-GDPpc	68.2	$ASFR_{15\text{-}29}$-GDPpc	76.5
$ASFR_{30\text{-}49}$-GDPpc	53.6	$ASFR_{15\text{-}29}$-Lab.Product.	73
$ASFR_{30\text{-}49}$-Lab.Product.	66.7	$ASFR_{30\text{-}49}$-Empl.Ratio	36.9
$ASFR_{15\text{-}29}$-Empl.Ratio	4.4	$ASFR_{15\text{-}29}$-Lab.Product. Male	34.2
$ASFR_{30\text{-}49}$-Lab.Product. Male	80.9	$ASFR_{30\text{-}49}$-Empl.Ratio Male	42.2
$ASFR_{15\text{-}29}$-Empl.Ratio Male	14.8	$ASFR_{15\text{-}29}$- Lab.Product. Female	26.8
$ASFR_{30\text{-}49}$- Lab.Product. Female	75.5	$ASFR_{30\text{-}49}$-Empl.Ratio Female	36.6
$ASFR_{15\text{-}29}$-Empl.Ratio Female	4.4	TFR- Empl.Ratio	12.1
TFR- Lab.Product.	13.2	TFR- Empl.Ratio Male	13.3
TFR- Lab.Product. Male	32.9	TFR-Aver.Work.Hours per Female	16.9
TFR- Lab.Product. Female	22.3	TFR- Empl.Ratio Female	8.8

*The R^2 coefficients refer to the FE models with D-K standard errors, hence they indicate the within variation.

6. CONCLUSIONS

In this study, we attempted to find out the major factors behind GDP per capita that are responsible for the observable fertility rebound in the wealthiest European Countries. Thus, we decomposed GDP per capita in its three components, and moreover these three components into their gender dimension. Additionally, we distinguished TFR into two age cohorts in order to discover whether economic development affects differently the decisions about fertility in various ages.

Figures of the evolution in fertility trends, display that the main contribution to the reversal is attributed to the ages 30 and above, and this reversal occurs at a low level of GDP per capita. This finding is important since it mitigates the importance of direct effect of economic development, indicating other social reasons which are indirectly linked to economic development (gender equity, assistance reproduction technology, etc.). Another serious issue that we ascertained, associates with the tempo effect that is the main disadvantage regarding the use of TFR. We demonstrated that when using the older age cohort, we deal - though partially - with tempo effect and derive the quantum effect on fertility trends. In addition to this, the reduced (positive) effect of present economic conditions on $ASFR_{30\text{-}49}$ - the age cohort that drives the fertility rebound - and the increased effect on $ASFR_{15\text{-}29}$, could have significant consequences to policy implementations.

The results we obtained indicate the labor productivity of men as the most crucial component of GDP per capita that explains trends in fertility at the different age cohorts we examined. We have seen in chapter 5, that male labor productivity is negatively correlated with $ASFR_{15\text{-}29}$ and positively with $ASFR_{30\text{-}49}$, this finding confirms the idea that also labor productivity is the main source of non-linearity (convexity) in the TFR-GDPpc relationship.

Finally, we have to refer to some vulnerabilities of our study. Due to lack of data, we restricted our sample in many cases reducing the observations (degrees of freedom) in our estimations. Especially, when decomposed GDP per capita, we constrained the time dimension of data for values since 1995 onward (except labor productivity). This kind of restriction attenuates the power of our estimations. One more weakness arises from the absence of any control variables in our regressions which produces the “omitted variable” bias results. Nevertheless, because in every regression we examined one variable each time and applied a between comparison, we believe that bias is not the main issue that affects our conclusions. Lastly, non-stationarity is probably the main problem of our estimations since stationarity test that we applied indicated that most of our variables are not stationary.

Appendix

Table 5.1: Regression results for TFR-GDPpc.

	Endogenous Variable[1]: ln(TFR)				Endogenous Variable[2]: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM[3]**	**RE**	**FE**	**FE (D-K s.e.)**	**GMM[4]**
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ln(GDPpc)	-0.391***	-0.391***	-0.397***	-0.248***	-0.163***	-0.164***	-0.164***	-0.073***
	(0.014)	(0.014)	(0.076)	(0.017)	(0.012)	(0.012)	(0.055)	(0.021)
constant	4.639***	4.698***	4.698***	3.169***	2.236***	2.249***	2.249***	1.306***
	(0.150)	(0.146)	(0.782)	(0.177)	(0.134)	(0.129)	(0.581)	(0.223)
R^2	0.549	0.549	0.549		0.212	0.212	0.212	
Quadratic Model	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
ln(GDPpc)	-6.631***	-6.614***	-6.614***	-7.135***	-2.308***	-2.308***	-2.308***	-2.260***
	(0.384)	(0.381)	(1.017)	(0.555)	(0.305)	(0.306)	(0.839)	(0.754)
$[\ln(GDPpc)]^2$	0.306***	0.305***	0.305***	0.336***	0.105***	0.105***	0.105***	0.106***
	(0.019)	(0.019)	(0.050)	(0.027)	(0.015)	(0.015)	(0.043)	(0.036)
constant	36.415***	36.351***	36.351***	38.448***	13.140***	13.145***	13.145***	12.532***
	(1.958)	(1.941)	(5.132)	(2.844)	(1.554)	(1.557)	(4.085)	(3.950)
R^2	0.682	0.682	0.682		0.268	0.268	0.268	

[1]Time Interval: 1960-2013, countries: 12, observations: 648.
[2]Time Interval: 1970-2013, countries: 15, observations: 660.
[3] Observations for GMM: 636.
[4]Observations for GMM: 645.

Table 5.2: Regression results for TFR-GDPpc 's components.

	Endogenous Variable: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**
[1]**Lab.Product**				
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**
ln(Lab.Product)	-0.151***	-0.149***	-0.149	-0.217***
	(0.019)	(0.019)	(0.096)	(0.029)
constant	0.503***	0.508***	0.508***	0.489***
	(0.029)	(0.006)	(0.022)	(0.09)
R^2	0.097	0.098	0.098	
Quadratic Model	**(5)**	**(6)**	**(7)**	**(8)**
ln(Lab.Product)	0.059	0.04	0.064	-0.102
	(0.048)	(0.048)	(0.142)	(0.074)
$[\ln(\text{Lab.Product})]^2$	0.322***	0.325***	0.325**	0.178
	(0.068)	(0.068)	(0.325)	(0.111)
constant	0.516***	0.522***	0.522***	0.496***
	(0.028)	(0.007)	(0.019)	(0.010)
R^2	0.132	0.132	0.132	
[2]**Av.Work.Hours**				
Linear Model	**(9)**	**(10)**	**(11)**	**(12)**
ln(Av.Work.Hours)	-0.704***	-0.761***	-0.761***	-0.094
	(0.111)	(0.114)	(0.138)	(0.106)
constant	5.722***	6.143***	6.143***	1.214
	(0.817)	(0.845)	(1.025)	(0.782)
R^2	0.143	0.143	0.142	
Quadratic Model	**(13)**	**(14)**	**(15)**	**(16)**
ln(Av.Work.Hours)	-0.512	-1.548	Variance matrix	-1.773***
	(9.684)	(9.763)		(0.096)
$[\ln(\text{Av.Work.Hours})]^2$	-0.013	0.053	Is not symmetric	0.114***
	(0.654)	(0.659)		(0.013)
constant	5.027	9.06	Or highly singular	7.413
	(35.868)	(36.17)		(-)
R^2	0.143	0.143		

Table 5.2: Regression results for TFR-GDPpc 's components.

	Endogenous Variable: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**
[3]**Empl.Ratio**				
Linear Model	**(17)**	**(18)**	**(19)**	**(20)**
ln(Empl.Ratio)	-0.186	-0.117	-0.117	-3.013***
	(0.260)	(0.261)	(0.415)	(0.486)
constant	0.443	0.471***	0.471**	-0.712***
	(0.111)	(0.107)	(0.176)	(0.201)
R^2	0.0007	0.0007	0.0007	
Quadratic Model	**(21)**	**(22)**	**(23)**	**(24)**
ln(Empl.Ratio)	-44.079***	-44.223***	-44.223***	-40.460
	(7.303)	(7.279)	(12.395)	(26.553)
$[\ln(\text{Empl.Ratio})]^2$	-53.591***	-53.838***	-53.838***	-45.642
	(8.908)	(8.880)	(15.347)	(32.180)
constant	-8.526***	-8.543***	-8.543***	-8.378
	(1.495)	(1.490)	(2.499)	(5.469)
R^2	0.121	0.121	0.121	

[1]Time Interval: 1970-2013, countries: 15, observations: 598, observations for GMM: 583.

[2]Time Interval: 1995-2013, countries: 15, observations: 282, observations for GMM: 267.

[3]Time Interval: 1995-2013, countries: 15, observations: 285, observations for GMM: 270.

Table 5.3: Regression results for TFR-GDPpc ‘s components (male dimension).

	Endogenous Variable: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**
[1]**Lab.ProductM**				
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**
ln(Lab.ProductM)	0.176***	0.209***	0.209***	-0.122***
	(0.025)	(0.026)	(0.049)	(0.019)
constant	-0.435***	-0.613***	-0.613**	1.183***
	(0.141)	(0.139)	(0.264)	(0.102)
R^2	0.206	0.206	0.206	
Quadratic Model				
ln(Lab.ProductM)	-1.713***	-1.785***	-1.785***	-1.091***
	(0.297)	(0.293)	(0.129)	(0.291)
$[\ln(\text{Lab.ProductM})]^2$	0.182***	0.192***	0.192***	0.092***
	(0.028)	(0.028)	(0.013)	(0.029)
constant	4.427***	4.53***	4.53***	3.725***
	(0.776)	(0.765)	(0.363)	(0.733)
R^2	0.329	0.329	0.329	
[2]**Week.H.Work.M**				
Linear Model	**(9)**	**(10)**	**(11)**	**(12)**
ln(Week.H.Work.M)	0.259***	0.265***	0.265	0.165
	(0.079)	(0.081)	(0.17)	(0.101)
constant	2.377***	2.420***	2.42	1.706**
	(0.570)	(0.582)	(1.217)	(0.727)
R^2	0.038	0.038	0.038	
Quadratic Model	**(13)**	**(14)**	**(15)**	**(16)**
ln(Week.H.Work.M)	2.087	1.196	Variance matrix	Variance matrix
	(7.019)	(7.094)		
$[\ln(\text{Week.H.Work.M})]^2$	0.127	0.065	Is not symmetric	Is not symmetric
	(0.488)	(0.493)		
constant	8.953	5.770	Or highly singular	Or highly singular
	(25.261)	(25.529)		
R^2	0.038	0.039		

Table 5.3: Regression results for TFR-GDPpc 's components(male dimension).

	Endogenous Variable: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**
[3]**Empl.RatioM**				
Linear Model	**(17)**	**(18)**	**(19)**	**(20)**
ln(Empl.RatioM)	-0.541**	-0.438*	-0.438	-3.674***
	(0.241)	(0.241)	(0.351)	(0.353)
constant	0.312***	0.352***	0.352**	-0.888***
	(0.096)	(0.092)	(0.141)	(0.136)
R^2	0.012	0.012	0.012	
Quadratic Model	**(21)**	**(22)**	**(23)**	**(24)**
ln(Empl.RatioM)	-31.765***	-31.306***	-31.306***	-62.487***
	(5.106)	(5.045)	(6.617)	(12.672)
$[\ln(\text{Empl.RatioM})]^2$	-40.459***	-39.991***	-39.99***	-76.273***
	(6.609)	(6.529)	(8.889)	(16.517)
constant	-5.695***	-5.5988**	-5.588***	-12.196***
	(0.986)	(0.974)	(1.222)	(2.425)
R^2	0.133	0.133	0.133	

[1]Time Interval: 1995-2012, countries: 15, observations: 270, observations for GMM: 255.

[2]Time Interval: 1995-2013, countries: 15, observations: 283, observations for GMM: 268.

[3]Time Interval: 1995-2013, countries: 15, observations: 285, observations for GMM: 270.

Table 5.4: Regression results for TFR-GDPpc's components (female dimension).

	Endogenous Variable: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**
[1]**Lab.ProductF**				
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**
ln(Lab.ProductF)	0.179***	0.253***	0.253***	-0.145***
	(0.032)	(0.035)	(0.031)	(0.018)
constant	-0.479***	-0.888***	-0.888***	1.328***
	(0.185)	(0.193)	(0.334)	(0.096)
R^2	0.174	0.174	0.174	
Quadratic Model	**(5)**	**(6)**	**(7)**	**(8)**
ln(Lab.ProductF)	-0.995***	-1.205***	-1.205***	-0.391
	(0.372)	(0.369)	(0.243)	(0.263)
$[\ln(\text{Lab.ProductF})]^2$	0.111***	-0.138***	0.138***	0.023
	(0.035)	(0.035)	(0.195)	(0.025)
constant	2.591***	2.935***	2.935***	1.991***
	(0.992)	(0.982)	(0.769)	(0.673)
R^2	0.222	0.223	0.223	
[2]**Week.H.Work.F**				
Linear Model	**(9)**	**(10)**	**(11)**	**(12)**
ln(Week.H.Work.F)	0.013*	0.012*	0.012	0.534**
	(0.007)	(0.007)	(0.008)	(0.236)
constant	0.615***	0.611***	0.611***	4.449***
	(0.061)	(0.052)	(0.056)	(1.733)
R^2	0.011	0.011	0.011	
Quadratic Model	**(13)**	**(14)**	**(15)**	**(16)**
ln(Week.H.Work.F)	-0.299***	-0.298***	-0.298***	-13.036
	(0.044)	(0.044)	(0.082)	(11.558)
$[\ln(\text{Week.H.Work.F})]^2$	-0.038***	-0.038***	-0.038***	-0.889
	(0.005)	(0.05)	(0.01)	(0.776)
constant	0.373***	0.373***	0.373***	-47.096
	(0.066)	(0.059)	(0.048)	(43.009)
R^2	0.169	0.169	0.169	

Table 5.4: Regression results for TFR-GDPpc 's components (female dimension).

	Endogenous Variable: ln(TFR)			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**
[3]**Empl.RatioF**				
Linear Model	**(17)**	**(18)**	**(19)**	**(20)**
ln(Empl.RatioF)	0.323	0.335	0.334	-0.269
	(0.259)	(0.261)	(0.437)	(0.479)
constant	0.659***	0.664***	0.664***	0.405*
	(0.118)	(0.113)	(0.194)	(0.209)
R^2	0.006	0.006	0.006	
Quadratic Model	**(21)**	**(22)**	**(23)**	**(24)**
ln(Empl.RatioF)	-32.341***	-32.804***	-32.803***	15.979
	(6.727)	(6.747)	(7.253)	(17.842)
$[\ln(\text{Empl.RatioF})]^2$	-37.943***	-38.494***	-38.494***	18.841
	(7.809)	(7.833)	(8.425)	(20.551)
constant	-6.359***	-6.456***	-6.456***	3.903
	(1.449)	(1.453)	(1.565)	(3.868)
R^2	0.088	0.088	0.088	

[1]Time Interval: 1995-2012, countries: 15, observations: 269, observations for GMM: 254.

