Thesis

A centuries old question answered with modern data: how are income and fertility connected?

ERASMUS UNIVERSITY ROTTERDAM
Erasmus School of Economics
Department of Economics

Supervisor: Dr. A.C. Gielen

Name: Hidde Veenstra
Exam Number: 379683
E-mail address: 379683hv@student.eur.nl
Date: 03 – 03 – 2017

I. Introduction

The average age of the population in the Netherlands is increasing. This increase is also visible in other OECD countries, and this raise will lead to modest declines in the economic growth rates of these countries (Bloom, Canning, & Fink, 2010). The main reason for this rise is the low birth-rate, also called fertility when only the absolute number of babies born is considered. Since people naturally get older, low fertility means that not enough babies are being born to keep the average age on a constant number. When this happens, the inhabitants of a country get older on average and this could have a negative impact on the economy. One of the things that could happen, for example, is that the working population becomes too small to effectively pay for the pensions for the retirees, which makes working less attractive, due to the low expandable income for the workers.

There is, and has been, a lot of discussion about the effect of certain variables on the fertility rate, one of these variables being the income per capita of a country. Some authors, including Malthus, think that income has a positive effect on fertility; in short, if someone has a higher income, they would sooner decide to get children because their financial position would be sufficient to take care of a child (Malthus, 1798). Other authors, such as Becker, believe that a higher income will lead to less babies; in short, if

someone has a higher income, they would lose more income if they decided to conceive children, thus they are less inclined to do so (Brue & Grant, 2013). The ideas of these authors will be further explained in section II. For now, it is evident that their thoughts are contradictory, which shows that the path between income and fertility is not obvious, and therefore, this paper has the objective to find an answer to the following question: when income changes, what kind of effect has this change on fertility?

It is relevant to study the precise connection between these variables, because this connection might influence numerous other variables. A result that might arise, as stated before, is a problem regarding the pension system. If the connection between income and fertility is considered to be negative, as Becker said it would be, and we look at a rich country, then the high income will result in an increase in the average age of the population. Since people stop working from a certain age, it is likely that the working population will become smaller, which results in a lower supply of and higher wages for workers. As income increases, fertility will further decrease, and the working population becomes smaller, while they have to pay the pensions for the expanding group of retirees[1]. To accommodate for this larger group of retirees, the workers have to pay a larger premium, which will result in dissatisfaction among the workers. If this premium keeps increasing, it will lead to a certain premium where the workers do not get to keep enough of their income to make working attractive[2].

A different repercussion might be that countries stay in their poor state. If the connection between income and fertility is considered to be positive, as Malthus said it would be, and we look at a poor country, then the low income will result in an increase in the average age of the population. As in the previous example, it is again likely that the working population will become smaller. Since the inhabitants of this country are considered poor, and thus the retirees do not have a lot of money, it might be possible that younger people start to take care of older people, which results in an even smaller working population. If people work less, most of the time they also earn less money,

[1] In the Netherlands, the pensions are financed by the working population; every employer and employee pays a certain premium to the tax authorities and the pensions of the people in retirement are being paid by this premium.

[2] If workers must pay a larger premium, their net income decreases, and thus fertility would increase. It is, though, not evident that their net income would decrease, since their wages keep increasing due to the lower supply. It is not evident which effect, a higher wage or larger premium, dominates the other, thus it is not clear if a problem between pensions and the fertility exists. However, it is potentially a problem, and that is all this example is trying to show.

through which they will be less inclined to get children. This means that fertility decreases even further, and that this country has found itself in a negative spiral, in which fertility keeps decreasing[3].

Apart from the effects mentioned above, the connection between income and fertility is also relevant during an economic crisis. In such a crisis, numerous people will lose their job and the average income will decline. If Becker's model is correct, this decline in income will lead to a temporarily higher birth rate and will temporarily work as a counter effect to the aging of the population. However, if we assume that Malthus' model is the more accurate model, then a crisis would temporarily lower the number of babies born and that would result in a temporary steep decline in the working population after a couple of years. This decline in work force will lead to a problem with the pensions and to a shortage of employees, both not very helpful to the economy.

