An empirical study of the fertility rebound in OECD countries

The impact of income and family policy

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Preface

First of all I would like to thank my supervisor Marte Strøm. I am very grateful for her brilliant suggestions and guidance throughout the process. Her encouragement gives me confidence to make this thesis possible.

I would also to thank all the lecturers as they provide me with the concept and method of analyzing economic issues. I benefit so much from all the lectures. I want to thank all my fellow students for an enjoyable time at UiO. I want to especially thank Lea for her friendly help when I have troubles in the thesis.

Two and half year's study at UiO is great treasure for me. I wish to thank Pei, for great advice and jokes, help me go through difficulties. My family deserves the biggest thanks for their unlimited support.

I am responsible for any errors or omissions.

Shaorong Zhang, Oslo, October 2014

Abstract

This thesis investigates the effect of income and family policy on fertility. Inspired by the convex impact of GDP per capita on fertility found by Angela and Olivier (2010), I empirically test the relationship between income and fertility around OECD countries, using panel data over the last three decades. The widely used family policy is correlated with economic outcome and also possibly encourages fertility. I therefore also test the impact of family policy on fertility. The results show that high income can explain fertility rebound in OECD countries while the effect of family policy is ambiguous.

Contents

List of Figures

List of Tables

1 Introduction

A series of studies have shown that high economic outcome goes along with low fertility. Considering the period from the early 1960s onwards across 30 OECD countries, it appears that the fertility rate did response negatively to economic development (measured by GDP per capita) at first, but after a certain stage, the connection turned to be positive. After a long time decrease in fertility rate in OECD countries, there has been a clear fertility rebound since the early 21century. According to recent research, some highly developed countries, like Nordic countries, have higher fertility rates than about 10 years ago. Is the rebound really connected to income growth or is it connected to other characteristics of highly developed countries like generous family policy?

In an article published in the "Nature" journal, Myrskylä et al. (2009) analyze the relationship between fertility and the human development index (HDI). The HDI measurement is used by the United Nations, which has three components: life expectancy, average income per person and level of education. They announced a quite new finding that in highly developed countries development-fertility relationship becomes J-shaped, which means that further advances in economic and social development would reverse the declining trend in fertility rates. However, after four month, Fumitaka Furuoka (2009) published a following article investigating the same topic. He concluded that "the findings of this study do not support the proposition that advances in development is able to reverse the declining fertility rate. In the course of the empirical analysis, no J-shaped development-fertility relationship could be established". The similar research ends up with the opposite conclusions.

A few following researchers focus on the impact of economic outcomes on fertility, where economic outcomes are mainly measured by GDP per capita. They prove that a convex impact of GDP per capita on fertility rate does exist. Angela Luci and Olivier Thévenon (2010) found an inverse J-shaped pattern with the decreasing branch on the left-hand side, longer than the increasing branch on the right-hand side. One purpose of this study is to investigate whether economic development is the driving reason of fertility rebound in OECD countries, therefore I will test for the relationship between GDP per capita and total fertility rate (TFR). The study is carried out by using the panel data of OECD countries from the last three decades, from the year 1980 to 2011.

By digging deeper into the datasets, I find an interesting phenomenon that counties with similar GDP per capita may have different fertility rates and trends. For example, the average GDP per capita over the last three decades in Japan and UK are almost the same. But their average total fertility rates at the same time are 1.49% and 1.80%, respectively. Many factors could be the explanation, such as preferences, different growth patterns and family policies.

Ever since last century, many OECD countries have introduced family-friendly policies to help parents find their preferred balance between parenting and employment (OECD, 2011). Evidence has shown that family policy has influence on fertility behavior. The welfare state appears to insulate fertility decisions from the relatively small variations seen in the Northern and Western European countries (Goldstein et al.2013). According to the definition by OECD Family Database, public spending on family benefits includes financial support that is exclusively for families and children (OECD Family Database, 2013). Generally the family policy can be classified into three types, one is cash transfers (e.g. child allowance), and the second one is in-kind benefits (e.g. child care services like kindergartens) and the last one is in-time (e.g. leave entitlement). The majority of countries spend a higher proportion on cash benefits. The Nordic countries, USA and some other Europe mainland counties spend more on services. It is natural to hypothesize that family policy plays a role in country's fertility pattern. The generousness of family policy is most probably related to GDP growth, I therefore include family policy measures in the analysis to see whether some of the impact of GDP per capita on fertility can be explained by family policy.

To understand the role of family policy in the fertility decisions, we might use economic theory. Becker has been influential in analyzing the "demand" for children as a utility maximizing problem where children incur both cost and benefits. Costs are typically direct costs like food and clothes (the child's consumption) and indirect costs like time spent in caring children (which has an alternative value- it could be spent at work). Family policy like kindergartens and paid parental leave lowers the cost of having children and may therefore increase the number of children a family wants.

The family policy in this thesis will be measured by three indicators, namely, the total length of maternity leave and parental leave, the average enrolment rate of children

under 3 years old in formal childcare and pre-school and public spending on child-care and early education per GDP. The results will provide evidence on the importance of family policy on household's fertility choice.

The paper is organized as follows. Section 2 presents an overview of the theoretical and empirical literature on the relationship between economic outcome and fertility rate, and will especially mention the previous literature on public policy's influence. The following section 3 contains the data used in the article and diagrams presenting the relationship between the variables. In section 4 I introduce the regression model as the empirical strategy as well as the estimation results. Section 5 presents the possible explanations for the results and the possible problems regarding the analysis. Section 6 concludes by summarizing the main findings.

2 Literary reviews

The changing relationship between income and fertility has drawn economists' interest since the last century. Theoretical development has proven that they are highly interconnected. The average income measured by GDP per capita kept increasing in most OECD countries, while the total fertility rates shifted downwards steadily. However, since the late 1990s there has been a fertility rebound while the economic condition is still increasing. In highly developed countries the impact of economic development on fertility is ambivalent. In 2009, a group headed by Mikko Myrskylä of the Max Planck Institute for Demographic Research proposed that there exists a "J-shaped" relationship between human fertility and development — i.e., that further advances in economic development can reverse the decline in fertility rate.(Wikipedia: "Fertility-development controversy"). There are many mechanisms through which macroeconomic outcome would influence fertility decisions.

2.1 Literary review of the relationship between economic outcome and fertility

The relationship between income and fertility behavior is a two-way relationship. Each of them has an impact on the other. There are many theoretical and empirical literary on this topic. I will review them separately.

2.1.1 The effect of fertility on economic outcome

In many macroeconomic theories, fertility decision will lead to different family size, thus will greatly influence the economic outcome. Exogenous growth model believes that with the limited resources, a growing population will consume more resource, which will leave less resources for each individual and hurt the economy's capacity to grow. Theories on intergenerational allocations suggest that the reduction of family size would encourage investment on human capital. The increased labor's productivity could then enhance economic advancement (Galor and Weil 1996, 2000; De la Croix and Doepke 2003; Doepke 2004; Galor 2005).

By contrast, some growth theorists hold the view that people are not only consumers of resource but also the creators of resources. A growing population will boost economic activity and encourage technological innovation. In this sense, the

increasing fertility has a positive influence on the economy. In the long run, a low fertility rate country can lead to problems with an ageing population. A reduction in the labor force will thereby hurt economic development. Besides, the country may spend a large percentage of GDP on the pension program, which would give burden to the state's finance situation. By this means, a country should keep a proper fertility growth rate in order to have a sustainable development.

2.1.2 The effect of economic outcome on fertility

The impact of income on fertility behavior is changing over time and area.

Gary Becker (1960) pointed out that childbearing decisions were based on the function of costs and utilities of having children, given family income. Becker hypothesized that income should have a positive impact on fertility rate, but found a negative relationship in empirical test.

Later Becker introduced the concept of trade-off between quality and quantity in fertility decision. Becker and Lewis (1973) found that under the condition of a rising income, parents would care more about the quality of the children so that the cost of raising children becomes more expensive, thus they prefer to have fewer children. When controlling for the quality, the relationship between income and number of children should be positive.

Based on the idea of the cost of childbearing, Mary O'Malley Borg (1989) examined the effect of the net price of a child- the opportunity cost of the wife. The result shows that when variables that control for the net price of a child, for example, relative preference for children, family's potential income, are included in the model, a positive relationship between income and fertility exists. Hotz et al (1996) also confirm that the increasing cost of having children is the key driver of the falling TFRs since the early 1970s.

However, if income reaches a certain level, households are able to afford the cost of bring up an additional children. Given high income, raising one more child will not lower the household's living standard. The relationship of income and fertility turns positive at a certain level of income. After the "turning-point" economic growth is associated with a rebound of fertility (Angela Luci, Olivier Thévenon, 2010). They conclude that economic

development is the driving factor for fertility in the majority of the OECD countries, they further indicate that the pattern between income inequality and fertility also play an important role on this topic.

Most of the European countries have gone through a financial crisis in recent years when many countries had just seen modest increase in their period fertility rate (Goldstein, Sobotka, and Jasilioniene 2009). Goldstein et al seek to provide macro-level evidence on the role of crisis on fertility. The unemployment rate is used as the measurement of economic condition. The result shows a negative impact of unemployment rate on fertility rates. However in Northern European countries where states provide strong family support, unemployment does not appear to have a substantial effect on fertility. It can be seen as evidence that the government's effort to influence fertility actual works.

Tomas, Vegard and Dimiter (2010) later also examined the relationship between economic recession and fertility. They found that periods of economics recession were frequently followed within one or two years by a slight decline in the period fertility rates. But they also point out that the relationship between economics situation and fertility is contingent upon social arrangements. In Nordic countries the government policies can be effective in softening or even reversing the depressing effects of the recession on fertility.