[2]Time Interval: 1995-2013, countries: 15, observations: 284, observations for GMM: 269.

[3]Time Interval: 1995-2013, countries: 15, observations: 285, observations for GMM: 270.

Table 5.5: Regression results for ASFRs-GDPpc and its components.

	Endogenous Variable: ln(ASFR$_{15\text{-}29}$)				**Endogenous Variable: ln(ASFR$_{30\text{-}49}$)**			
	RE	**FE**	**FE(D-K s.e.)**	**^{2}GMM**	**RE**	**FE**	**FE(D-K s.e.)**	**^{2}GMM**
^{1}GDPpc								
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ln(GDPpc)	-0.492***	-0.498***	-0.498***	-0.268***	0.440***	0.440***	0.440***	0.487***
	(0.017)	(0.016)	(0.024)	(0.029)	(0.029)	(0.029)	(0.152)	(0.054)
constant	5.139***	5.203***	5.203***	2.841***	-5.015***	-5.018***	-5.018***	-5.512***
	(0.176)	(0.168)	(0.237)	(0.306)	(0.297)	(0.295)	(1.577)	(0.561)
R^2	0.705	0.705	0.705		0.377	0.377	0.377	
Quadratic Model	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**	**(16)**
ln(GDPpc)	2.956***	3.016***	3.016***	1.22**	-6.401***	-6.459***	-6.459***	-5.091***
	(0.361)	(0.353)	(0.602)	(0.51)	(0.596)	(0.599)	(0.757)	(0.616)
[ln(GDPpc)]^2	-0.172***	-0.175***	-0.175***	-0.07***	0.341***	0.343***	0.343***	0.275***
	(0.018)	(0.175)	(0.031)	(0.03)	(0.029)	(0.029)	(0.041)	(0.031)
constant	-12.136***	-12.404***	-12.404***	-4.69*	29.278***	29.561***	29.561***	22.740***
	(1.816)	(1.772)	(2.906)	(2.54)	(2.994)	(3.012)	(3.393)	(3.096)
R^2	0.765	0.765	0.765		0.536	0.536	0.536	
^{1}Lab.Product								
Linear Model	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**	**(24)**
ln(Lab.Product)	-0.790***	-0.789***	-0.789***	-0.835***	0.868***	0.880***	0.880***	0.678***
	(0.026)	(0.025)	(0.047)	(0.041)	(0.041)	(0.041)	(0.178)	(0.055)
constant	-0.152***	-0.143***	-0.143***	-0.157***	-0.239***	-0.215***	-0.215***	-0.278***
	(0.039)	(0.009)	(0.015)	(0.014)	(0.049)	(0.014)	(0.040)	(0.018)
R^2	0.722	0.722	0.722		0.561	0.561	0.561	
Quadratic Model	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**	**(31)**	**(32)**
ln(Lab.Product)	-1.007***	-1.002***	-1.001***	-1.203***	1.826***	1.839***	1.839***	1.475***
	(0.068)	(0.068)	(0.077)	(0.105)	(0.097)	(0.096)	(0.158)	(0.142)
[ln(Lab.Product)]^2	-0.311***	-0.307***	-0.307***	-0.534***	1.375***	1.380***	1.380***	1.155***
	(0.091)	(0.092)	(0.091)	(0.132)	(0.130)	(0.129)	(0.222)	(0.193)
constant	-0.172***	-0.162***	-0.162***	-0.191***	-0.153***	-0.127***	-0.127***	-0.203***
	(0.037)	(0.011)	(0.018)	(0.018)	(0.049)	(0.015)	(0.013)	(0.019)
R^2	0.730	0.730	0.730		0.667	0.667	0.667	

[1]Time Interval: 1970-2009, countries:10, observations for GDPpc/Lab.Productivity:40/373, [2]observations for GDPpc/Lab.Produc.: 390/363.

Table5.5 : Regression results for ASFRs-GDPpc and its components.

	Endogenous Variable: ln($ASFR_{15-29}$)				**Endogenous Variable: ln($ASFR_{30-49}$)**			
	RE	**FE**	**FE(D-K s.e.)**	**[4]GMM**	**RE**	**FE**	**FE(D-K s.e.)**	**[4]GMM**
[3]Av.Work.Hours								
Linear Model	**(33)**	**(34)**	**(35)**	**(36)**	**(37)**	**(38)**	**(39)**	**(40)**
ln(Av.Work.Hours)	-0.704***	-0.761***	-0.761***	-0.094	-3.664***	-4.144***	-4.144***	-0.529***
	(0.111)	(0.114)	(0.138)	(0.106)	(0.260)	(0.256)	(0.465)	(0.199)
constant	5.722***	6.143***	6.143***	1.214	26.794***	30.34***	30.34***	3.656**
	(0.817)	(0.845)	(1.025)	(0.782)	(1.921)	(1.887)	(3.442)	(1.472)
R^2	0.143	0.143	0.142		0.654	0.654	0.654	
Quadratic Model	**(41)**	**(42)**	**(43)**	**(44)**	**(45)**	**(46)**	**(47)**	**(48)**
ln(Av.Work.Hours)	-0.512	-1.548	Variance	-1.773***	16.618	17.235	Variance	-65.775**
	(9.684)	(9.763)	matrix	(0.096)	(23.048)	(21.616)	matrix	(31.099)
$[\ln(\text{Av.Work.Hours})]^2$	-0.013	0.053	Is not	0.114***	-1.378	-1.449	Is not	4.422**
	(0.654)	(0.659)	symmetric	(0.013)	(1.562)	(1.465)	symmetric	(2.109)
constant	5.027	9.06	Or highly	7.413	-47.801	-48.488	Or highly	244.269**
	(35.868)	(36.17)	singular	(-)	(85.002)	(79.719)	singular	(114.650)
R^2	0.143	0.143			0.657	0.657		
[3]Empl.Ratio								
Linear Model	**(49)**	**(50)**	**(51)**	**(52)**	**(53)**	**(54)**	**(55)**	**(56)**
ln(Empl.Ratio)	-1.197**	-0.809	-0.809	-5.331***	3.522***	4.359***	4.360***	-2.896***
	(0.582)	(0.594)	(1.092)	(0.649)	(0.948)	(0.973)	(0.445)	(0.839)
constant	-0.607**	-0.447*	-0.447	-2.309***	1.185***	1.529***	1.530***	-1.441***
	(0.242)	(0.244)	(0.436)	(0.265)	(0.393)	(0.400)	(0.184)	(0.352)
R^2	0.013	0.013	0.013		0.126	0.126	0.126	
Quadratic Model	**(57)**	**(58)**	**(59)**	**(60)**	**(61)**	**(62)**	**(63)**	**(64)**
ln(Empl.Ratio)	22.290	33.059**	33.059***	-135.07***	-162.318***	-160.220***	-160.22***	-148.433***
	(16.750)	(15.963)	(10.071)	(30.732)	(22.705)	(22.566)	(22.42)	(35.774)
$[\ln(\text{Empl.Ratio})]^2$	28.644	40.783**	40.783***	-157.419***	-200.159***	-198.190***	-198.19***	-176.585***
	(20.179)	(19.209)	(12.799)	(37.402)	(27.338)	(27.156)	(26.862)	(43.044)
constant	4.196	6.567**	6.567***	-28.984***	-33.087***	-32.558***	-32.558***	-31.362***
	(3.472)	(3.313)	(1.989)	(6.301)	(4.709)	(4.683)	(4.656)	(7.418)
R^2	0.035	0.044	0.044		0.368	0.369	0.369	

[3]Time interval: 1995-2009, countries: 10; observations forAv.Work.Hours/Empl.Ratio:373/150, [4]observations for GDPpc/Lab.Produc:363/140.

Table 5.6 : Regressions results for ASFRs-GDPpc and its components(male dimension).

	Endogenous Variable: ln($ASFR_{15-29}$)				**Endogenous Variable: ln($ASFR_{30-49}$)**			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**	**RE**	**FE**	**FE (D-K s.e.)**	**GMM**
[1]Lab.ProductM								
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ln(Lab.ProductM)	-0.34***	-0.376***	-0.376***	-0.124**	0.829***	0.985***	0.985***	-0.067**
	(0.042)	(0.045)	(0.043)	(0.028)	(0.056)	(0.051)	(0.089)	(0.028)
constant	1.731***	1.926***	1.926***	0.553**	-4.758***	-5.604***	-5.604***	0.113
	(0.235)	(0.244)	(0.237)	(0.146)	(0.314)	(0.275)	(0.481)	(0.151)
R^2	0.336	0.336	0.336		0.732	0.732	0.732	
Quadratic Model								
ln(Lab.ProductM)	-0.023	0.133	0.133	-2.949***	-2.207***	-2.156***	-2.157***	-0.649
	(0.443)	(0.446)	(0.201)	(0.367)	(0.498)	(0.426)	(0.261)	(0.511)
$[\ln(Lab.ProductM)]^2$	-0.029	-0.049	-0.049***	0.27***	0.295***	-0.299***	0.299***	0.056
	(0.042)	(0.042)	(0.016)	(0.036)	(0.047)	(0.04)	(0.023)	(0.05)
constant	0.885	0.605	0.605	7.874***	2.966**	2.545**	2.546***	1.622
	(1.168)	(1.177)	(0.627)	(0.919)	(1.314)	(1.124)	(0.807)	(1.274)
R^2	0.342	0.342	0.342		0.808	0.732	0.809	
[2]Week.H.Work.M								
Linear Model	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**	**(24)**
ln(Week.H.Work.M)	-0.316*	-0.324*	-0.324	-0.209	1.195***	1.401***	1.401***	0.431***
	(0.166)	(0.175)	(0.199)	(0.156)	(0.261)	(0.289)	(0.450)	(0.134)
constant	-2.376**	-2.431*	-2.431	-1.621	8.289***	9.764***	9.764***	2.832***
	(1.188)	(1.250)	(1.429)	(1.123)	(1.870)	(2.066)	(3.234)	(0.955)
R^2	0.024	0.024	0.024		0.147	0.147	0.147	
Quadratic Model	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**	**(31)**	**(32)**
ln(Week.H.Work.M)	18.848	17.310	Variance	Variance	-6.795	-12.478	Variance	Variance
	(11.512)	(11.751)	matrix	matrix	(19.002)	(19.552)	matrix	matrix
$[\ln(Week.H.Work.M)]^2$	1.333*	1.227	Is not	Is not	-0.555	-0.966	Is not	Is not
	(0.801)	(0.817)	symmetric	symmetric	(1.322)	(1.360)	symmetric	symmetric
constant	66.461	60.919	Or highly	Or highly	-20.459	-40.097	Or highly	Or highly
	(41.364)	(42.232)	singular	singular	(68.26)	(70.267)	singular	singular
R^2	0.040	0.040			0.149	0.149		

Table 5.6: Regressions results for ASFRs-GDPpc and its components (male dimension).

	Endogenous Variable: ln($ASFR_{15-29}$)				**Endogenous Variable: ln($ASFR_{30-49}$)**			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**	**RE**	**FE**	**FE (D-K s.e.)**	**GMM**
[3]**Empl.RatioM**								
Linear Model	**(33)**	**(34)**	**(35)**	**(36)**	**(37)**	**(38)**	**(39)**	**(40)**
ln(Empl.RatioM)	-0.103	0.295	0.295	-4.131***	0.569	1.403	1.403**	-3.569***
	(0.539)	(0.551)	(0.688)	(0.492)	(0.897)	(0.953)	(0.56)	(0.693)
constant	-0.154	-0.002	0.002	-1.699***	-0.445	0.274	0.274	-1.615***
	(0.210)	(0.211)	(0.249)	(0.188)	(0.346)	(0.364)	(0.231)	(0.269)
R^2	0.0021	0.0021	0.002		0.015	0.015	0.015	
Quadratic Model	**(41)**	**(42)**	**(43)**	**(44)**	**(45)**	**(46)**	**(47)**	**(48)**
ln(Empl.RatioM)	41.612***	42.888***	42.888***	-5.096	-123.987***	-122.547***	-122.547***	-152.522***
	(8.926)	(8.794)	(3.168)	(17.647)	(12.706)	(12.604)	(12.045)	(16.362)
$[\ln(\text{Empl.RatioM})]^2$	53.945***	55.186***	55.176***	-1.253	-161.679***	-160.568***	-160.568***	-193.282***
	(11.545)	(11.373)	(4.458)	(23.129)	(16.436)	(16.299)	(15.481)	(21.299)
constant	7.880***	8.187***	8.187***	-1.885	-23.946***	-23.558***	-23.558***	-30.214***
	(1.725)	(1.699)	(0.587)	(3.355)	(2.454)	(2.435)	(2.326)	(3.136)
R^2	0.145	0.148	0.148		0.419	0.422	0.422	

[1]Time Interval: 1995-2009, countries: 10, observations: 149, observations for GMM: 139.

[2]Time Interval: 1995-2009, countries: 10, observations: 148, observations for GMM: 138.

[3]Time Interval: 1995-2009, countries: 10, observations:150, observations for GMM:140.

Table 5.7: Regressions results for ASFRs-GDPpc and its components (female dimension).