As described above, a negative connection between fertility and income could lead to a decreasing working population, whereas the number of retirements would only increase. But the causation leading to this problem, could also be a solution for this problem. A higher income increases the opportunity costs of a person in their decision to conceive children, which leads to less children. But if the opportunity costs could be lowered, then more people would choose to conceive children. A way to lower these opportunity costs is to give parents a certain amount of income; they choose to work less or stop working and in return they receive some kind of child benefits. These benefits consist of some income, which lowers the decrease in income resulting from unemployment or less work. The level of these benefits could be lowered or heightened if, relatively, a lower or higher fertility is the objective.

The examples mentioned above are just some chains of events where multiple other effects are not included. These examples only show that the connection between income

[3] In this example, the change of wages could also have an effect. If the working population is decreasing, then is it likely that the wages will increase, which will counteract the negative spiral. It is, however, not evident which effect dominates the other, so it is not obvious how this country is influenced by income and fertility. Although it is not clear, it follows that there is potentially a problem regarding fertility and income.

and fertility is relevant to examine, they do not show what this connection precisely induces in an economy.

After this introduction, a theoretical and empirical part will follow. For the theoretical part, the opinions of Malthus, Becker and other authors will be examined, whereas also two models of Becker will be further scrutinised. After this examination, a study of empirical data will follow. For this study, data of 32 OECD countries will be taken into account. If a connection between income and fertility were to exist, then this connection should be visible during a recession. The dataset for this study includes data regarding the years 1990 until 2015, which means that data regarding the 2001 internet bubble and the 2007 financial crisis are a part of this set, and this could help determine whether the connection exists.

II. Theories and theoretical model

A. Malthus

In the 18th and 19th century, Malthus wrote about the connection between income and fertility. One of the relevant variables, according to him, was the age at which people decided to marry (Malthus, 1798). This variable works in conjunction with the frequency of coitus during a marriage, but only the age at which people married depended on income. If a citizen had a low income, he did not have the recourses to take care of a potential partner. This meant he had to wait a couple of years until he had saved enough money so his partner could financially rely on him. The lower his income, the longer it would take for someone to accommodate enough money, and thus the longer it would take for someone to get married. The longer it took for someone to get married, the longer it took for someone to get children. Thus, the age at which people marry had a negative effect on fertility, which means that a positive effect exists between income and fertility. Additionally, Malthus thought that a too low income discouraged people from having children (Brue & Grant, 2013). A low income meant that a couple could not feed a child, and this idea should have prevented them from having one. When income increased, they would be able to take care of a child and thus could decide to get one. As income kept increasing they could take care of more children and thus follow their desire for getting children. Malthus also explained this from a perspective of income, birth and death rates. In every society, there would be an income per person at which the

population has the means to reproduce itself, called the subsistence income. When the income per person at a certain moment, called material income, is lower than this subsistence income, the birth rate will be lower than the death rate. This means that the population will shrink and that income per person will increase. It works in a reverse way if the material income is higher than the subsistence income. In this case, the population has more than enough money to reproduce itself and thus the birth rate will be higher than the death rate. Due to these births, the income per person will decrease and in the long run the birth and death rate should be equal with a steady income per person (Clark, 2007). This line of reasoning reconfirms that income has a positive effect on fertility.

Since fertility is negatively influenced by the age at which people marry, the connection between income and fertility is in total positive; if someone had a high income, he would get married sooner, could take care of more children and thus also get more children.

In the 20th and 21st centuries, data suggest that this connection has changed. The development of contraception might mean the end of the connection between fertility and the frequency of coitus during a marriage. Subsequently, it looks like the morals of people changed; in the 19th century it was unheard of that two people who were not married had a baby, whereas in the two centuries that followed, that moral changed. This means that the variable of frequency of coitus during marriage is not relevant any more, which also leads to the irrelevance of the variable of the age at marriage. However, it seems that the means to take care of a child is still important in the decision-making process, so Malthus' theory has not lost its relevance.