An interesting interpretation on how economic development encourages fertility behavior is brought up by an article published on The Economist in 2009. The opinion is that compared with most animals, humans are at the predictable-environment and doting-parent end of the scale, but from a human perspective those in less developing countries are further from it than those in rich ones. "Only when the environment becomes super-propitious can parents afford more children without compromising those they already have—and only then, as Dr. Myrskyla has now elucidated, does the birth-rate start to rise again."

2.2 literary review of the impact of family policy on fertility

As mention above, empirical researches have shown that government's policy would influence the degree of the impact of income on fertility. Family policy may help

households fulfil their fertility intentions by reducing the direct financial cost to parents or by reducing the indirect cost of children by relaxing the constraints that adults face in balancing work and family. For example, the Nordic countries, well known for their social welfare have seen a more clear fertility rebound than other countries. From the empirical findings I think that looking deeper into the family policy is worthwhile.

Family policies can generally divided by three basic aspects, namely, in-cash, in-time and in-kind. Policy can affect fertility patterns in different ways. Parental leave, childcare policy, flexible workplace practices, national tax and benefits systems, etc., are often used as instruments indicating family policy (OECD 2011). Oliver Thévenon (2011) classifies OECD countries as the following. The article concludes that different policy types will have various impacts on fertility rates.

Country Group	**Key Feature Description**
Nordic countries	Substantial help to combine work and family
Anglo-Saxon countries	Support for selected families (poor background, etc.)
Southern Europe, Japan, Korea	Even more limited assistance
Eastern Europe	Policies in transition
Continental Europe countries	In an intermediate position

By providing more flexible support related to child caring, parents, especially the mothers will feel more confident to be able to take good care of both themselves and the babies. Therefore the friendly policy would encourage household to have more children. National studies for Nordic countries show that there is a positive effect of childcare on fertility rates (Randfuss et al., 2010). Adsera (2004), and Gauthier and Hazius (1997) also found that fertility rates increases with an extension of parental leave. Aassve and Lappegård (2009) find the childcare benefit would speed up the birth of second and third children in Norway.

One concern for family policies is that some of them are conditional. For instance, the entitlement to maternity leave is based on the condition that the mother has a job. This would encourage young females to establish themselves in the labor market before giving birth. The resulting postponement of birth has a negative effect on fertility rates (Doing better for the families, OECD 2011). Until now there is no unanimity in the literature regarding which indicators best describe a country's family policy (Oliver

Thévenon, 2011) and which pattern could be properly describe family policy and fertility. It is proven that in order to make the policy effective, policy support has to be sufficiently comprehensive and consistent over time (OECD 2011).

As a result, the effect of family policy on fertility rates may present ambiguous results depending time period and area.

3 Data description

Since the fertility rebound is mainly found in highly developed countries, it is appropriate to look at the OECD countries where they enjoy good economic outcomes for many years. Furthermore, OECD member countries are located in different continents and represent various types of countries.

The data used in this article is macroeconomics panel datasets including observations from 33 OECD countries from the year 1981 to 2012. The datasets contain total fertility rates, GDP per capita and other family policy measurements. As I plan to test whether GDP per capita is the driving reason of fertility rebound and whether the family policy plays an important role, I will first estimate the impact of GDP per capita on fertility. Then I will add the indicators of family policy, which is measured by the length of paid leave related to childbearing, the average enrolment rate of children under 3 years of age in formal childcare and pre-school and public spending on child-care and early education per GDP.

3.1 The trend of total fertility rates in OECD countries

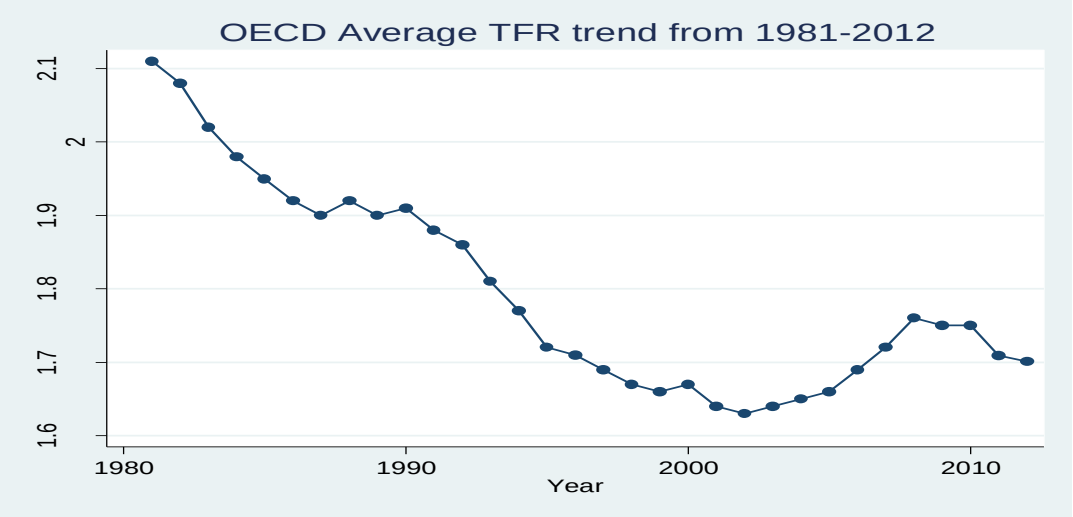
The total fertility rate (TFR) can be treated as the most widely used indicator to compare fertility trends between countries and over years. According to the OECD definition "The total fertility rate is the number of children that would be born to each woman at the end of her childbearing years if the likelihood of her giving birth to children at each age was the currently prevailing age-specific fertility rates."

Data are typically come from civil population registers or other administrative records. These are harmonized according to United Nations and Eurostat recommendations. The exception is Turkey, where fertility data are survey-based.

As clearly displayed in the figure 1, the average trend of fertility is changing over time. At first, the fertility rate keeps decreasing until the year 2000. Then it begins to climb up afterwards, until 2010. It is notable that there is a slight decline trend since 2009. I belief this phenomenon is due to the recession of the economy in Europe at that time. People may change their attitude and expectation towards the future economy and therefore adjust their fertility decision, either by postponing or having fewer children. Joshua R. Goldstein, Michaela Kreyenfeld, Aiva Jasilioniene, Deniz Karaman Örsal (2013)

have proven that countries that were hit hard by the recession show reduced fertility when compared with a continuation of recent trends, especially at younger ages. Even though, in general we cannot deny the fertility rebound trend.

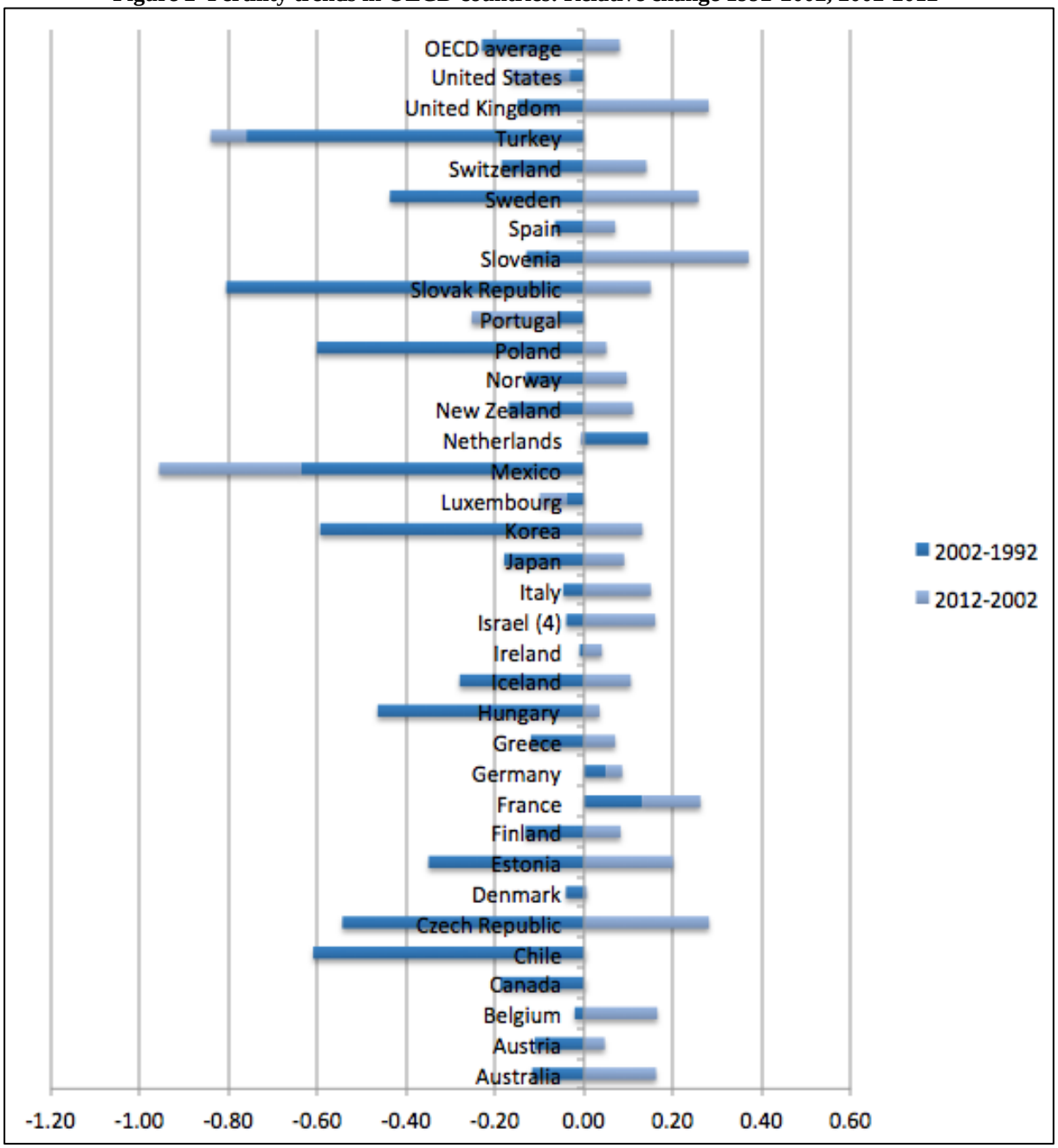
Figure 1 Overall fertility trends in OECD countries, 1981-2012



Data source: OECD Data Base (2013)

Figure 2 presents a comparison between the fertility growth 1992-2002 and 2002-2012. All the countries' fertility rates decrease in the first time period. By contrast, almost all of them experience an increase in the second period except for United States, Mexico, Luxembourg and Portugal. Nevertheless, the total fertility growth rates between 2002 and 2012 are clearly positive.