	Endogenous Variable: ln($ASFR_{15-29}$)				**Endogenous Variable: ln($ASFR_{30-49}$)**			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**	**RE**	**FE**	**FE (D-K s.e.)**	**GMM**
[1]**Lab.ProductF**								
Linear Model	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ln(Lab.ProductF)	-0.324***	-0.378***	-0.378***	-0126***	0.753***	1.06***	1.06***	-0.091***
	(0.049)	(0.056)	(0.07)	(0.026)	(0.073)	(0.069)	(0.087)	(0.025)
constant	1.68***	1.983***	1.983***	0.579***	-4.44***	-6.145***	-6.145***	0.256*
	(0.282)	(0.309)	(0.395)	(0.141)	(0.414)	(0.385)	(0.481)	(0.138)
R^2	0.251	0.251	0.251		0.628	0.628	0.628	
Quadratic Model								
ln(Lab.ProductF)	0.167	0.533	0.533***	-2.718***	-2.885***	-3.35***	-3.35***	-0.235
	(0.504)	(0.513)	(0.159)	(0.357)	(0.649)	(0.526)	(0.526)	(0.517)
$[\ln(\text{Lab.ProductF})]^2$	-0.046	-0.087*	-0.087***	0.242***	0.357***	0.423***	0.423***	0.134
	(0.048)	(0.049)	(0.014)	(0.034)	(0.062)	(0.05)	(0.05)	(0.043)
constant	0.385	-0.363	-0.363***	7.458***	4.657***	5.214***	5.214***	0.637
	(1.33)	(1.345)	(0.537)	(0.913)	(1.711)	(5.214)	(1.383)	(1.323)
R^2	0.266	0.268	0.268		0.755	0.755	0.755	
[2]**Week.H.Work.F**								
Linear Model	**(17)**	**(18)**	**(19)**	**(20)**	**(21)**	**(22)**	**(23)**	**(24)**
ln(Week.H.Work.F)	-0.522***	-0.549***	-0.549***	0.142	1.505***	1.567***	1.567***	0.781***
	(0.095)	(0.097)	(0.056)	(0.364)	(0.132)	(0.136)	(0.132)	(0.134)
constant	-3.940***	-4.142***	-4.142***	0.922	10.765***	11.214***	11.214***	5.463***
	(0.699)	(0.707)	(0.413)	(1.000)	(0.969)	(0.994)	(0.982)	(0.975)
R^2	0.190	0.190	0.190		0.491	0.491	0.491	
Quadratic Model	**(25)**	**(26)**	**(27)**	**(28)**	**(29)**	**(30)**	**(31)**	**(32)**
ln(Week.H.Work.F)	-22.429***	-26.582***	Variance	Variance	2.200	2.806	Variance	Variance
	(8.268)	(8.219)	matrix	matrix	(11.751)	(11.963)	matrix	matrix
$[\ln(\text{Week.H.Work.F})]^2$	-1.484***	-1.763***	Is not	Is not	0.047	0.084	Is not	Is not
	(0.559)	(0.556)	symmetric	symmetric	(0.796)	(0.809)	symmetric	symmetric
constant	-84.762***	-100.228***	Or highly	Or highly	13.319	15.791	Or highly	Or highly
	(30.516)	(30.342)	singular	singular	(43.364)	(44.163)	singular	singular
R^2	0.245	0.246			0.491	0.491		

Table 5.7: Regressions results for ASFRs-GDPpc and its components (female dimension).

	Endogenous Variable: ln($ASFR_{15-29}$)				**Endogenous Variable: ln($ASFR_{30-49}$)**			
	RE	**FE**	**FE (D-K s.e.)**	**GMM**	**RE**	**FE**	**FE (D-K s.e.)**	**GMM**
[3]**Empl.RatioF**								
Linear Model	**(33)**	**(34)**	**(35)**	**(36)**	**(37)**	**(38)**	**(39)**	**(40)**
ln(Empl.RatioF)	-1.197**	-0.809	-0.808	-5.331***	3.522***	4.359***	4.359***	-2.896***
	(0.582)	(0.594)	(1.092)	(0.649)	(0.948)	(0.973)	(0.445)	(0.839)
constant	-0.607**	-0.447*	-0.447	-2.309***	1.185***	1.529***	1.529***	-1.441***
	(0.242)	(0.244)	(0.436)	(0.265)	(0.393)	(0.400)	(0.184)	(0.352)
R^2	0.013	0.013	0.013		0.126	0.126	0.126	
Quadratic Model	**(41)**	**(42)**	**(43)**	**(44)**	**(45)**	**(46)**	**(47)**	**(48)**
ln(Empl.RatioF)	22.290	33.06**	33.059***	-135.07**	-162.319***	-160.220***	-160.22***	-148.433***
	(16.750)	(15.96)	(10.071)	(30.732)	(22.705)	(22.566)	(22.419)	(35.774)
$[\ln(\text{Empl.RatioF})]^2$	28.647	40.78**	40.783***	-157.419**	-200.159***	-198.190***	-198.19***	-176.586***
	(20.179)	(19.20)	(12.799)	(37.402)	(27.338)	(27.156)	(26.862)	(43.044)
constant	4.196	6.57**	6.567***	-28.984**	-33.097***	-35.558***	-32.558***	-31.362***
	(3.472)	(3.31)	(1.989)	(6.301)	(4.709)	(4.683)	(4.656)	(7.419)
R^2	0.035	0.044	0.044		0.368	0.369	0.366	

[1]Time Interval: 1995-2009, countries: 10, observations: 149, observations for GMM: 139.

[2]Time Interval: 1995-2009, countries: 10, observations: 149, observations for GMM: 139.

[3]Time Interval: 1995-2009, countries: 10, observations: 150, observations for GMM: 140.

Table 5.8: Regression of $ASFR_{30-49}$ on five years lags of GDP per capita.

	RE	FE	GMM[1]	FE with D-K s.e.
lnGDPpc_lag5	-5.972***	-6.019***	-4.231***	-6.019***
	(0.530)	(0.532)	(0.619)	(0.645)
$(lnGDPpc\_lag5)^2$	0.331***	0.333***	0.238***	0.333***
	(0.266)	(0.027)	(0.031)	(0.033)
constant	25.983***	26.205***	17.898***	26.204***
	(2.637)	(2.645)	(3.059)	(3.149)
R^2	0.717	0.717		0.718

Time interval: 1970-2009, countries: 10, observations for GDPpc: 350.

[1]Instruments: $\ln GDP\ pc_{t-6}$ and $(\ln GDP\ pc_{t-6})^2$, observations: 340.

Table 5.9: Regression of $ASFR_{15-29}$ on five years lags of GDP per capita.

	RE	FE	GMM[1]	FE with D-K s.e.
lnGDPpc_lag5	3.21***	3.27***	1.29**	3.27***
	(0.35)	(0.35)	(0.52)	(0.393)
$(lnGDPpc\_lag5)^2$	-0.18***	-0.19***	-0.07***	-0.185***
	(0.02)	(0.02)	(0.03)	(0.198)
constant	-13.73***	-13.99***	-5.51**	-13.996***
	(1.77)	(1.73)	(2.55)	(1.948)
R^2	0.73	0.73		0.727

Time interval: 1970-2009, countries: 10, observations for GDPpc: 350.

[1]Instruments: $\ln GDP\ pc_{t-6}$ and $(\ln GDP\ pc_{t-6})^2$, observations: 340.

The regressions (analytically)

FE estimator

GDP per capita

<u>Linear Model</u> (1)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (2)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{GDP_{pc}})_{\mathrm{it}}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{GDP_{pc}})_{\mathrm{it}}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{GDP_{pc}})_{\mathrm{it}}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Labor Productivity

<u>Linear Model</u> (3)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (4)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Lab.Product}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Lab.Product}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Lab.Product}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Labor Productivity Male

<u>Linear Model</u> (5)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Lab.\,Product.\,M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (6)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Lab.\,Product.\,M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Lab.\,Product.\,M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Lab.\,Product.\,M})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Lab.\,Product.\,M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Lab.\,Product.\,M})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Lab.\,Product.\,M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Labor Productivity Female

Linear Model (7)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Lab.\,Product.\,F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Lab.\,Product.\,F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Lab.\,Product.\,F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (8)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Lab.\,Product.\,F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Lab.\,Product.\,F}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Lab.\,Product.\,F})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Lab.\,Product.\,F}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Lab.\,Product.\,F})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Lab.\,Product.\,F}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Average Working Hours per Worker

Linear Model (9)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Av.\,Work.\,Hours})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Av.\,Work.\,Hours})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Av.\,Work.\,Hours})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (10)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Av.\,Work.\,Hours})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Av.\,Work.\,Hours}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Av.\,Work.\,Hours})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Av.\,Work.\,Hours}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Av.\,Work.\,Hours})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Av.\,Work.\,Hours}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Weekly Hours Worked per Male

Linear Model (11)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (12)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Week.H.Work.M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Week.H.Work.M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Week.H.Work.M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Weekly Hours Worked per Female

Linear Model (13)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (14)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Week.H.Work.F}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Week.H.Work.F}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Week.H.Work.F}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Employment Ratio

Linear Model (15)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (16)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Ratio}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Empl.Ratio}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Empl.Ratio}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Employment Ratio Male

<u>Linear Model</u> (17)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (18)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Rat.M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_4 \ln(\mathrm{Empl.Rat.M})^2_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Empl.Rat.M}_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Employment Ratio Female

<u>Linear Model</u> (19)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (20)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_4 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_5 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_6 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

RE estimator

GDP per capita

<u>Linear Model</u> (21)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{GDP}_{\mathrm{pc}})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{GDP}_{\mathrm{pc}})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

Quadratic Model (22)

$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{GDP}_{\mathrm{pc}})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{GDP}_{\mathrm{pc}})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{GDP}_{\mathrm{pc}})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{GDP}_{\mathrm{pc}})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{GDP}_{\mathrm{pc}})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{GDP}_{\mathrm{pc}})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

Labor Productivity

Linear Model (23)

$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

Quadratic Model (24)

$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \beta_2 \ln[\mathrm{Lab.Product})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \beta_5 \ln[\mathrm{Lab.Product})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Lab.Product})_{\mathrm{it}} + \beta_8 \ln[\mathrm{Lab.Product})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

Labor Productivity Male

Linear Model (25)

$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

Quadratic Model (26)

$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \beta_2 \ln[\mathrm{Lab.Product.M})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \beta_5 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}}^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \beta_8 \ln[\mathrm{Lab.Product.M})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$

Labor Productivity Female

<u>Linear Model</u> (27)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (28)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \beta_2 \ln[\mathrm{Lab.Product.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \beta_5 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}}^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \beta_8 \ln[\mathrm{Lab.Product.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Average Working Hours

<u>Linear Model</u> (29)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (30)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \beta_2 \ln[\mathrm{Av.Work.Hours})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \beta_5 \ln[\mathrm{Av.Work.Hours})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \beta_8 \ln[\mathrm{Av.Work.Hours})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Weekly Hours Worked per Male

<u>Linear Model</u> (31)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln\,(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

<u>Quadratic Model</u> (32)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_2 \ln[\mathrm{Week.H.Work.M})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_5 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}}^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_8 \ln[\mathrm{Week.H.Work.M})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Weekly Hours Worked per Female

Linear Model (33)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_4 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (34)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Week.H.Work.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Week.H.Work.F})_{\mathrm{it}}^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_8 [\ln[\mathrm{Week.H.Work.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Employment Ratio

Linear Model (35)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (36)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Ratio})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Empl.Ratio})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Empl.Ratio})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Employment Ratio Male

Linear Model (37)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (38)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Rat.M})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_5 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}}^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Empl.Rat.M})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Employment Ratio Female

Linear Model (39)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

Quadratic Model (40)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \nu_{\mathrm{i}} + \varepsilon_{\mathrm{it}}$$

GMM estimator

GDP per capita

Linear Model (41)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{GDP_{pc}})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\text{ASFR}_{30-49})_{\text{it}} = \beta_4 + \beta_5 \ln(\text{GDP}_{\text{pc}})_{\text{it}} + \varepsilon_{\text{it}}$$

I.R.: $\ln(\text{GDP}_{\text{pc}})_{\text{it}} = \gamma_0 + \gamma_1 \ln(\text{GDP}_{\text{pc}})_{\text{it}-1} + \text{u}_{\text{it}}$

Quadratic Model (42)

$$\ln(\text{TFR})_{\text{it}} = \beta_0 + \beta_1 \ln(\text{GDP}_{\text{pc}})_{\text{it}} + \beta_2 [\ln(\text{GDP}_{\text{pc}})_{it}]^2 + \varepsilon_{\text{it}}$$

$$\ln(\text{ASFR}_{15-29})_{\text{it}} = \beta_3 + \beta_4 \ln(\text{GDP}_{\text{pc}})_{\text{it}} + \beta_5 [\ln(\text{GDP}_{\text{pc}})_{it}]^2 + \varepsilon_{\text{it}}$$

$$\ln(\text{ASFR}_{30-49})_{\text{it}} = \beta_6 + \beta_7 \ln(\text{GDP}_{\text{pc}})_{\text{it}} + \beta_8 [\ln(\text{GDP}_{\text{pc}})_{it}]^2 + \varepsilon_{\text{it}}$$

I.R.: $\ln(\text{GDP}_{\text{pc}})_{\text{it}} = \gamma_0 + \gamma_1 \ln(\text{GDP}_{\text{pc}})_{\text{it}-1} + \text{u}_{\text{it}}$

$\ln(\text{GDP}_{\text{pc}})_{\text{it}} = \gamma_2 + \gamma_3 [\ln(\text{GDP}_{\text{pc}})_{it-1}]^2 + \text{u}_{\text{it2}}$

Labor Productivity

Linear Model (43)

$$\ln(\text{TFR})_{\text{it}} = \beta_0 + \beta_1 \ln(\text{Lab. Product})_{\text{it}} + \varepsilon_{\text{it}}$$

$$\ln(\text{ASFR}_{15-29})_{\text{it}} = \beta_2 + \beta_3 \ln(\text{Lab. Product})_{\text{it}} + \varepsilon_{\text{it}}$$

$$\ln(\text{ASFR}_{30-49})_{\text{it}} = \beta_4 + \beta_5 \ln(\text{Lab. Product})_{\text{it}} + \varepsilon_{\text{it}}$$

I.R.: $\ln(\text{Lab. Product})_{\text{it}} = \gamma_0 + \gamma_1 \ln(\text{Lab. Product})_{\text{it}-1} + \text{u}_{\text{it}}$

Quadratic Model (44)

$$\ln(\text{TFR})_{\text{it}} = \beta_0 + \beta_1 \ln(\text{Lab. Product})_{\text{it}} + \beta_2 [\ln(\text{Lab. Product})_{it}]^2 + \varepsilon_{\text{it}}$$

$$\ln(\text{ASFR}_{15-29})_{\text{it}} = \beta_3 + \beta_4 \ln(\text{Lab. Product})_{\text{it}} + \beta_5 [\ln(\text{Lab. Product})_{it}]^2 + \varepsilon_{\text{it}}$$

$$\ln(\text{ASFR}_{30-49})_{\text{it}} = \beta_6 + \beta_7 \ln(\text{Lab. Product})_{\text{it}} + \beta_8 [\ln(\text{Lab. Product})_{it}]^2 + \varepsilon_{\text{it}}$$

I.R.: $\ln(\text{Lab. Product})_{\text{it}} = \gamma_0 + \gamma_1 \ln(\text{Lab. Product})_{\text{it}-1} + \text{u}_{\text{it1}}$

$\ln(\text{Lab. Product})^2_{\text{it}} = \gamma_2 + \gamma_3 [\ln(\text{Lab. Product})_{it-1}]^2 + \text{u}_{\text{it2}}$

Labor Productivity Male

Linear Model (45)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R: $\ln(\mathrm{Lab.Product.M})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (46)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Lab.Product.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Lab.Product.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Lab.Product.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R: $\ln(\mathrm{Lab.Product.M})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Lab.Product.M})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Lab.Product.M})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Lab.Product.M})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Labor Productivity Female

Linear Model (47)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R: $\ln(\mathrm{Lab.Product.F})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (48)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Lab.Product.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Lab.Product.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Lab.Product.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R: $\ln(\mathrm{Lab.Product.F})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Lab.Product.F})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Lab.Product.F})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Lab.Product.F})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Average Working Hours

Linear Model (49)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R: $\ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (50)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Av.Work.Hours})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Av.Work.Hours})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Av.Work.Hours})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R: $\ln(\mathrm{Av.Work.Hours})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Av.Work.Hours})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Av.Work.Hours})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Av.Work.Hours})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Weekly Hours Worked per Male

Linear Model (51)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (52)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Week.H.Work.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Week.H.Work.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Week.H.Work.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Week.H.Work.M})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Week.H.Work.M})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Week.H.Work.M})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 \ln(\mathrm{Week.H.Work.M})^2_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it2}}$

Weekly Hours Worked per Female

Linear Model (53)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (54)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Week.H.Work.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Week.H.Work.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Week.H.Work.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Week.H.Work.F})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Week.H.Work.F})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Week.H.Work.F})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Week.H.Work.F})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Employment Ratio

Linear Model (55)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Empl.Ratio})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (56)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Ratio})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Empl.Ratio})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Empl.Ratio})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Empl.Ratio})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Empl.Ratio})_{\mathrm{it}-1} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Empl.Ratio})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Empl.Ratio})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Employment Ratio Male

Linear Model (57)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (58)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Rat.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Empl.Rat.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Empl.Rat.M})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Empl.Rat.M})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Empl.Rat.M})_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Empl.Rat.M})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Employment Ratio Female

Linear Model (59)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_2 + \beta_3 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_4 + \beta_5 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it}}$

Quadratic Model (60)

$$\ln(\mathrm{TFR})_{\mathrm{it}} = \beta_0 + \beta_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_2 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{15-29})_{\mathrm{it}} = \beta_3 + \beta_4 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_5 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

$$\ln(\mathrm{ASFR}_{30-49})_{\mathrm{it}} = \beta_6 + \beta_7 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} + \beta_8 [\ln(\mathrm{Empl.Rat.F})_{it}]^2 + \varepsilon_{\mathrm{it}}$$

I.R.: $\ln(\mathrm{Empl.Rat.F})_{\mathrm{it}} = \gamma_0 + \gamma_1 \ln(\mathrm{Empl.Rat.F})_{\mathrm{it-1}} + \mathrm{u}_{\mathrm{it1}}$

$\ln(\mathrm{Empl.Rat.F})^2_{\mathrm{it}} = \gamma_2 + \gamma_3 [\ln(\mathrm{Empl.Rat.F})_{it-1}]^2 + \mathrm{u}_{\mathrm{it2}}$

Graphs

GDP per capita

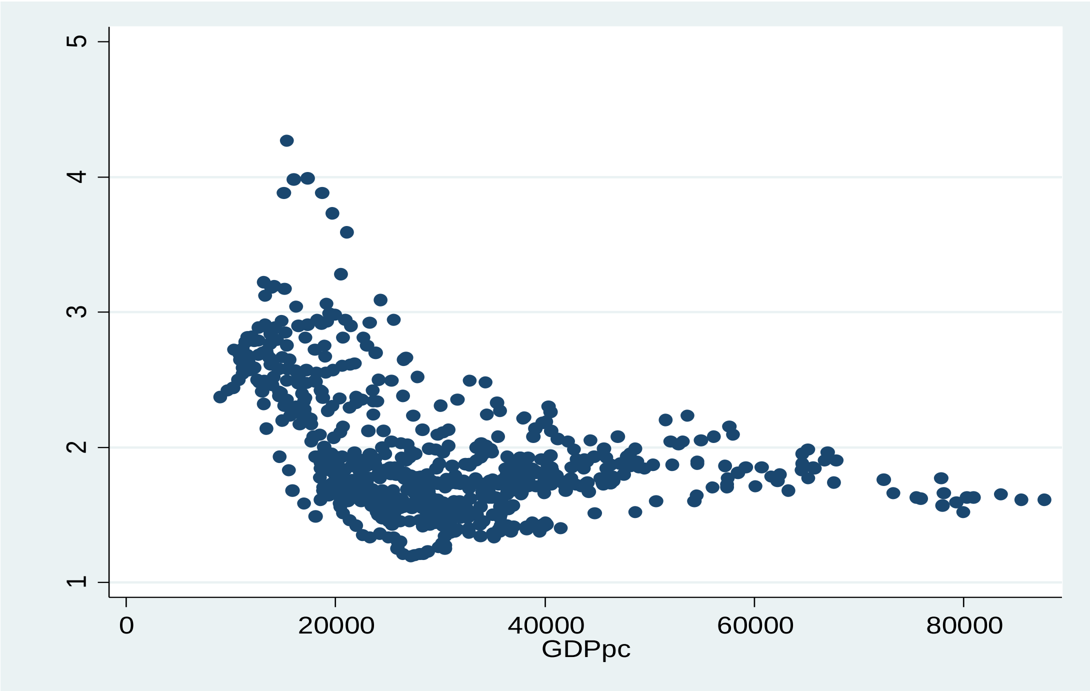

Figure A.1: TFR and GDP per capita plot for period 1960-2013.

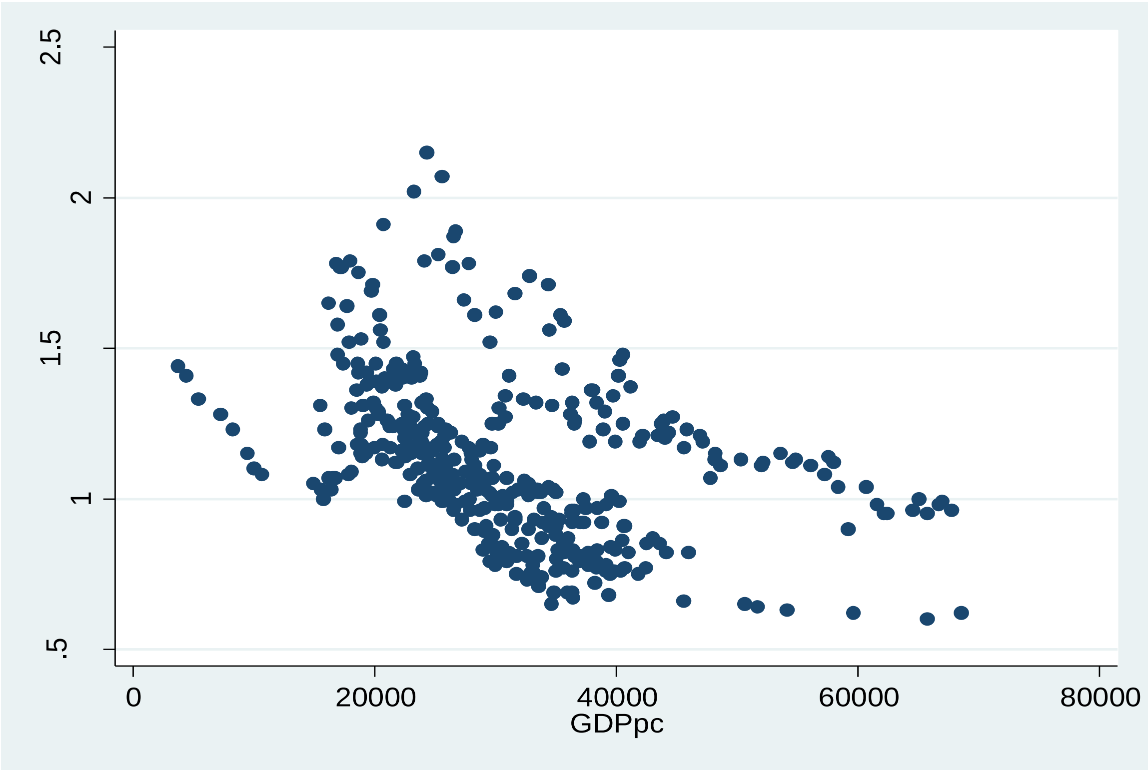

Figure A.2: ASFR$_{15\text{-}29}$ and GDP per capita plot for period 1970-2009.

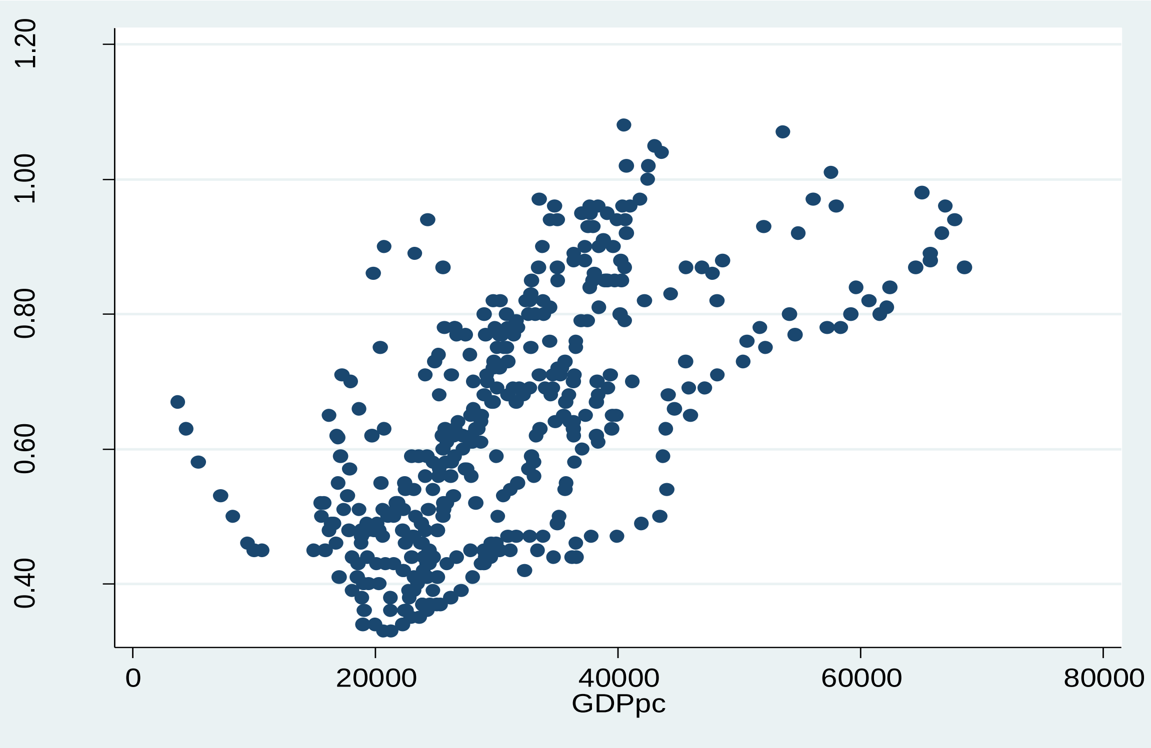

Figure A.3: ASFR$_{30\text{-}49}$ and GDP per capita plot for period 1970-2009.

Labor Productivity

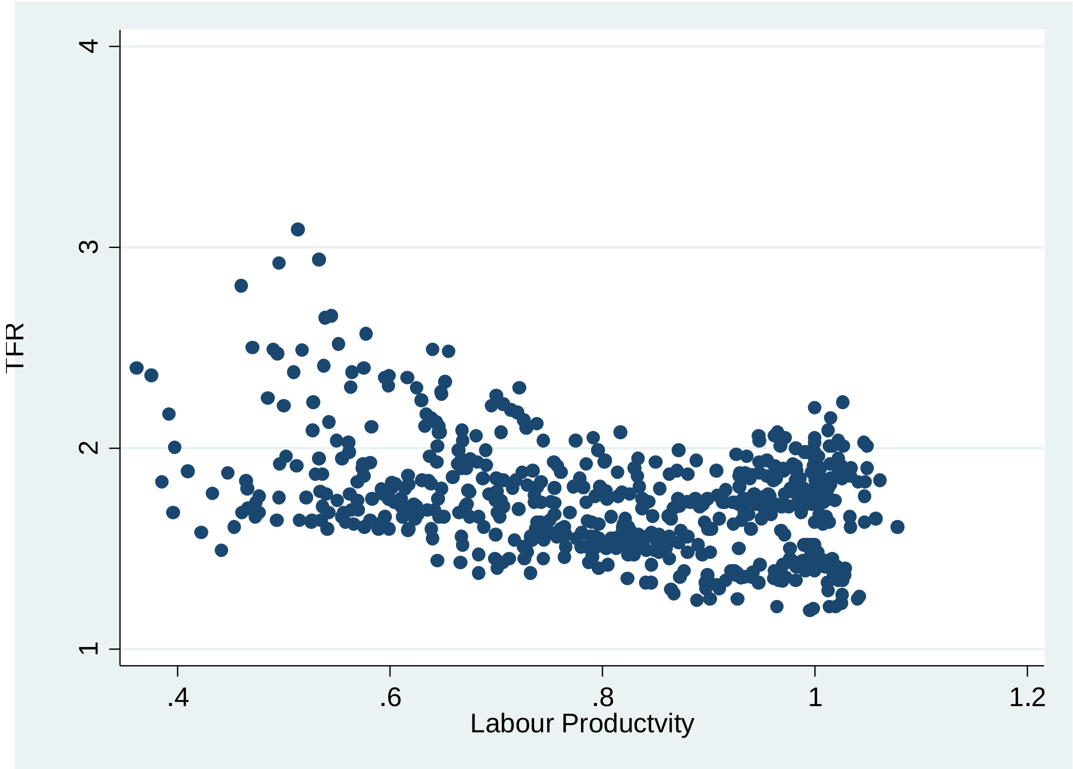

Figure A.4: TFR and Labor Productivity plot for period 1970-2013.