Figure 2 Fertility trends in OECD countries: Relative change 1992-2002, 2002-2012



Data sauce: OECD Data Base (2013)

3.2 The trend in GDP per capita in OECD countries

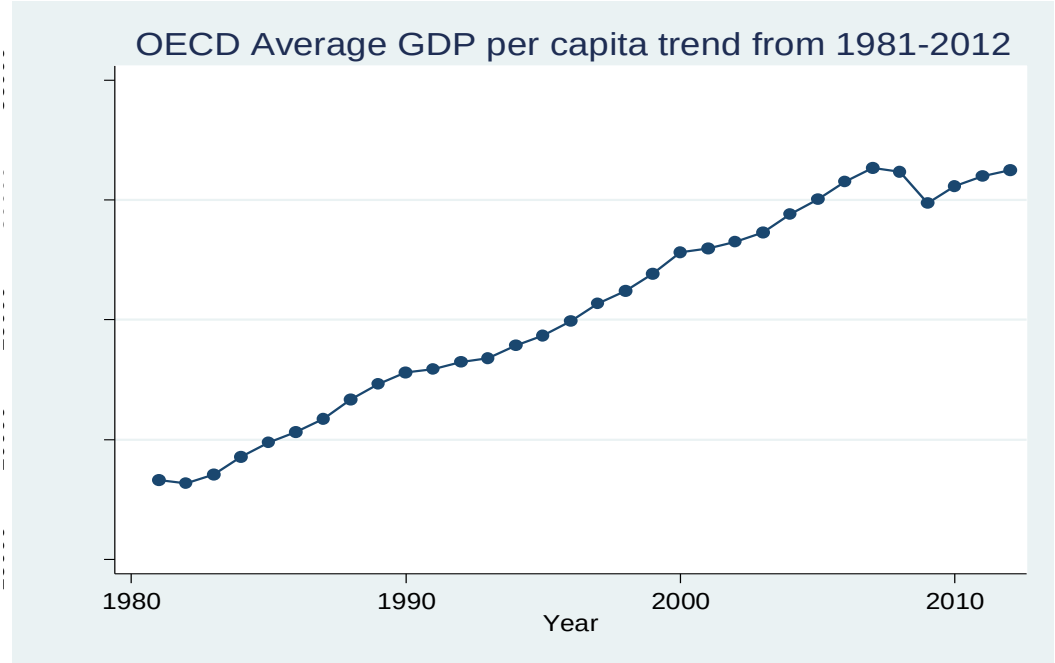
Since we have checked the trend of fertility rate in OECD countries, I think it is necessary to make a general description of the trend of GDP per capita for the same time period. GDP per capita is selected to measure at purchasing power parity in constant 2005 US dollar.

The figure 3 presents the overall trend of GDP per capita from 1981 to 2012. The data is the average GDP per capita over 30 OECD countries. The total trend is upwards

with a slight exception point at the year 2009. The average income is from lower than 20000US dollar to above 30000US dollar in the past three decades. It is notable that the economic development level varies among OECD countries. The highest GDP per capita in 2012 is observed from Luxembourg with 65728 US dollar compared with the 13557 US dollar from Turkey.

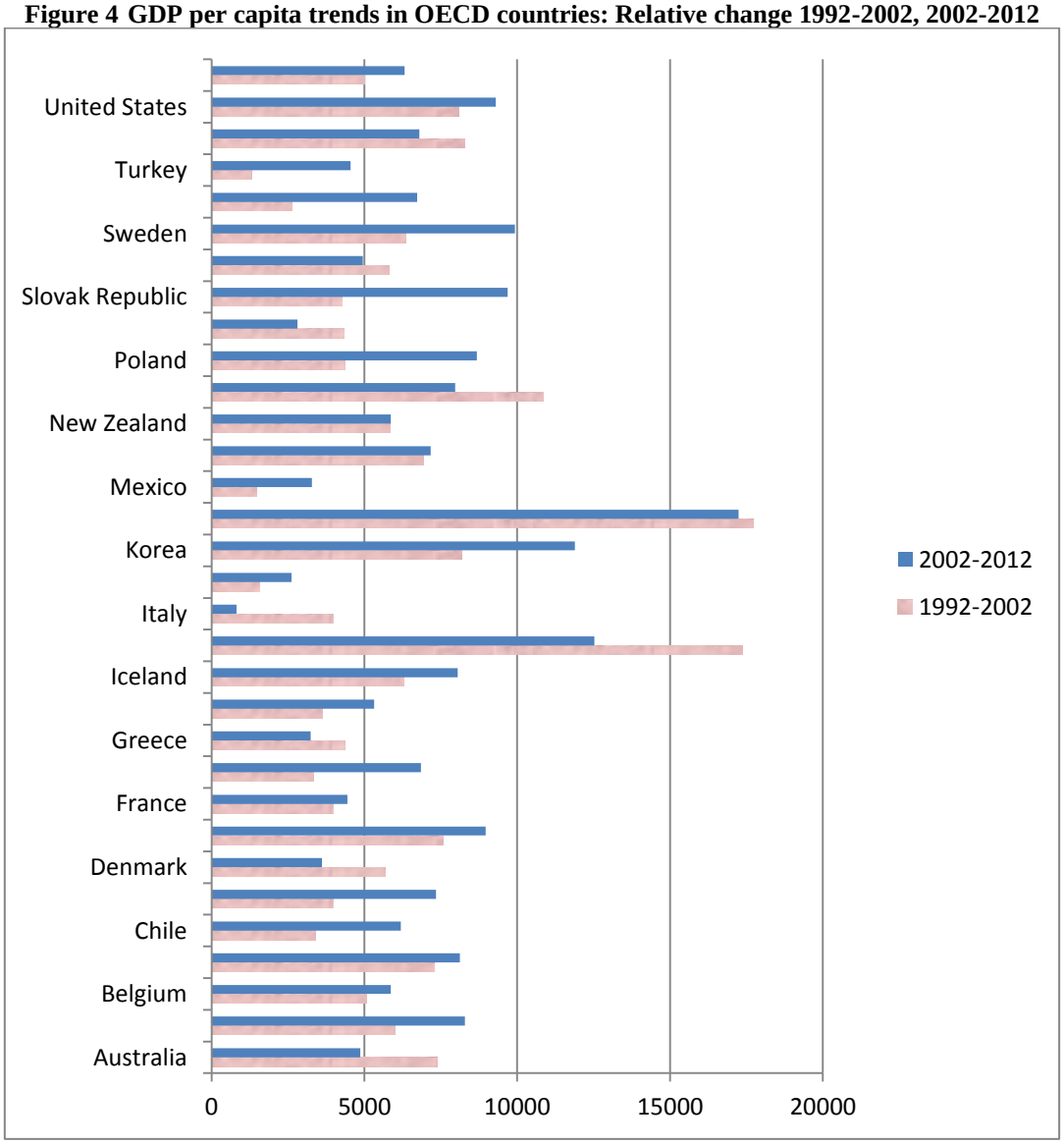
I also make a graph of the comparison of net growth in GDP per capita in 1992-2002 and 2002-2012 as in the above subsection. Some countries' income grows at a faster level while some others are speed down, as shown in Figure 4.

Figure 3 Overall GDP per capita trends in OECD countries, 1981-2012



Data sauce: OECD Data Base (2013)

Figure 4 GDP per capita trends in OECD countries: Relative change 1992-2002, 2002-2012



Data sauce: OECD Data Base (2013)

3.3 Relationship between total fertility rate and GDP per capita

The previous analysis suggests that whereas until the late 1980s in all observed countries economic development was accompanied with fertility decline. Since the early 2000s, the situation began to change, and the fertility rebound first took place in highly developed countries. This growth pattern suggests a convex impact of economic outcome on fertility decision.

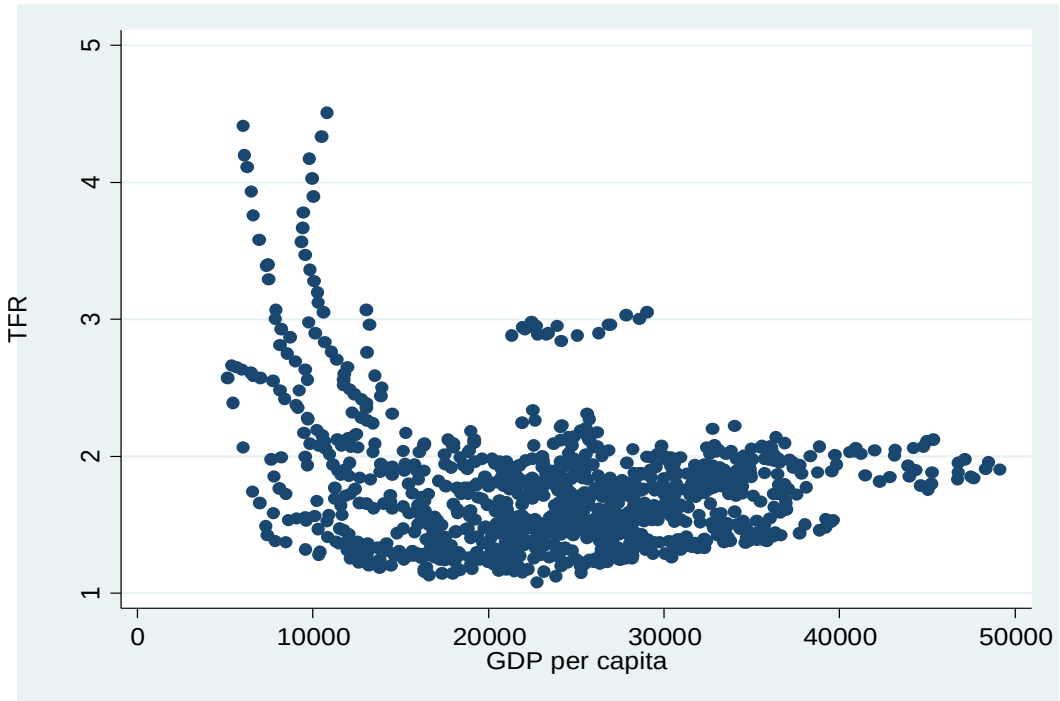
In order to get a visual picture of the relationship between fertility rate and GDP per capita and check whether the inverse J-shaped pattern can be observed, I make a plot graph of total fertility rate and GDP per capita from all the observed countries. The graph

excludes Luxembourg, since its GDP per capita is far more than the average level of OECD countries, especially in the 2000s.

We can see from the figure that there has a trend of a rebound in fertility rate corresponding to the growth GDP. The effect becomes more robust when GDP per capita reaches 30000US dollar. The result consistent with the findings of Angela and Olivier (2011) that "a reversal of the relation between economic development and fertility at a fertility level of 1.51 and an income level of lnGDPpc=10.39, which corresponds to $32,600 (PPP)". We can treat it as a turning point of fertility trends. There is a clear decline trend of fertility rate when GDP per capita keep increasing below 30000US dollar, whereas the positive relationship occurs above that point.

The plot figure 5 proves the existence of the inverse J-shaped pattern of fertility along the economic development path. It indicates that at lower income levels, households choose to have fewer children when their income increases. On the other side, when income arrives at a certain level, they begin to have more children when their income increases.

Figure 5 GDP per capita against TFR for 29 OECD countries, 1980-2011

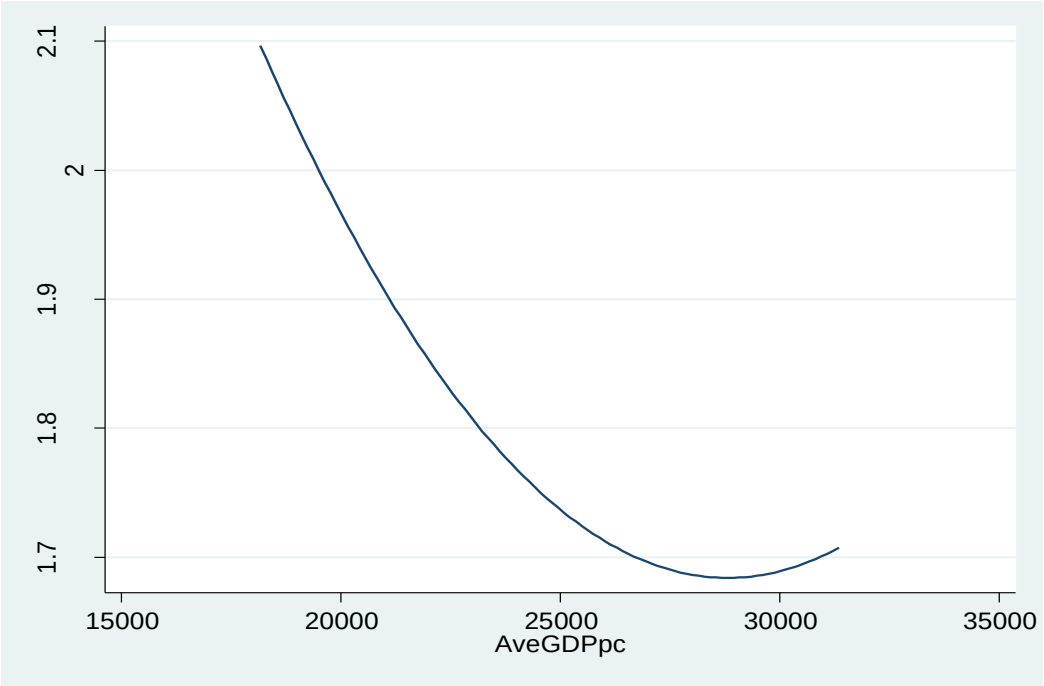


Data source: OECD Data Base, 2013

In order to make the relationship more accurate and clear, I define the average TFR in 30 OECD countries as the Y variable and the average GDP per capita as X variable for a

quadratic prediction. The graph 6 shows an inverse "J-shaped" pattern with the lowest point at the GDP per capita a little lower than 30000 US dollar.

Figure 6 Quadratic prediction of average GDP per capita on average TFR from 1981-2012



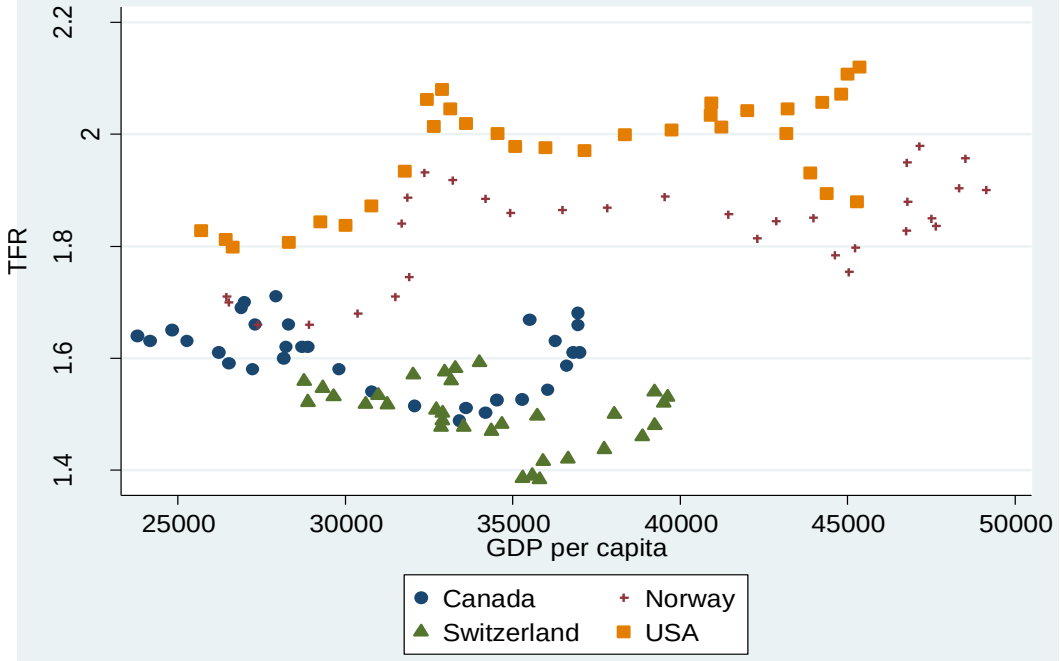
Data source: OECD Data Base, 2013

3.3.1 Group discussion according to income factor

It is easier to make the analysis readable by making a comparison. Therefore I divide the countries in groups according to the level of GDP per capita. The first group contains the four countries with highest average income during the last three decades. They are Canada, Switzerland, Norway and the United States. Here I also exclude Luxembourg for its outstanding high GDP per capita. From the following figure 7 we can clearly see a fertility rebound trend in these four countries which enjoy the highest economic outcome.