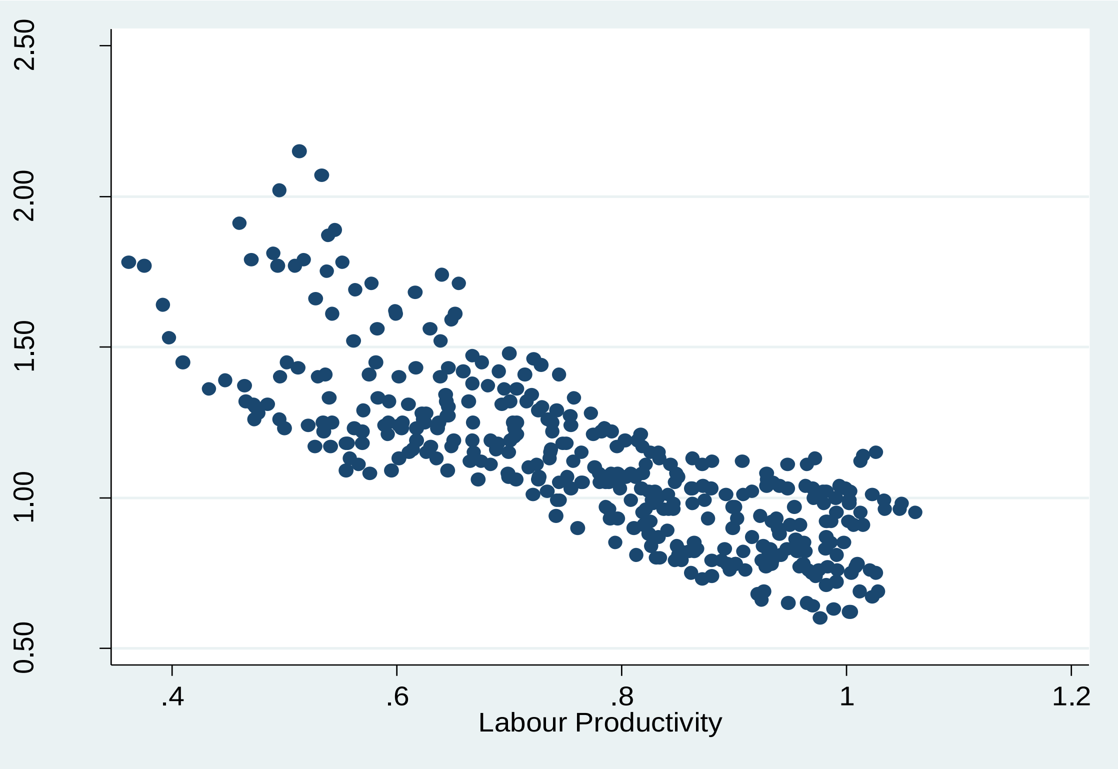

Figure A.5: ASFR$_{15\text{-}29}$ and Labor Productivity plot for period 1970-2009.

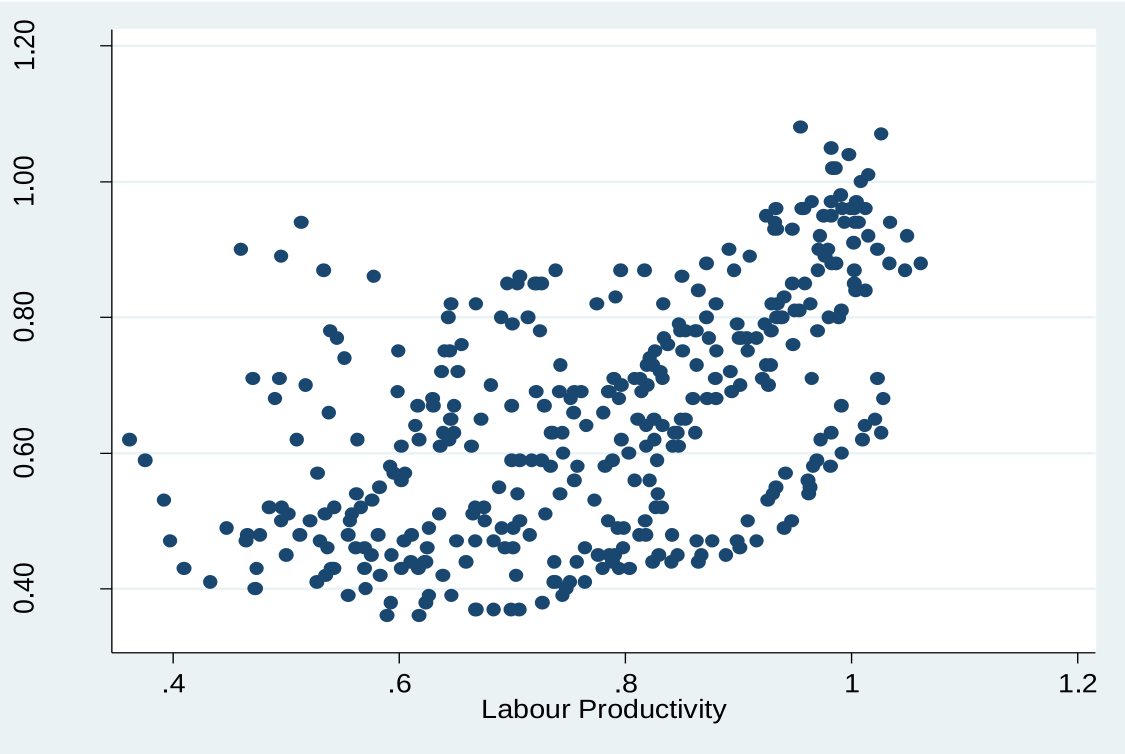

Figure A.6: ASFR$_{30\text{-}49}$ and Labor Productivity plot for period 1970-2009.

Labor Productivity Male

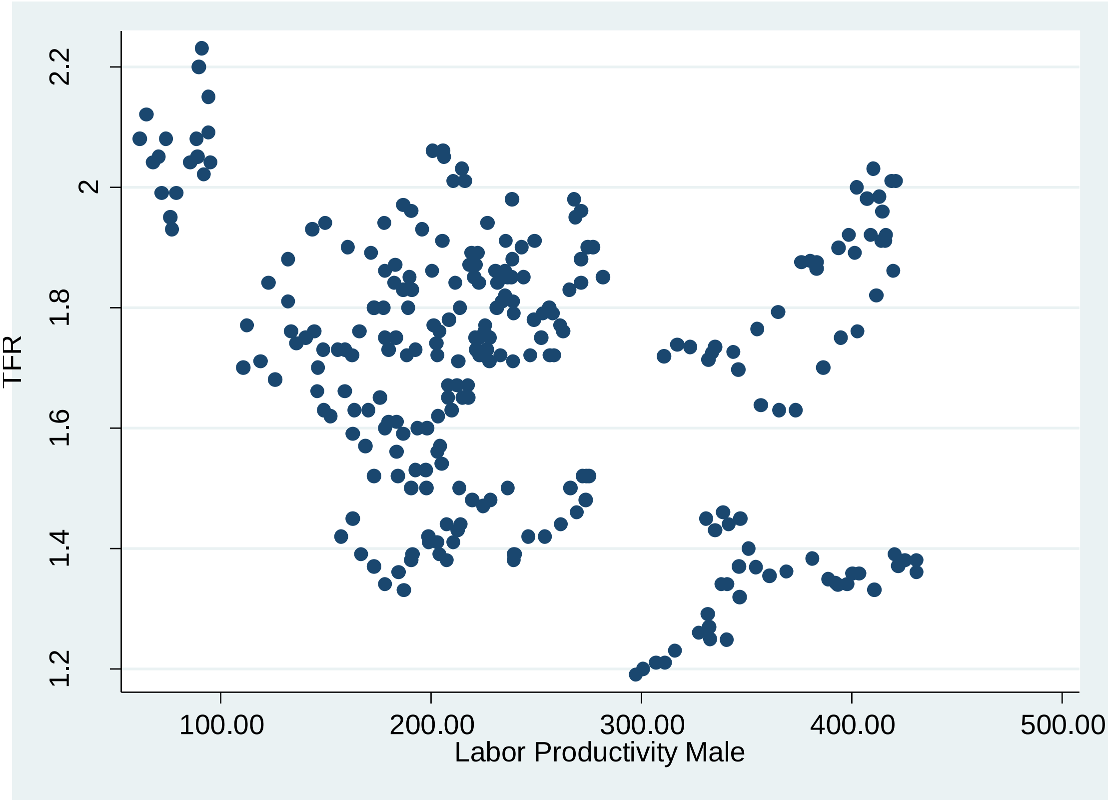

Figure A.7: TFR and Labor Productivity Male plot for period 1995-2012.

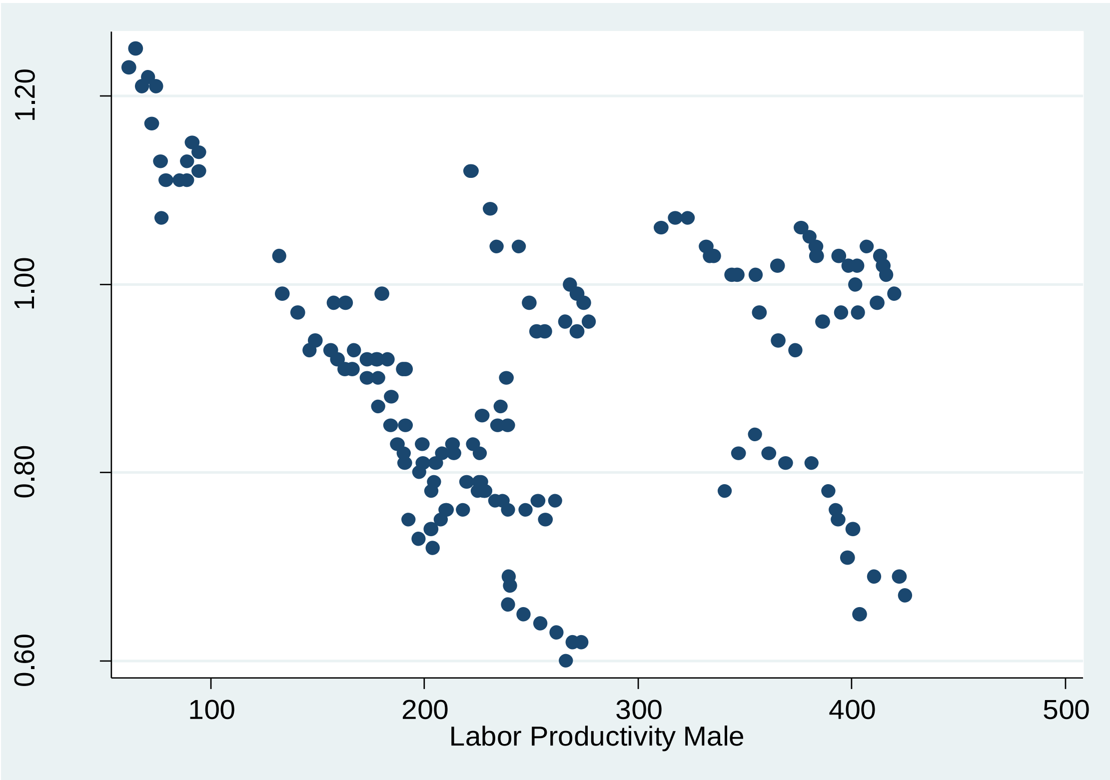

Figure A.8: ASFR$_{15\text{-}29}$ and Labor Productivity Male plot for period 1995-2009.

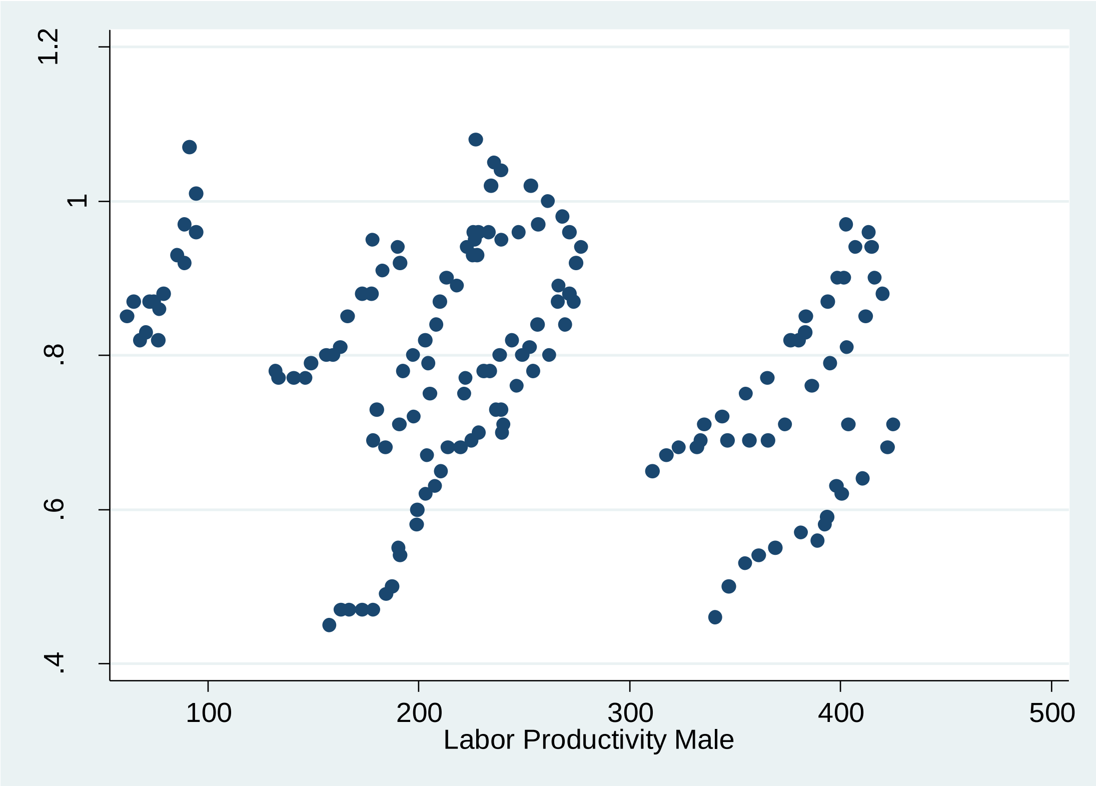

Figure A.9: ASFR$_{30\text{-}49}$ and Labor Productivity Male plot for period 1995-2009.

Labor Productivity Female

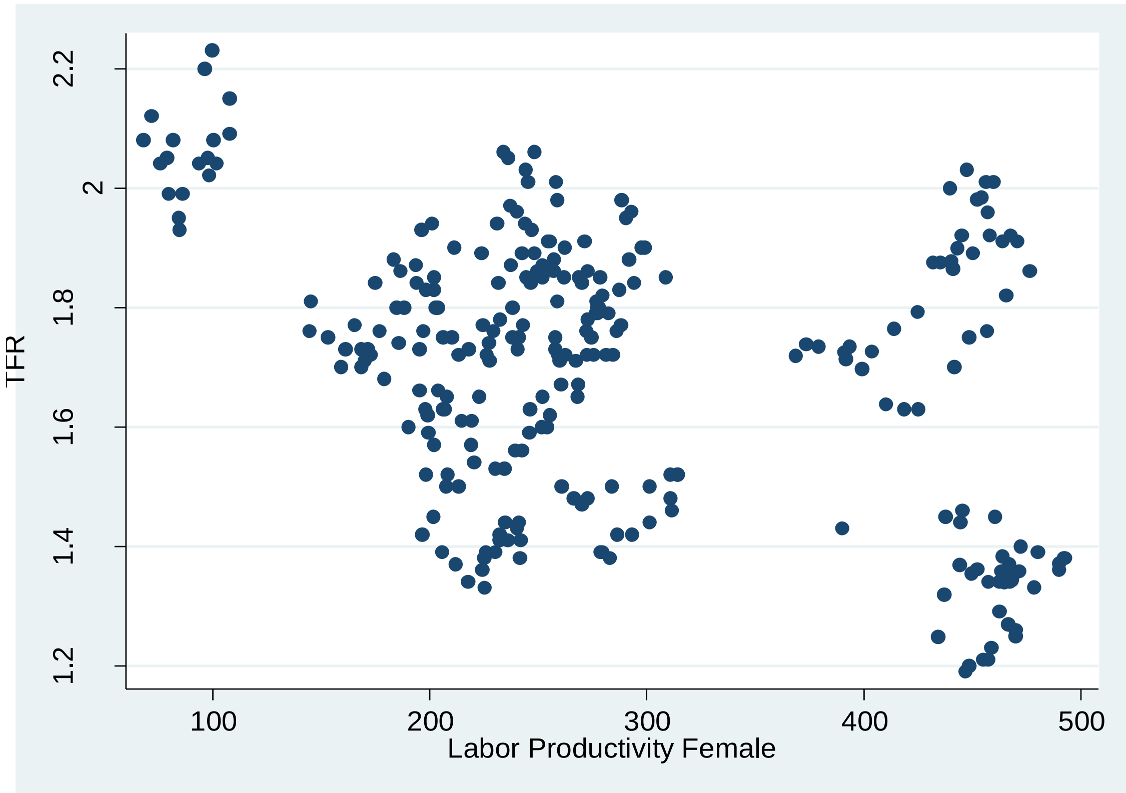

Figure A.10: TFR and Labor Productivity Female plot for period 1995-2012.

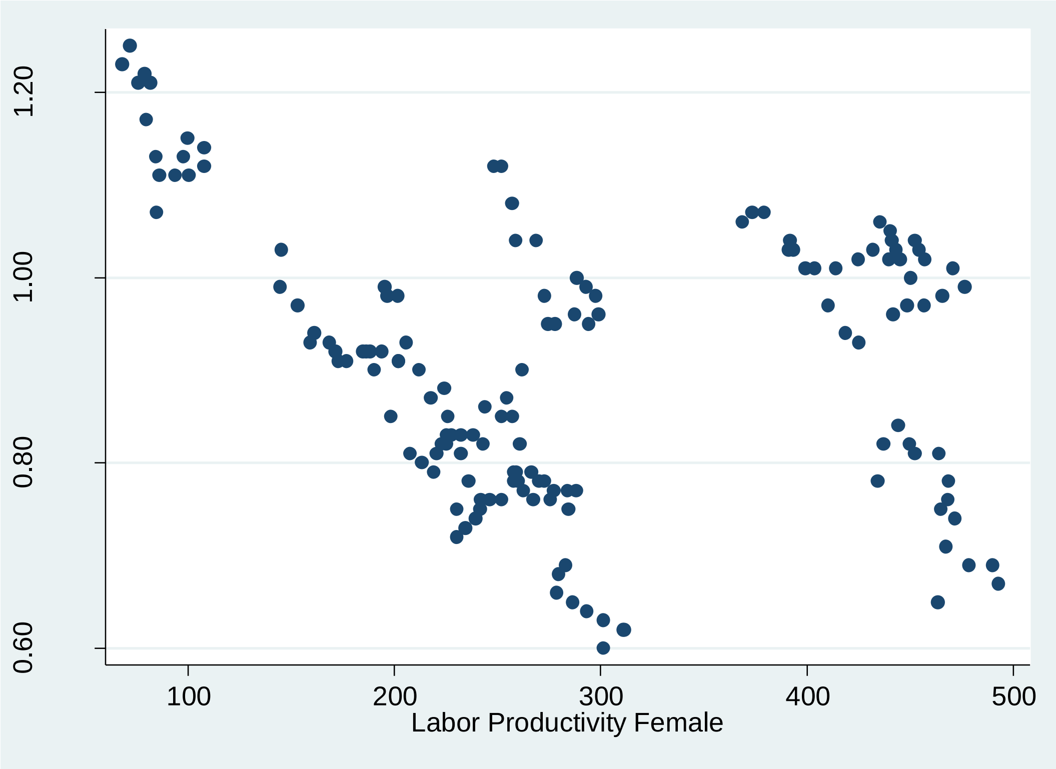

Figure A.11: ASFR$_{15\text{-}29}$ and Labor Productivity Female plot for period 1995-2009.

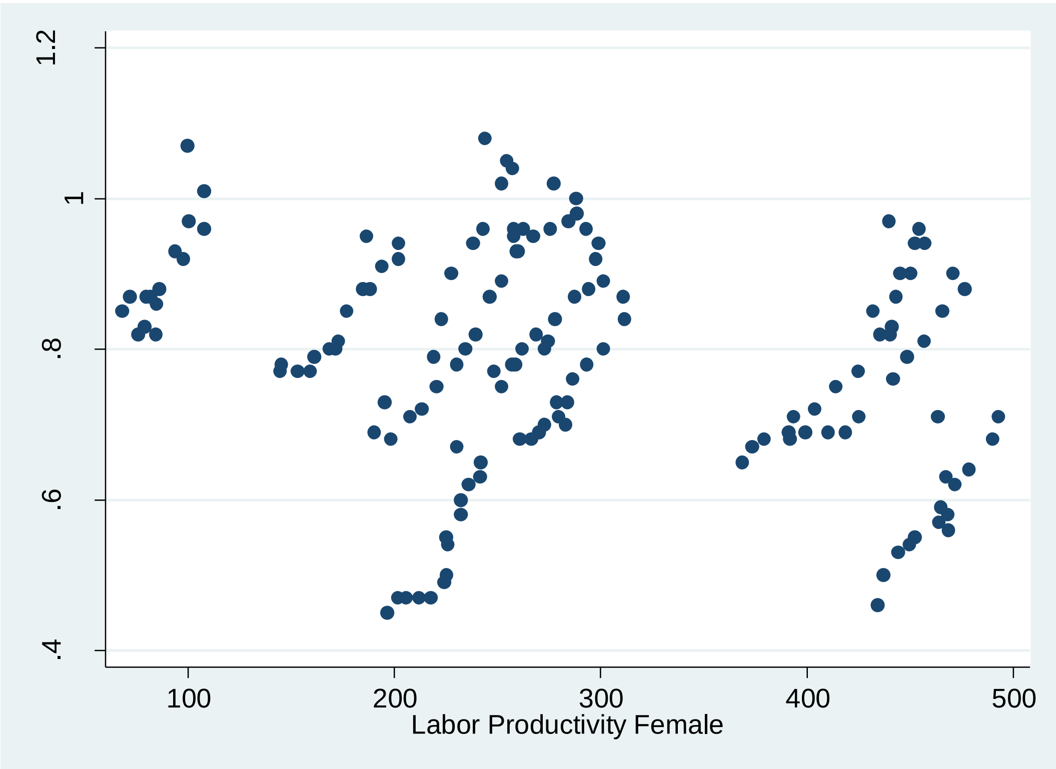

Figure A.12:ASFR$_{30\text{-}49}$ and Labor Productivity Female plot for period 1995-2009.

Average Working Hours per Person

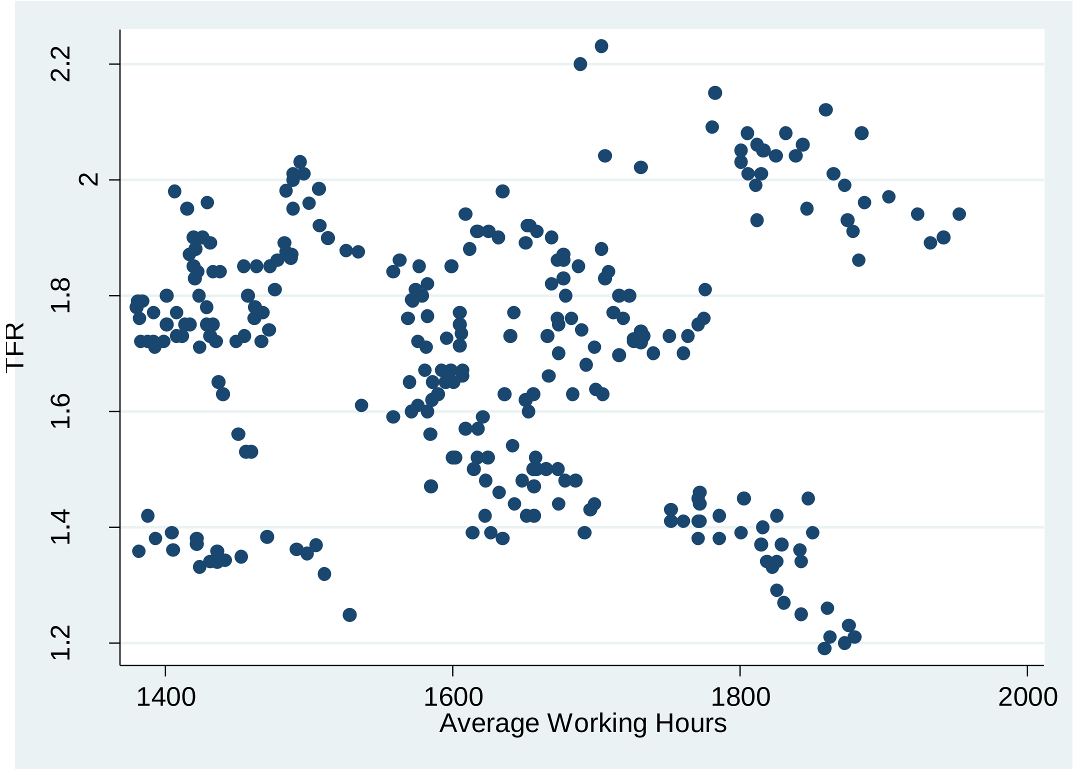

Figure A.13: TFR and Average Working Hours per person plot for period 1995-2013.

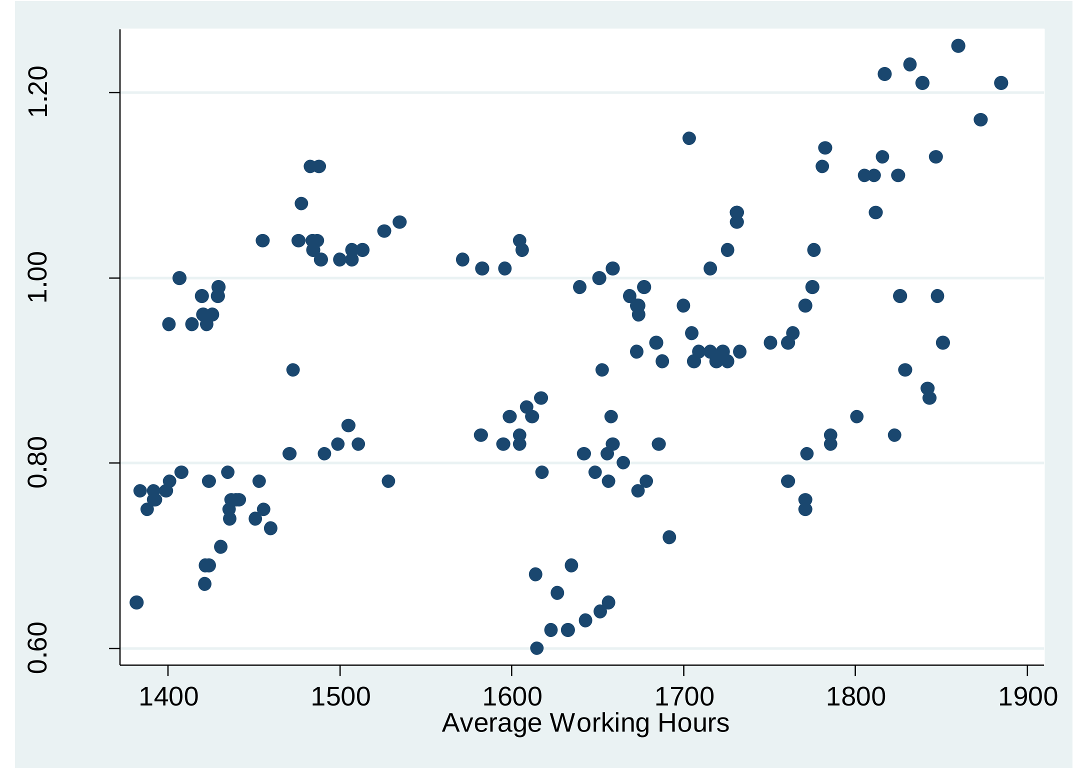

Figure A.14:ASFR$_{15-29}$ and Average Working Hours per person plot fo period r 1995-2009.

Figure A.15:ASFR$_{30\text{-}49}$ and Average Working Hours per person plot for period 1995-2009.

Weekly Hours Worked per Male

Figure A.16: TFR and Weekly Hours Worked per Male plot for period 1995-2013.