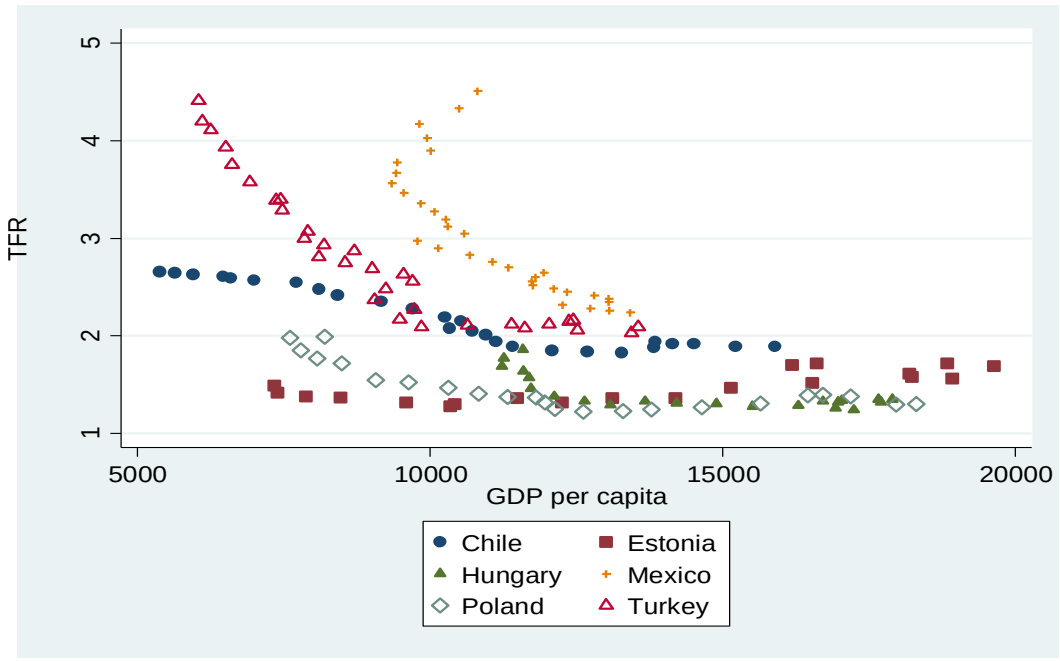
By contrast, I list the six countries with the lowest average GDP per capita within the last three decades, which also below 20000US dollar. They are Chile, Estonia, Hungary, Mexico, Poland and Turkey. The negative relationship between income and fertility can be seen from figure 8. It is obvious that the trends in high income and low income countries are completely different.

Figure 7 GDP per capita against TFR for four highest income countries, 1980-2011



Data source: OECD Data Base, 2013

Figure 8 GDP per capita against TFR for six lowest income countries, 1980-2011



Data source: OECD Data Base, 2013

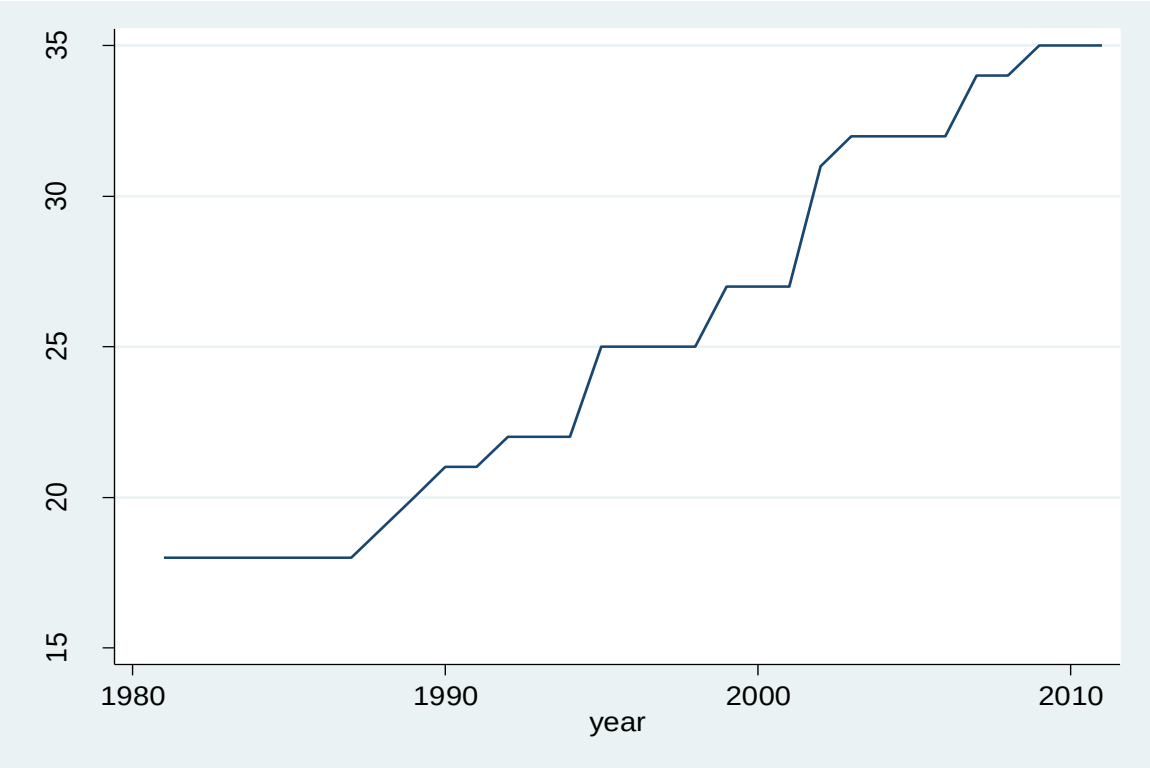
3.4 Family policy measurements

I have selected the family policy in three indicators in this thesis. The first one is the length of paid leave related to childbearing. The second indicator is the average

enrolment rate of children under 3 years of age in formal childcare and pre-school. And the third one is public spending on child-care and early education per GDP.

The paid leave includes the total duration of both maternity leave and parental leave. The dataset contain 22 OECD countries and range from the year 1981 to 2011. As Czech Republic, Hungary, Poland and Slovak Republic show extreme high level of paid leave (more than 100 weeks) and the paid leave is calculated without considering the income support so I exclude these countries in order to make the estimation more accurate. Due to large gaps in data availability, I also exclude the following countries: Australia, New Zealand, Switzerland, United States, Chile, Estonia and Israel. We can see from figure 9 that in the past 30 years, the total paid leave in OECD countries keeping increasing, indicating that countries are promoting the family friendly working environment.

Figure 9 Average trend of paid leave, 1981-2011



Data source: OECD Family Data Base, 2013

According to the definition of OECD data base, the average enrolment rate presented here for 0 to 2 year olds concern "formal childcare arrangements such as group care in childcare centers, registered child-minders based in their own homes looking after one or more children and care provided by a professional child-minder at

the home of the child". The dataset contains 12 countries and ranges from year 1998 to 2009 for the reason of data availability. Table 1 present the selected dataset.

Table 1 Average enrolment rates of children under 3 years of age in formal childcare and pre-school (%)

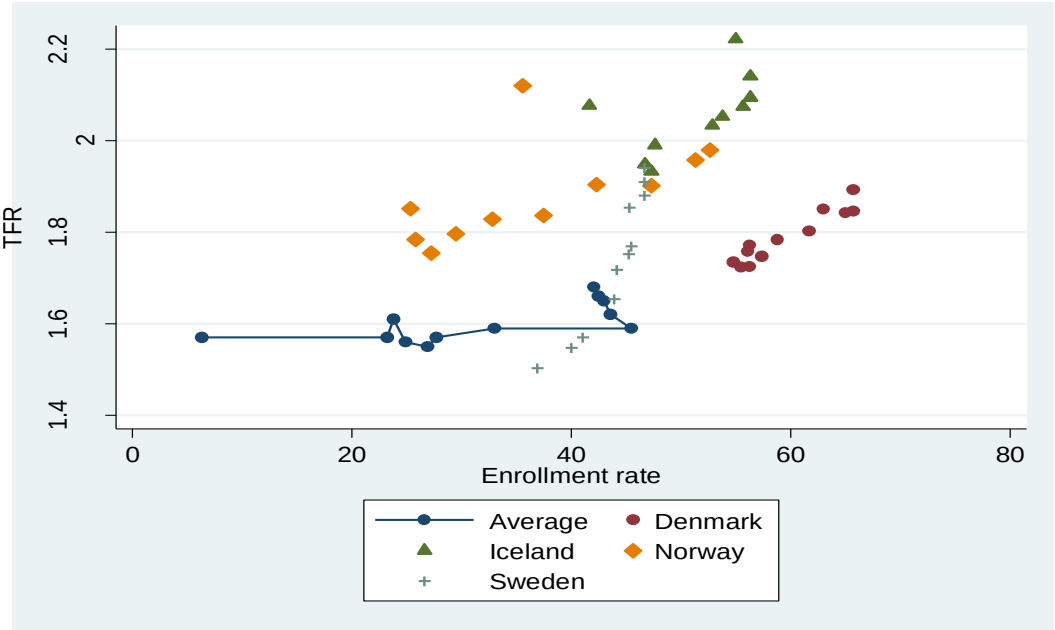
country	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	Average
Austria	3,0	3,7	4,2	3,7	5,1	5,2	5,3	..	10,5	10,9	12,1	15,9	7,2
Denmark	56,3	54,8	56,3	57,4	55,5	56,1	58,8	61,7	63,0	65,7	65,7	65,0	59,7
Finland	23,4	22,5	21,6	22,2	21,6	21,3	21,8	22,5	23,7	25,0	28,3	27,0	23,4
Hungary	7,2	6,8	6,5	6,4	6,6	6,7	6,4	..	10,5	9,0	8,8	7,5	7,5
Iceland	..	..	41,7	46,7	47,3	47,6	52,9	53,8	55,7	56,3	56,3	55,0	51,3
Japan	11,1	11,7	12,4	13,1	13,9	14,5	15,2	..	22,5	23,2	24,0	24,7	16,9
Korea	10,8	12,5	13,3	14,3	15,6	16,7	18,1	19,3	26,3	30,6	36,3	41,6	21,3
New Zealand	26,7	27,5	28,6	28,7	30,4	31,5	32,1	33,9	34,4	35,1	35,3	35,6	31,7
Norway	..	..	25,3	25,8	27,2	29,5	32,9	37,5	42,3	47,3	51,3	52,7	37,2
Portugal	..	..	11,7	12,3	12,5	12,7	13,3	..	43,6	32,5	47,4	47,2	25,9
Spain	6,3	6,9	7,7	8,7	9,9	11,3	20,7	..	41,9	39,3	37,5	38,3	20,8
Sweden	..	39,6	40,0	41,1	43,9	44,1	45,2	45,5	45,3	46,7	46,7	46,7	44,1

Data source: OECD Family Data Base, 2013

Table 3.1 shows wide variation in childcare participation among children less than 3- year-old across OECD countries. The countries ranking top four with this index are Denmark, Iceland, Norway and Sweden. The figure 10 describes a positive relationship between enrollment rate and total fertility rate. In addition, we can tell the Nordic countries with high enrollment rate do have higher fertility rate above the average level. But if the high fertility is due to generous family policy or to high GDP needs to be tested in the next section.

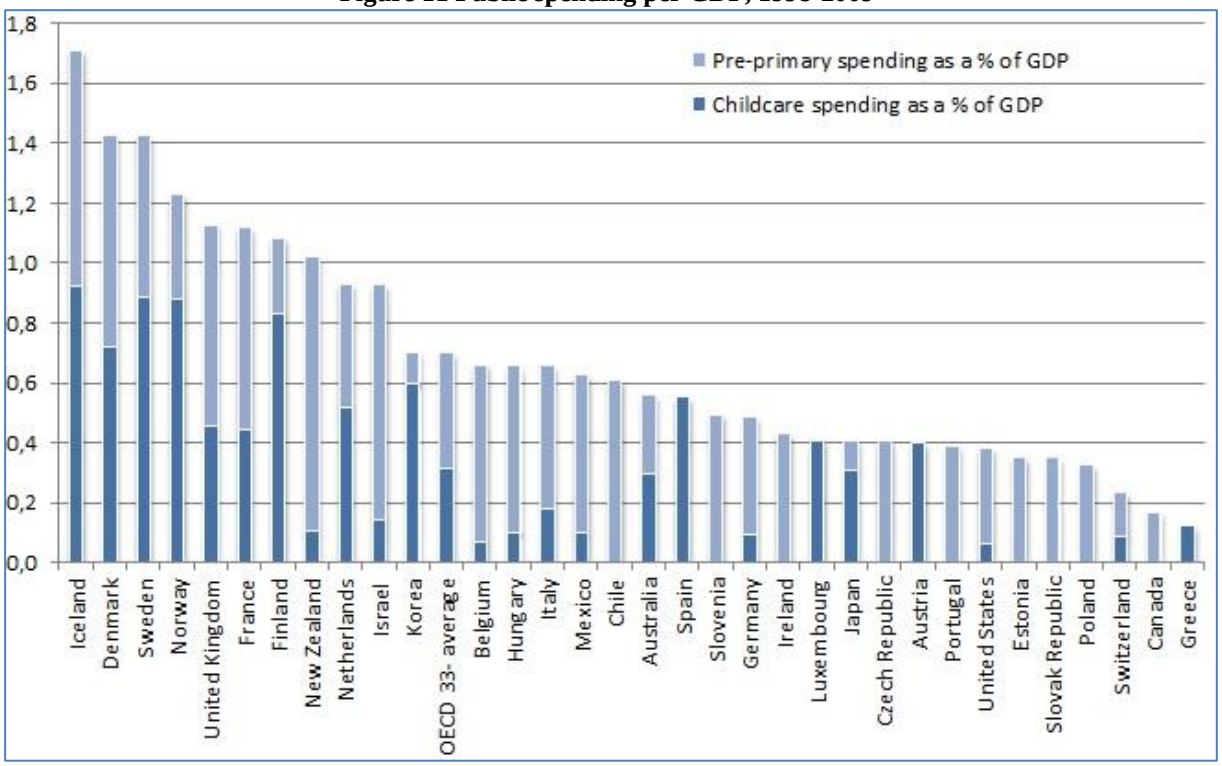
The third measurement is public spending on child-care and early education per GDP. Public expenditure on childcare and early educational services is all public financial support for families with children participating in formal daycare services and pre-school institutions (OECD Family Data base definition). At the year 2009 the average ratio around all OECD countries is 0.7% and the variation is big among different countries. Figure 11 presents this ratio.

Figure 10 Relationship between TFR and enrollment in selected countries, 1998-2009



Data source: OECD Family Data Base, 2013

Figure 11 Public spending per GDP, 1998-2009



Source: OECD Family Data Base, 2013

4 Empirical analysis

The main aim of this thesis is to figure out whether the current observed fertility rebound in OECD countries is connected to economic development, and to what extent. As the plot graph showed in the previous section, there is a declining trend in fertility when GDP per capita is below 30000US dollar, whereas the trend is rising above that point. In this part I will test for the reversal relationship between GDP per capita and fertility rates in a regression analysis. To test the hypothesis that family policy explains some of this relationship, I further introduce three different measurements of family policy to the model.

As a part of that analysis, I check the correlation between family policy and lnGDP to see whether countries with higher GDP invest more on family policy. If this is the case, then some of the positive effect of income may really capture the effect of family policy.

The software used to achieve the estimation results is STATA.

4.1 Empirical strategy

In order to explore the relationship between fertility and income, I first estimate a linear model by using total fertility rate (TFR) as dependent variable and the ln of GDP per capita (lnGDP) as explanatory variables. After this I will continue with a quadratic regression by adding the square of the lnGDP per capita ($lnGDP^2$) as explanatory variable. The regressions are based on pooled Least Squares Estimation. The dataset consists of observations from 34 OECD countries comprising the period from 1981-2011.

The reason for using the natural logarithmic transformation of GDP per capita is that the coefficients can be interpreted as percentage changes instead of absolute changes. It is also used in most of the macro-level economic works that is related to GDP data.

The reason for introducing the quadratic regression is to examine the convexity of the relationship and find out the minimum point. To confirm a convex impact of economic advancement on fertility, and also with a minimum point, a significant positive β_3 must be found, as β_3 is the indicator of the convex pattern of a trend curve. With a

negative β_2 and a positive β_3 we can conclude that at the first small levels, an increase in lnGDP will lead to a decrease in fertility. When GDP reaches a certain level (the minimum point), an increase of lnGDP will result in an increasing fertility rate.

In the next step I include country fixed effect (country specific dummy variables) to account for unobserved country-specific factors. Unobserved factors that are potentially related to both GDP and fertility rates are e.g. cultural factors like family orientedness, gender equality etc. These are included in the vector country in the estimating equation (1) below. With country fixed effects, the coefficients are estimated using within-country variations in all regressors. Unobserved heterogeneity that is constant over time between countries is therefore controlled for. I also include year-dummies to account for unobserved time-specific variables. These are included in the vector year.

The estimation equation for the fixed effect regression model is:

$$TFR_{i,t} = \beta_1 + \beta_2 * lnGDP_{i,t} + \beta_3 * lnGDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \varepsilon_{i,t} \qquad (1)$$

Where "i" denotes country and "t" denotes year.

After estimating the effect of GDP on fertility, I continue the analysis by employing the family policy measures. Due to the limited data availability, the datasets used here contain different countries and range from different time period. The estimations will therefore be carried out separately.

The estimations with family policy start with pooled OLS first and then fixed effect within countries. The purpose is to see if using the between country variation yields a different conclusion than using the within country variation (with country fixed effects). Equations become the following in three groups.

Equation Set1:

$$TFR_{i,t} = \beta_1 + \beta_2 * lnGDP_{i,t} + \beta_3 * lnGDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \varepsilon_{\iota,\tau}$$

$$TFR_{i,t} = \beta_1 + \beta_2 * lnGDP_{i,t} + \beta_3 * lnGDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \beta_6 * enrollment\ rate_{i,t} + \varepsilon_{i,t}$$

The observations for estimating enrollment rate are selected from 12 countries and from period 1998-2009.

Equation Set2:

$$TFR_{i,t} = \beta_1 + \beta_2 * \ln GDP_{i,t} + \beta_3 * \ln GDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \varepsilon_{i,t}$$

$$TFR_{i,t} = \beta_1 + \beta_2 * \ln GDP_{i,t} + \beta_3 * \ln GDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \beta_6 * \text{public spending}_{i,t} + \varepsilon_{i,t}$$

The dataset for equation set2 contains 33 OECD countries ranging from 1998 to 2009 expect Turkey because of the missing data.

Equation Set3:

$$TFR_{i,t} = \beta_1 + \beta_2 * \ln GDP_{i,t} + \beta_3 * \ln GDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \varepsilon_{i,t}$$

$$TFR_{i,t} = \beta_1 + \beta_2 * \ln GDP_{i,t} + \beta_3 * \ln GDP^2_{i,t} + \beta_4 * country_i + \beta_5 * year_t + \beta_6 * \text{paid leave}_{i,t} + \varepsilon_{i,t}$$

The observations for examining total paid leave concludes 22 countries except for Australia, New Zealand, Switzerland, US, Chile, Czech Republic, Estonia, Hungary, Slovak Republic, Slovenia and Israel, ranging from 1981 to 2011.

The three equation sets respectively examine the effect of 1) enrollment rate of children under 3 years of age in formal childcare and pre-school, 2) public expenditure on childcare and pre-school per GDP, 3) total paid leave. The estimation results will show how family policy affects fertility.

By comparing the coefficient β_2 with and without family policy measures, we can see whether part of the effect of GDP per capita is due to differences in family policy.

4.2 Estimation results

4.2.1 Effect of GDP per capita on fertility

Table 2 displays the summary of results of both pooled OLS and fixed effect estimations.

A significant negative correlation between lnGDP and TFR is found through the linear regression. With one percentage increase in GDP per capita, the total fertility decrease by 0.345. The negative relationship is consistent with the empirical findings in the early and middle of 20th century when increasing income came together with decreasing fertility rates in OECD countries.