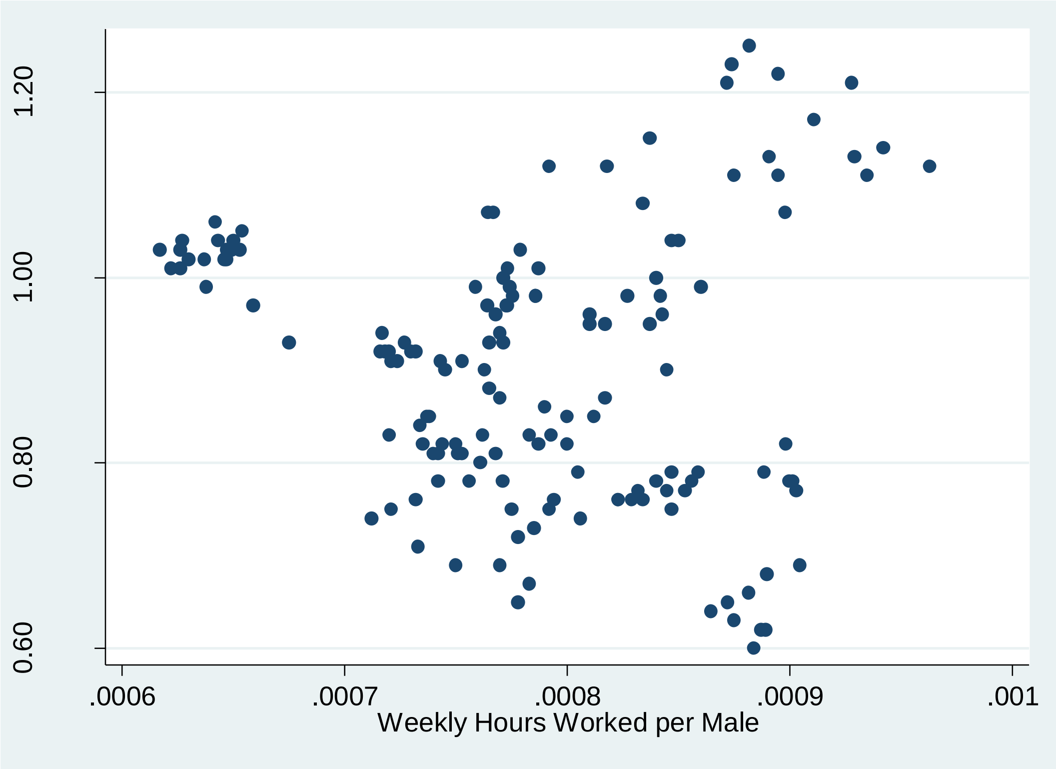

Figure A.17:ASFR$_{15\text{-}29}$ and Weekly Hours Worked per Male plot for period 1995-2009.

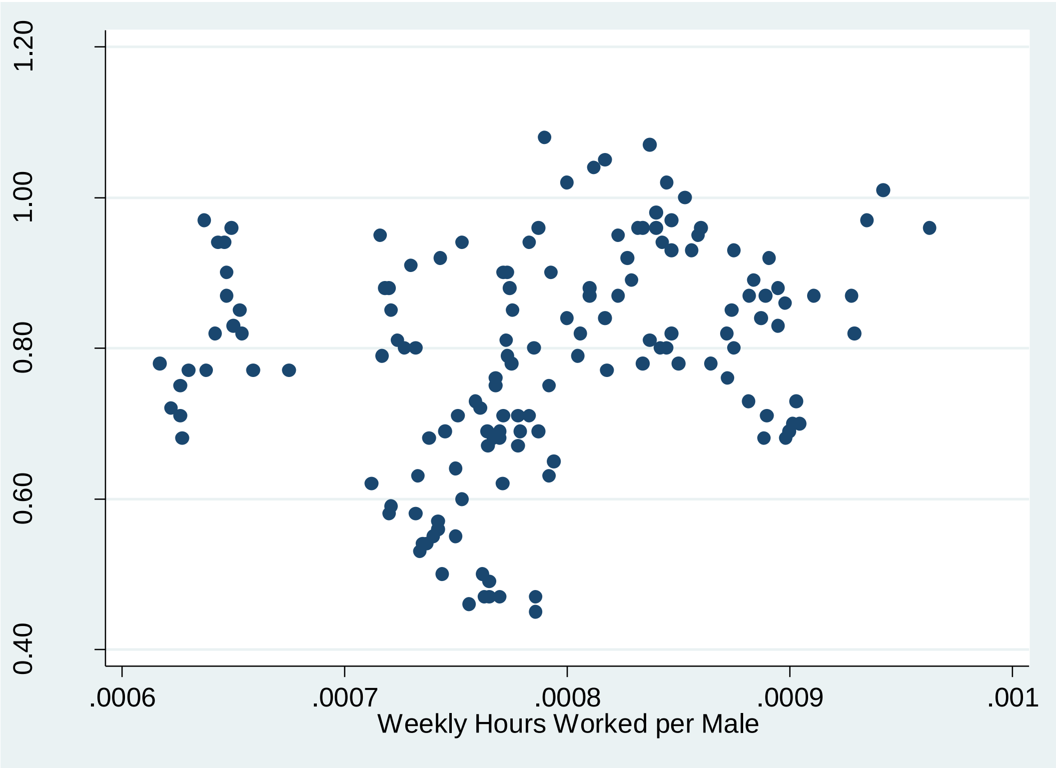

Figure A.18:ASFR$_{30\text{-}49}$ and Weekly Hours Worked per Male plot for period 1995-2009.

Weekly Hours Worked per Female

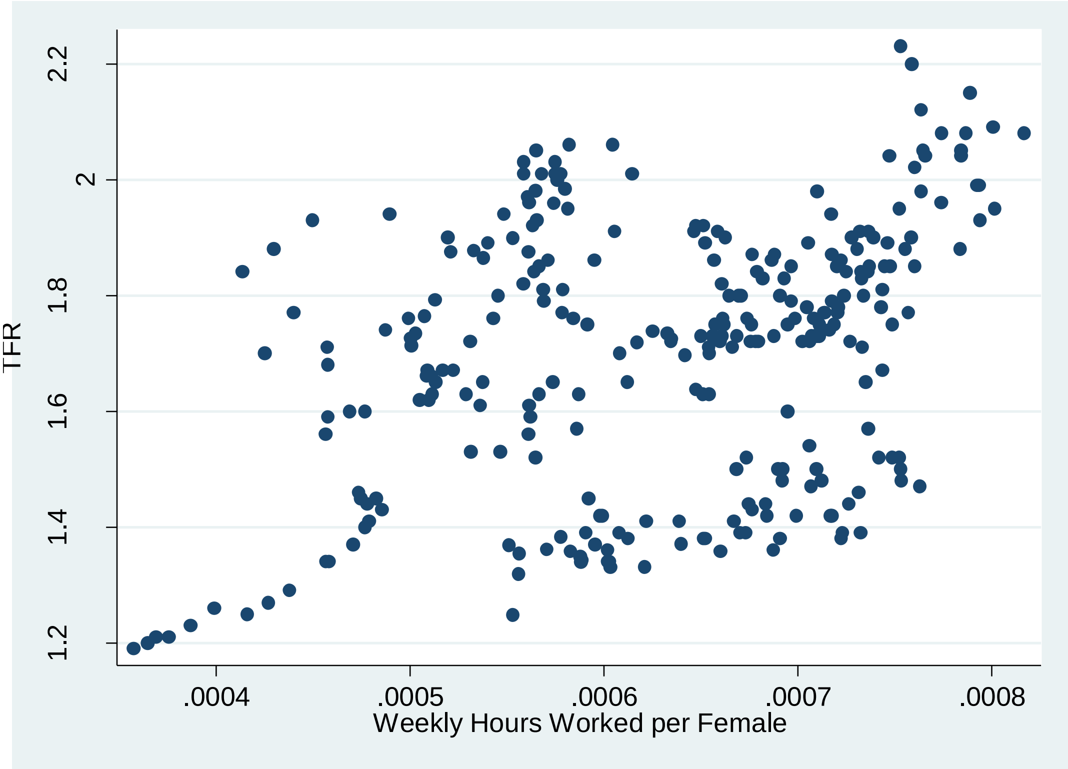

Figure A.19:TFR and Weekly Hours Worked per Female plot for period 1995-2013.

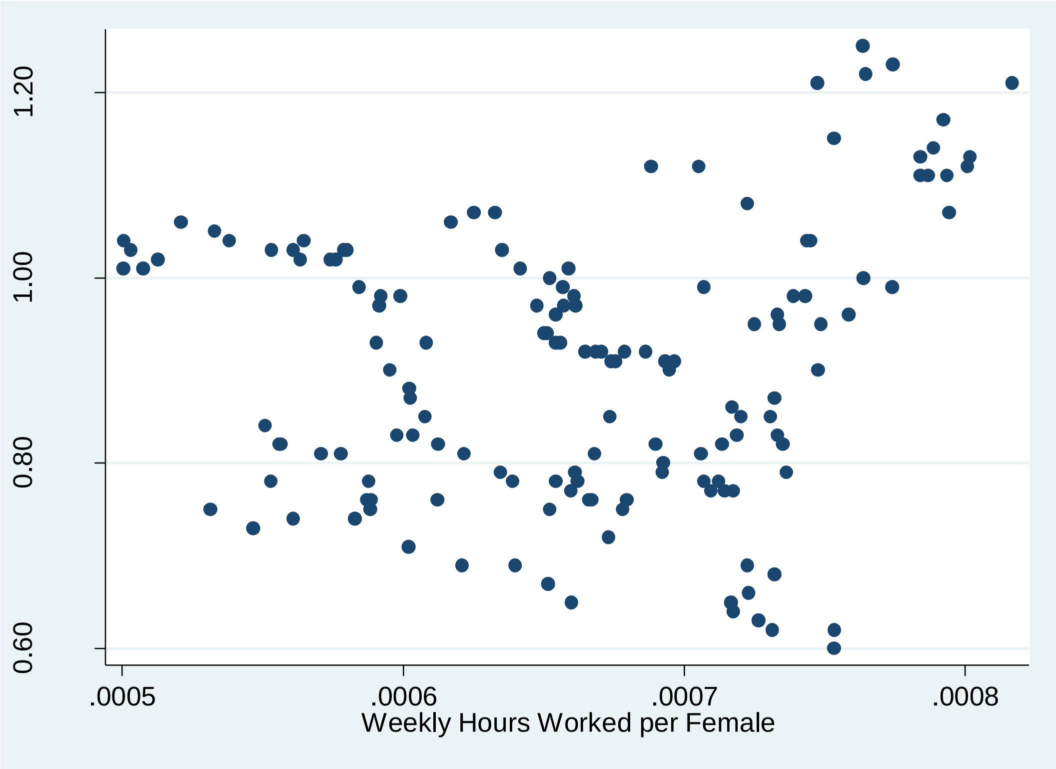

Figure A.20:ASFR$_{15\text{-}29}$ and Weekly Hours Worked per Female plot for period 1995-2009.

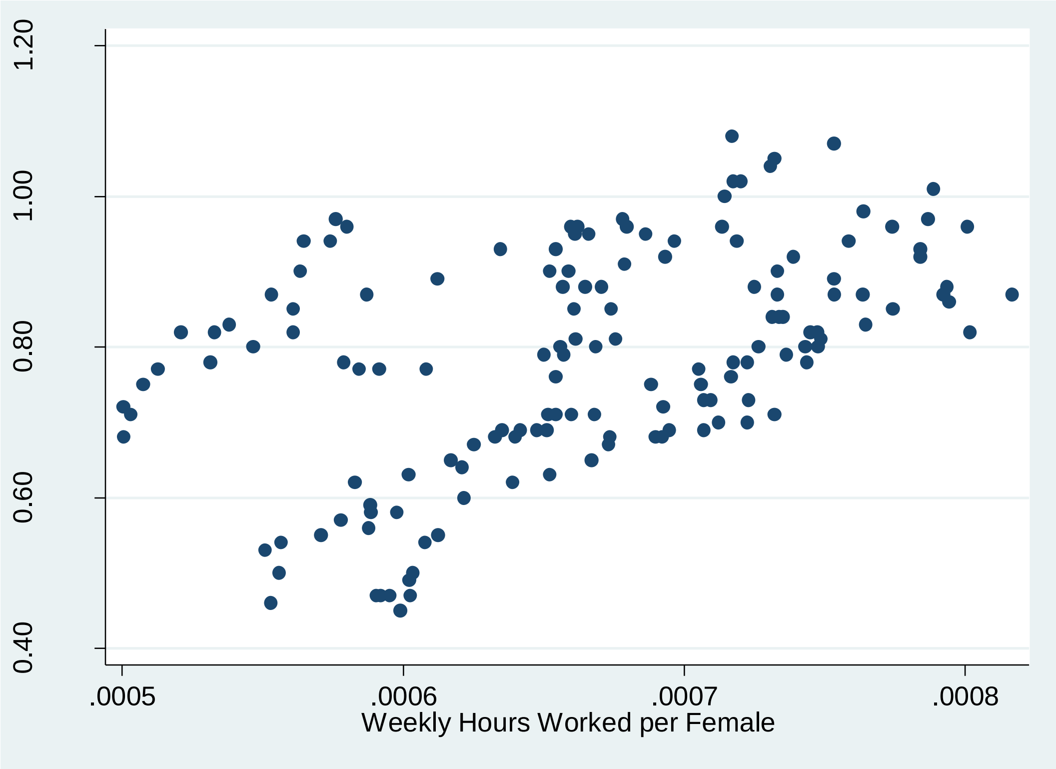

Figure A.21:ASFR$_{30\text{-}49}$ and Weekly Hours Worked per Female plot for period 1995-2009.

Employment Ratio

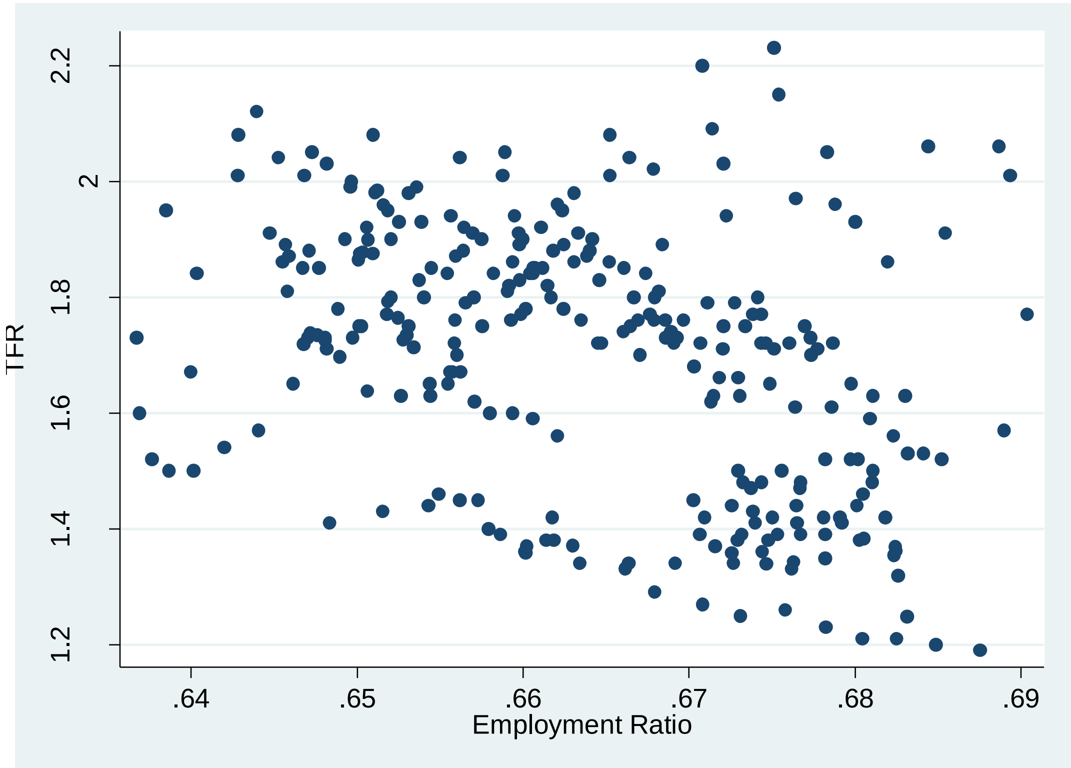

Figure A.22:ASFR$_{30\text{-}49}$ and Employment Ratio plot for period 1995-2013.