Like previous studies, by adding the variable of $\ln GDP^2$, the result obtained by the quadratic regression presents a positive coefficient of $\ln GDP^2$. The coefficients predict

generally that the relationship between income and total fertility rate is changeable. It will change with the level of income.

Table 2 Pooled OLS VS Fixed effect model

	Pooled OLS fertility	Pooled OLS fertility	Fixed Effect fertility
lnGDP	-0.345***	-11.90***	-12.66***
	(-10.22)	(-13.17)	(-22.69)
$lnGDP^2$		0.586***	0.650***
		(12.79)	(22.15)
_cons	5.439***	62.28***	63.71***
	(15.90)	(13.98)	(23.84)
N	1004	1004	1004
R^2	0.1423	0.2661	0.8778

t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Even though the negative coefficient on lnGDP indicates a dominant negative relationship between GDP per capita and fertility, the positive coefficient on $lnGDP^2$ shows a positive relationship when GDP per capita arrives at a certain level. In addition, the relationship between the two variables' pattern clearly has a minimum point. At this point, the total fertility rate is on the bottom and will go upwards if income increases.

The minimum point is calculated in the following way:

Firstly, the least squares estimate yields: $TFR = 62.28 - 11.90 * lnGDP + 0.586 * lnGDP^2$

Secondly, the first order derivative yields: $dTFR/dlnGDP = -11.90 + 1.17 lnGDP$

Thirdly, the minimum point arrives at the condition: $-11.90 + 1.17 lnGDP = 0$

By calculating the equation above, yields: $lnGDP = 10.17 \rightarrow GDP = 26108.08$ (US dollar)

The conclusion is that based on the pooled OLS, after the economic development reaches to a level of GDP per capita equal to 26108 US dollar (PPP), fertility is positively affected by an increase in GDP. Furthermore, the pooled OLS estimation result matches the prediction result shown in figure 6 in the previous section, in other words, the same inverse J-shaped pattern is found. Thus we can conclude that the quadratic specification is better than the linear specification when estimating the relationship GDP and fertility.

The same pattern is found in a fixed effected model. We can see a significant and stronger impact of GDP on fertility when controlling for country-specific unobserved characteristics. The goodness of fit of the fixed effect estimation is 87.78%, significant higher than in Pooled OLS estimation making fixed effect model superior. Using the within country variation explains more of this relationship. The coefficients are however very similar, which means that unobservable characteristics of the country are not that important to control for when estimating the relationship between fertility and GDP.

The results of both estimations shows a negative coefficient of lnGDP and a positive coefficient of $lnGDP^2$ which confirm a convex pattern of economic development and fertility rates with a turning point. The implication is that if income level develops to a certain stage, further advancement is expected to exert a positive effect on fertility behavior.

4.2.2 Correlation between family policy and GDP per capita

Since family policy is possibly correlated with GDP level, I test the correlation coefficients between family policy measures and GDP per capita. The results are illustrated in table 3. We can conclude that enrollment rate and public spending are significant positively correlated with GDP per capita.

Table 3 Correlation between family policy and lnGDP

Coefficient	(1) Enrollment rate	(2) Public spending	(3) Paid leave
lnGDP	0.4528*	0.2443*	-0.0462
N	132	395	767

Note: presents that the correlation coefficient is significant at the 5% level.

The result provides a reason why including family policy should influence the effect of GDP on fertility. The countries with higher GDP tend to invest more on family policies, and also have higher fertility as shown. It is necessary to investigate the reason of high fertility- is it due to higher level of GDP or more generous family policy or both?

4.2.3 Effect of family policy on fertility

The estimation results are listed in table 4 and table 5, respectively represent the pooled OLS model and the fixed effect model.

Table 4 Estimation result of family policy by OLS

	(1) fertility	(2) fertility	(1) fertility	(2) fertility	(1) fertility	(2) fertility
lnGDP	-2.044	-4.806	-5.095**	-8.109***	-14.81***	-14.56***
	(-0.49)	(-1.38)	(-2.79)	(-4.91)	(-15.42)	(-15.22)
$lnGDP^2$	0.125	0.248	0.257**	0.401***	0.717***	0.707***
	(0.61)	(1.45)	(2.84)	(4.90)	(14.76)	(14.60)
enrollment		0.0101***				
		(7.49)				
Public spending				0.548***		
				(10.05)		
Paid leave						-0.00213**
						(-3.21)
_cons	9.389	24.56	26.88**	42.33***	78.15***	76.74***
	(0.44)	(1.39)	(2.92)	(5.07)	(16.50)	(16.25)
N	132	132	395	395	682	682
R^2	0.249	0.492	0.245	0.242	0.479	0.488

T statistics in parentheses
* $P < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 5 Estimation result of family policy by fixed effect

	(1) fertility	(2) fertility	(1) fertility	(2) fertility	(1) fertility	(2) fertility
lnGDP	-12.50***	-12.55***	-4.427***	-4.435***	-14.53***	-14.31***
	(-3.95)	(-4.14)	(-3.88)	(-3.88)	(-19.66)	(-19.39)
$lnGDP^2$	0.612***	0.611***	0.241***	0.242***	0.737***	0.725***
	(3.79)	(3.95)	(4.07)	(4.07)	(19.38)	(19.06)
enrollment		-0.00397**				
		(-3.26)				
Public spending				-0.0248		
				(-0.65)		
Paid leave						0.00175**
						(2.95)
_cons	65.47***	66.26***	21.88***	21.92***	73.21***	72.11***
	(4.22)	(4.46)	(4.00)	(4.00)	(20.26)	(19.97)
N	132	132	395	395	682	682
R^2	0.9511	0.9592	0.9673	0.9674	0.8682	0.8700

T statistics in parentheses
* $P < 0.05$, ** $p < 0.01$, *** $p < 0.001$

I repeated the experiments using lnGDP and $lnGDP^2$ as the explanatory economic variables. All of the estimation groups have the same negative coefficient of lnGDP and positive coefficient of $lnGDP^2$. The significant results once more confirm a convex pattern of GDP per capita on total fertility rate in OECD countries.

Take a closer look at both tables. Compared with the regression on lnGDP and $lnGDP^2$, the three groups of estimation with family policy instrument come up with a bigger R^2. We can conclude that by controlling for the family policy, the regression model fits better for the actual relationship.

The OLS estimation result presented in Table 4 shows a significant positive effect of enrollment rate and public spending per GDP on fertility, while paid leave has a significant weak negative impact. Compared with OLS estimation, Table 5 shows converse family policy effect. Enrollment rate and public spending have weak negative relationship with fertility. Paid leave has positive impact on fertility.

Using the between country variation therefore yields a different conclusion than using the within country variation. The positive coefficient for family policy with OLS indicates that countries with more generous family policy also have higher fertility rates. The negative coefficients in the fixed effect model indicate that countries that increase enrollment and public spending have decreasing fertility rates.

The increased income may influence fertility through two channels. The first channel has a positive direction. Given more income, having children is a smaller financial burden on the household. The second channel has a negative direction. Given higher income, both direct and indirect cost of raising children increases. The indirect cost is the alternative cost of staying home with the child, which increases when incomes rise. A direct cost can be connected to preferences to invest more in each child when incomes are high, e.g. better schooling, more time with each child etc. (the "quality" of a child, Becker, 1981) The two channels works together to determine the total effect.

With enrollment rate and public spending included in both estimations, the negative effect of lnGDP becomes stronger. We can conclude that both measures capture some of the positive effect of lnGDP on fertility, because they directly lower the cost of having children, leaving the negative effect of lnGDP stronger.

Paid leave influence effect of lnGDP on fertility in a different way. With paid leave included, the negative effect of lnGDP becomes weaker. The interpretation is that with longer paid leave, (note that not all of the paid leave is fully paid), the more time parents spend with children at home, the higher opportunity cost will turn out. Therefore the duration of paid leave captures mainly the negative effect of increased income on fertility. This finding is counterintuitive because the right to parental leave is supposed have a positive effect on fertility. One reason for this finding may be the negligence of income support in this measure. I make a detailed discussion in the next section.

4.3 Estimation results summary

Based on all the estimations above, we can conclude that there is a change in the impact of GDP per capita on total fertility rate. When the economy develops to a certain stage, future advancements in GDP will possibly go hand in hand with a fertility rebound.

The government family policy aimed at balancing work-life for households do have

impact on fertility decision, but the impact is ambiguous. Family polices selected in this thesis are proven to be related to income level, but the measures are not ideal. In the next section I will discuss some of the problems in investigating the role of family policy.

5 Further discussion of family policy

Given the estimation results listed in the previous section, we can conclude that family policy plays an ambiguous role in fertility decisions around OECD countries. The factors driving this result can be discussed in two aspects. One is the data issue regarding measurement. The other one is the actual concerns of households when they make fertility decisions.

5.1 Evaluation of data measurement

The measures I select for estimating the relationship between family policy and fertility are based on current available data from the OECD database. Due to missing data, the observations are not as complete as in an ideal situation. This may lead to insignificant and/or downward biased estimates of the true relationship. I will analyze the three measures individually.

The enrollment rate used in the thesis is the average enrollment for children under 3 years old to formal childcare and preschool. Only 12 countries are taken into account so that the result may lack the validness of generalizing.

Regarding this measure, important concerns for parents are the availability and price of formal childcare and pre-school. Enrollment rate is an imprecise pooled measure of them instead of clearly distinguishing them. For example, as formal childcare is not always fully supported by the state, the ratio paid by households is not included in the data.

The total paid leave includes maternity leave and employment-protected parental leave. This measure only captures the duration of the leave, neglecting country specific factors like eligibility coverage, the percentage of payment, etc. Consider the employment-protected statutory maternity leave arrangements in 2013. The eligibility varies across different countries. For example, in Korea only women who are employed are covered in this benefit system, in Denmark it requires to have 6 weeks of residence while in Finland all parents are eligible.

Income support during parental leave also plays important role. In 2008, parental leave was unpaid in 8 countries including Australia, Greece, Ireland, New Zealand,

Portugal, Spain, Turkey and UK. 12 countries provide full-paid parental leave while the other 14 only make certain payments during part of the leave (OECD, 2011). As taking parental leave will directly increase the opportunity cost of raising a child, especially for the middle or high-income family, parents may refuse to take the whole provided parental leave. Based on this point, if the leave duration is the only thing taken into account, the measure is obviously only able to explain part of the issue.

Public expenditure on childcare and pre-school per GDP concerns the central governments' spending, but for some federal countries, local governments provide additional financial support for parents on leave which is not included in the data (OECD, 2011). Hence the actual spending is not properly captured in the data and it is much more difficult to get a good view of public support for childcare across such countries. These omitted factors are also important for the impact of family policy on fertility.

Moreover, three instruments are not enough to explain everything behind fertility, more instruments needs to be included to determine the degree of importance.

5.2 The actual impact of family policy on households' fertility decisions

Even though family policy is not perfectly measured, the effect of family policy on fertility may be small in OECD countries for many reasons. In this part, I will discuss some economic reasons.

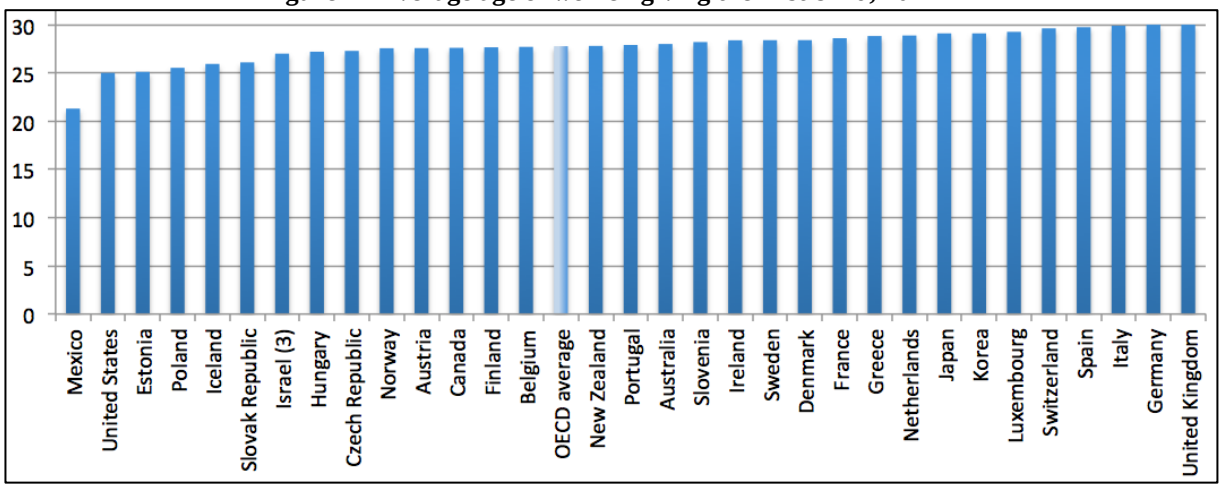
OECD countries are relatively richer than other part of the world, even the least developed countries like Chile and Estonia, GDP per capita exceed 15000US dollar. Compared with households' high income, the additional cost of raising one more child is not that expensive. The relative cost of raising a child is small enough that they care little about the public support policy. An increase in income may encourage fertility since the costs are easier borne ("income effect"). Meanwhile with higher income, the increased opportunity cost of staying home with children may depress fertility ("substitution effect"). Richer countries may be less sensitive to the changing price of raising a child because at their level of income, the income effect dominates the substitution effect. Households can afford the alternative cost so that they would have the ideal number of

children regardless of a slight change of family policy. It would be interesting to examine the effect of family policy in developing countries to see if the result is stronger.

Most family policies are designed to help balancing work-life and family-life. It would be worthwhile to take the actual labor market into consideration. Most of public supports are provided under certain conditions. For example, the eligibility criterion for paid maternity leave in Australia is 12 months continuous service with the same employer for employees with permanent position. This strict eligibility will encourage rational young people to work today for tomorrow's "benefits". The resulting postponed fertility behavior will affect fertility rate.

Even excluding the concern for eligibility, concerns regarding the career life also exist. Figure 12 indicates that the average ages of women around OECD countries giving first birth are between 25-30 years old, which is also considered as perfect time for gaining experience and social network from career. Consider given long time paid leave, not all the parents will take the whole duration. Long time absent from work is probably reducing the possibility of future promotion. Therefore, people may not be response positive to the family friendly policy, as it will "cost" some further potential gain. Some countries have started to make care supports and/or leave entitlements available to grandparents as they care less about the career, hence the policy may be more effective.

Figure 12 Average age of women giving the first child, 2011*



Note: * Data refers to 2009 for Canada and Italy; 2008 for Australia, Denmark, Japan, Korea, Mexico and the United States.

Source: Eurostat (2014) and United Nations Statistical Division (2012) and National Statistical Offices.

In addition, it is important to consider the country difference. Compared with European countries with similar GDP and family policy, Japan and Korea have significantly lower total fertility rate. Consider Hong Kong where the GDP per capita reaches around 52722US dollar in 2013（IMF data）, its total fertility rate is 1.3, one of the lowest in the world. Strong competition in East Asia could be a reasonable explanation. Parents have to spend extra money on education than other regions. In addition to attending publicly financed schools, most Korean children have to go to private tutoring school in order to gain chances to the top universities. This expense in the mid-2000s is up to USD 25000 per child per annum (OECD2007). The same thing happened in Japan and Hong Kong, therefore even with strong public support, the relatively higher education cost in these countries prevents more children because of the "quantity–quality trade-off" (Becker, 1981).

In order to get a better-explained relationship, reverse causality also needs to be discussed as the effect of family policy on fertility may go in the other direction. The negative coefficients found in the fixed effect model indicate that countries with low fertility rates have stronger incentive to invest more in family policy. The countries with a higher growth in public spending and enrollment rate have decreasing fertility, but from another perspective, the higher investment in these policies might be a reaction to the falling fertility rates.

Family policy work on fertility through different channels and the total effect may often change. Moreover, fertility may also affect government's investment in family policy. It is important to consider the interaction and consider specific factors when analyzing family policy.

6 Conclusions

The trend in total fertility rate has changed over the last decades in OECD countries. From the 1960s the fertility rate kept declining until early this century. Together with the trend is the increasing GDP per capita. From the early 2000's, there has been a fertility rebound in OECD countries, especially in highly developed ones. Empirical studies for the last three decades confirm the convex impact of GDP per capita on fertility. The negative coefficient of lnGDP and positive coefficient of $lnGDP^2$ in all estimation equations support the previous hypothesis of an inverse J-shaped pattern of fertility along with economic development. The implication is that if GDP per capita reaches a certain level, further increases in income are expected to improve fertility. The turning-point is found to be around USD 26000 in the dataset used in this thesis. In a similar study conducted by Angela and Olivier (2010), they conclude that the turning-point is from USD 26000 to USD 32600 by using different models. Comparing the estimation results of a pooled OLS model and a fixed effected model, the effect of income on fertility becomes stronger when controlled for country specific unobserved factors. I also conclude that fixed effect estimation is better captures the critical value of GDP per capita that leads to an increase in fertility.

A further step in the thesis is to investigate whether family policy plays an important role in fertility decisions around OECD countries. During the process of collecting and analyzing data, I find that all OECD countries invest in family friendly policy with an increasing intensity over time. Even through the emphasis points vary between different countries, the overall trend of investing in family policy is inspiring. Households in OECD countries are given a better chance to enjoy a balanced life combined with work and family.

In order to get an accurate result, I introduce three family policy measures to the regression analysis by using both pooled OLS model and fixed effect model within countries. Estimation results show that with family policy measures included, the impact of GDP per capita on fertility changes, we can infer that family policy explains some of the effect.

It is notable that two estimations yield different results, indicating that the impact of family policy is ambiguous and changeable. Enrollment rate of children under 3-year-old to formal childcare and pre-school together with public spending on very young children per GDP show different effect on fertility compared with total duration of paid leave. With fixed effect estimation, the coefficients of family policy measures are smaller than those in pooled OLS. By taking country-specific factors into consideration, fertility decision is less explained by family policy. The income variable captures the main reason for fertility change.

The macro-level study successfully answers the question of whether economic development can explain the fertility rebound. The confirmed result is consistent with the intuitive hypothesis that economy development is one of the driving factors behind households' rational decisions. The ambiguous impact of family policy on fertility seems counterintuitive as they are designed to ensure households to be able to have the ideal number of children. Family policies are supposed to have a positive impact. A possible explanation is that fertility decision is complex and supposed to be explained by many factors, three simple explanatory variables cannot capture all characteristics. On the other hand, family policy will influence fertility through different channels, and it will change over time and across regions, the actual effect of family policy on fertility is not easily defined.

This thesis takes a simple step in the analysis of fertility rebound in OECD countries, since the reversal trend is just visible the last few years. Future study with more available data would be meaningful. Furthermore, it is important to consider more detailed factors when evaluating family policy.

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