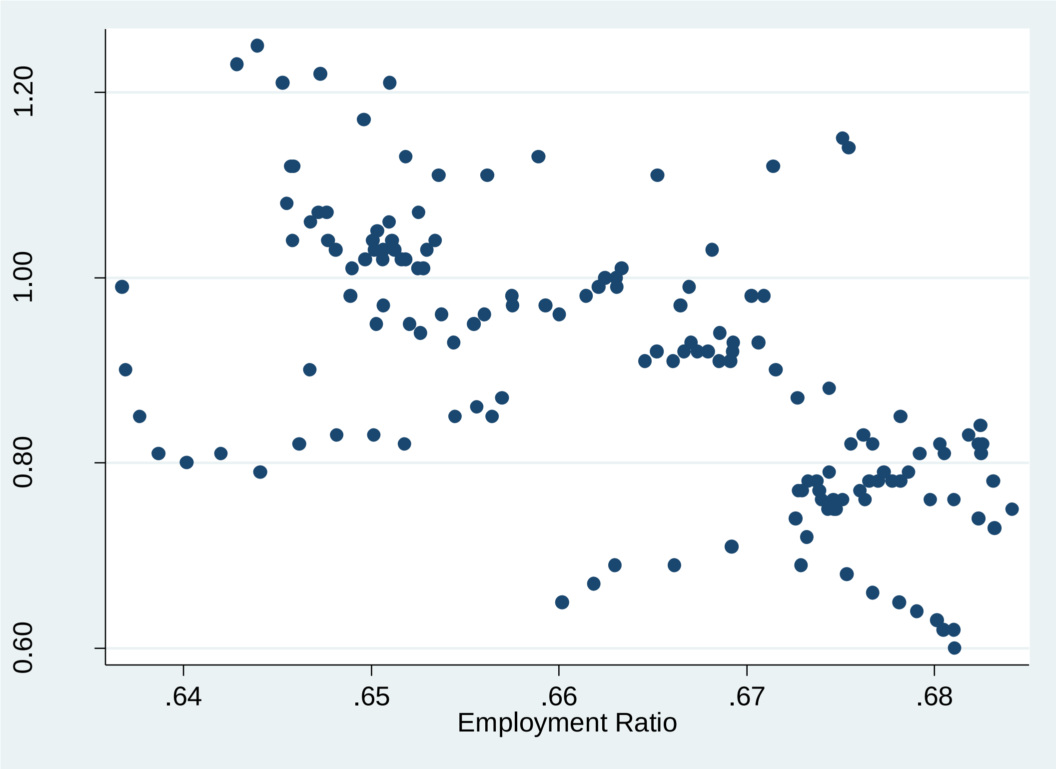

Figure A.23:ASFR$_{15\text{-}29}$ and Employment Ratio plot for period 1995-2009.

Figure A.24: ASFR$_{15\text{-}29}$ and Employment Ratio plot for period 1995-2009.

Employment Ratio Male

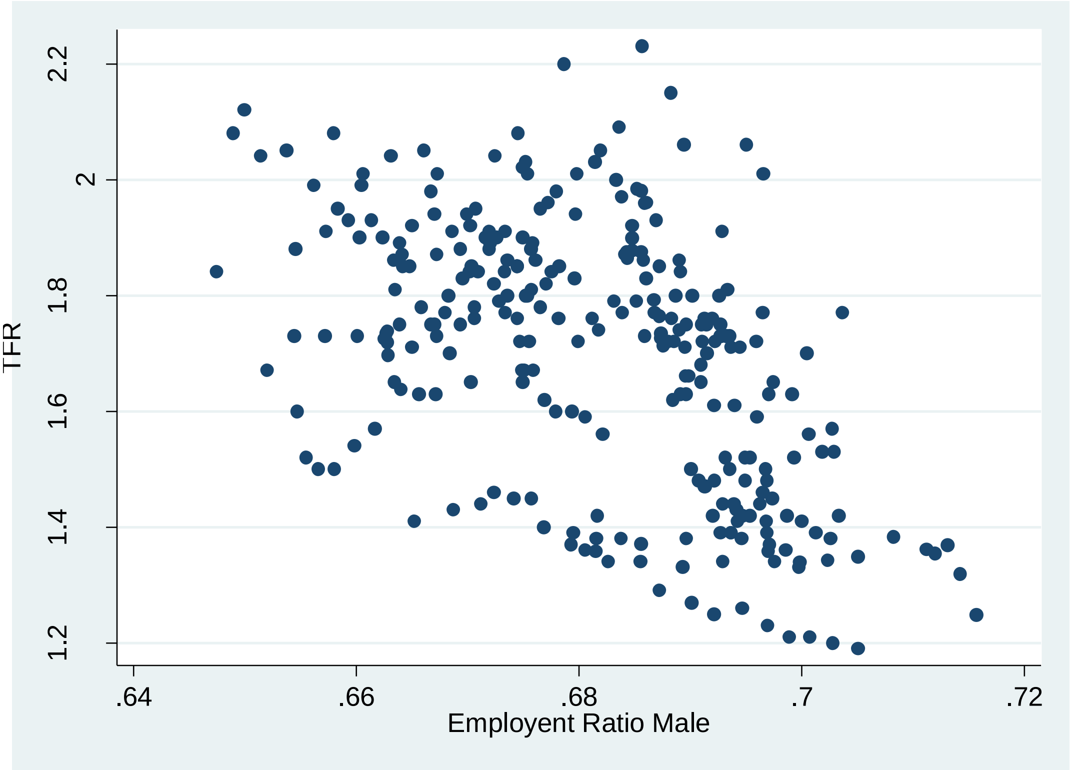

Figure A.25: TFR and Employment Ratio Male plot for period 1995-2013.

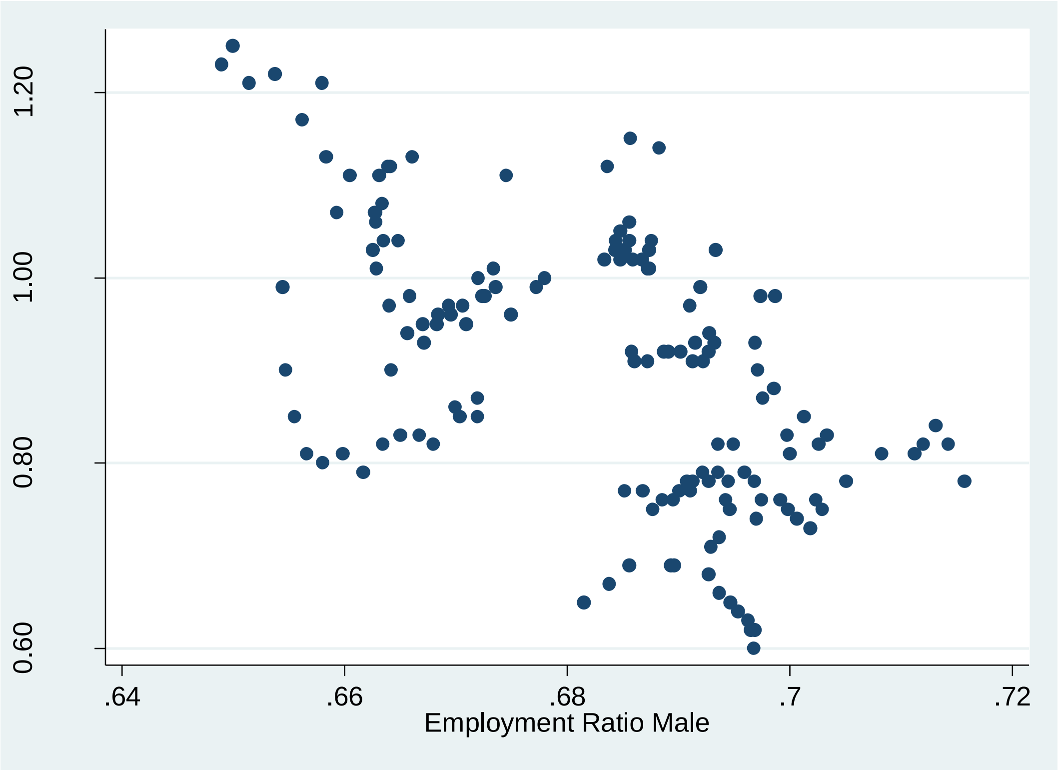

Figure A.26: ASFR$_{15\text{-}29}$ and Employment Ratio Male plot for period 1995-2009.

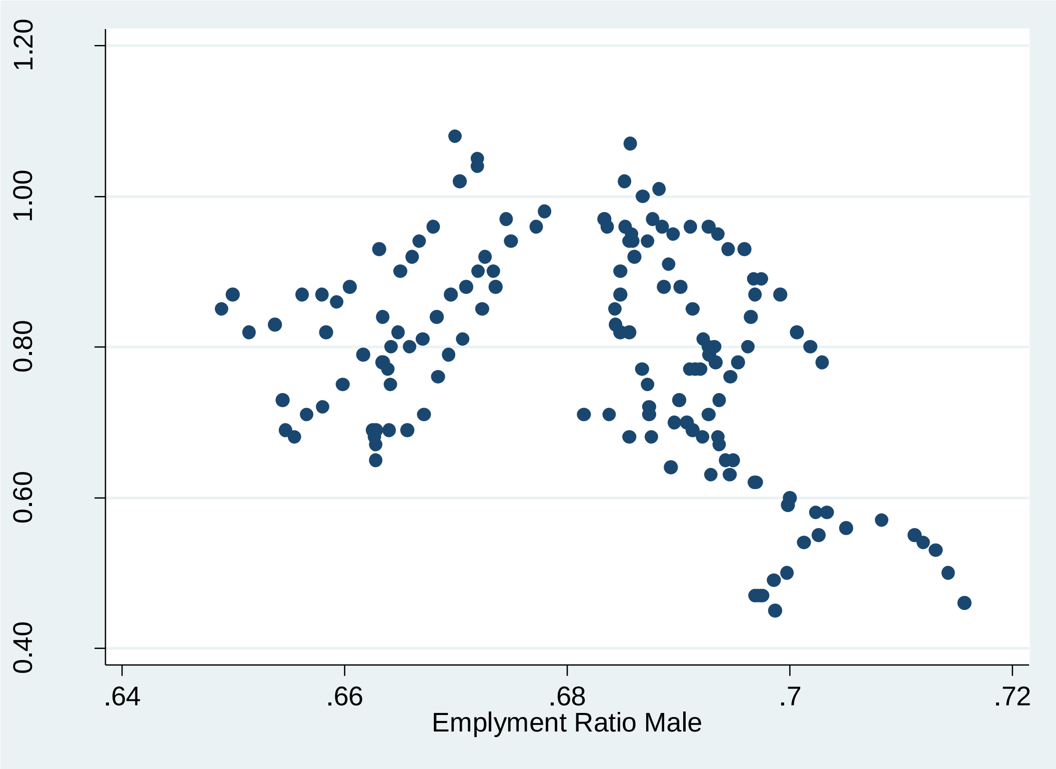

Figure A.27:ASFR$_{30\text{-}49}$ and Employment Ratio Male plot for period 1995-2009.

Employment Ratio Female

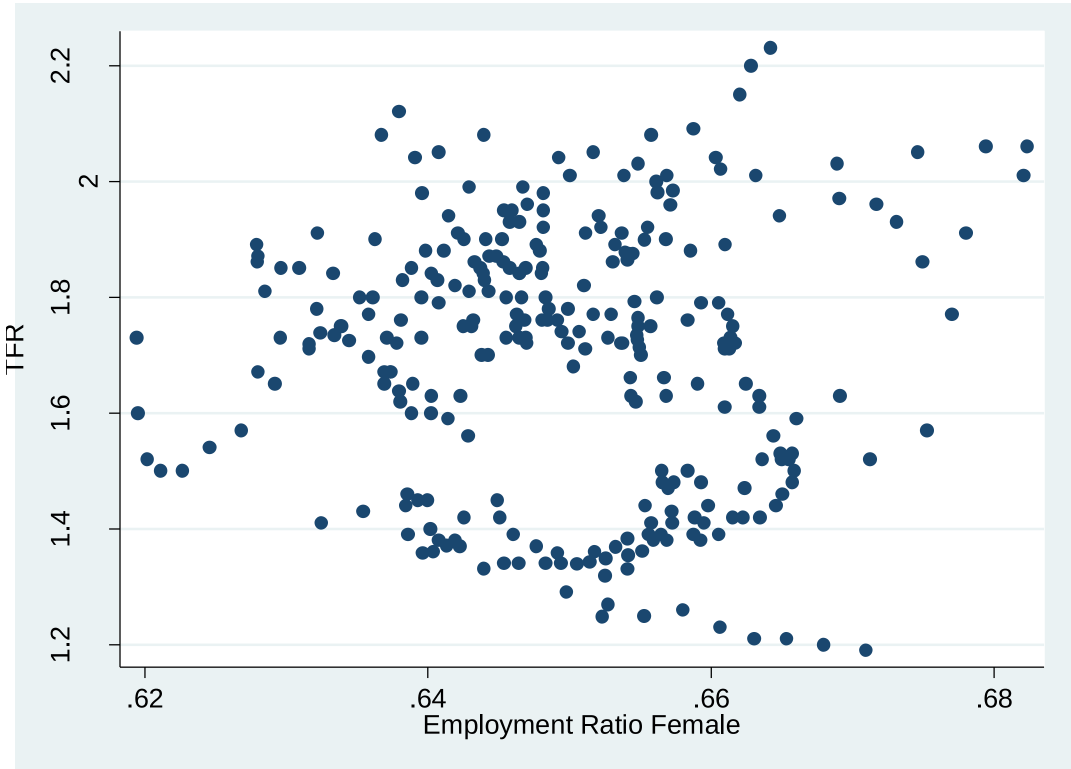

Figure A.28: TFR and Employment Ratio Female plot for period 1995-2013.

Figure A.29: ASFR$_{15\text{-}29}$ and Employment Ratio Female plot for period 1995-2009.

Figure A.30: ASFR$_{30\text{-}49}$ and Employment Ratio Female plot for period 1995-2009.

References

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