B. Becker

In the 20th century, Becker followed the theory of Malthus and added an important variable, opportunity costs. These costs emerged because Becker saw time as a scarce good, for time was available in a limited capacity and thus everyone had to choose how to spend their limited time. For every decision one makes regarding their time management, a second-best option was deemed inferior to their first option, and the utility that would have been conceived from this second option, form the opportunity costs of the first option. This is also the case with a decision to get children. If a couple

decides to get children, they must decide to work less, which means that either of the partners stops working and takes care of the child(ren), or that both partners slim down their working hours. Either way, if a couple gets a child, their combined income will decrease. This decrease in income can be seen as the opportunity costs of having children, which will become larger if the decrease in income is larger. This means that if the wages increase, the opportunity costs of having children also increase and it becomes less attractive to conceive children (Brue & Grant, 2013).

Becker also said that children could be seen as durable capital, and thus that they should be seen in a quality and quantity matter. This quality setting is defined as the amount of money that is spent on a child; if more money is spent, for instance on more education, higher quality food or a separate bedroom, then that child is qualified as a higher quality child. This quality measure does not say anything about the morals of children (Becker, 1960).

In a different model, Becker also made a connection between fertility and human capital. Looking at these variables, he found a negative connection between human capital and fertility; if the amount of human capital is low, then this will lead to a higher fertility, whereas a high amount of human capital will lead to a lower fertility. This relationship exists because of the rates of return. If the rate of return on investments in human capital is relatively low in comparison to the rate of return on children, which happens when human capital is low, then it becomes attractive to conceive children (Becker, Murphy, & Tamura, 1994).

Combining the two models of Becker, there are two main effects regarding fertility, income and human capital. The first contains the opportunity costs: if a couple has high human capital, then their income will be high and thus their opportunity costs of having children is also high, which will lead to low fertility. The second consists of rates of return: again, if a couple has high human capital, the rate of return on an investment in their human capital will lead to an increase in their income that is higher than the rate of return on conceiving children. Thus, according to these models, through opportunity costs, high income will diminish fertility, and the high rate of return that comes with this high income will even further reduce fertility.

Malthus and Becker are two of the biggest contributors in de discussion about the connection between income and fertility. As described, their views follow a similar path, but the conclusions at the end of these paths are quite different. Malthus reasoned that a higher income would lead to an earlier marriage, a position to financially take care of a child and thus also to a higher birth-rate. Becker followed this reasoning, but focused on a different effect; he reasoned that a higher income meant that the opportunity costs were higher, and this would lead to a lower birth-rate. Both men lead to a different outcome, but since Becker has contemplated the ideas of Malthus, it is probable that Becker's models are more accurate, and thus for the next part of this paper, models of Becker will be further scrutinised.

C. Becker's models

The economic framework for this study is based on a combination of the theory of the demand for consumer durables, which is a model that Becker used in one of his analyses (Becker, 1960), and the Malthusian model that Becker used in a different analysis (Becker, 1992). To study the demand for children, a look at utility maximisation is required. In this utility function, people choose how to spend their income towards different goods. This means that a simple utility function is as follows:

$$U = v(x) + b(n), v', b' > 0,$$
$$v'' < 0, b'' < 0\,.$$

In this function, n is specified as the number of children, the other goods are called x, and utility increases at a decreasing rate in both x and n.

In this model, children are treated as durable consumption and production goods. At first sight this may seem strange, but this classification is not very illogic. Children give their parents pleasure and satisfaction, and that are the characteristics of a consumer good. The classification of a production good becomes also evident when a look is taken at older children. When parents and children grow older, it is natural for the children to take care of their parents. When a 'good' yields money, it can be considered a production good, so this means that children are also a production good. However, in this model children will be addressed as durable consumer goods. They will yield some money, but according to Becker, if opportunity costs are considered, the costs are larger than the monetary gains. This means that a monetary pay-off is not the main incentive

to have children and thus the conclusion is reached that a child cannot be a durable production good.

Another part that is important for the utility function is income, and it is immediately a very important one. The income, the price of other goods and the price of children together form the budget constraint of a couple:

$$p_x x + p_n n = I \,,$$

where I is income, p_x the price of other goods and p_n the price of children.

However, income is not a fixed variable. Income depends on the wage, the number of hours worked and a non-labour part (Borjas, 2016). The number of working hours also has a connection with the first part of the budget constraint; if someone chooses to get children, they have less time available for work, and thus their income will decrease. These thoughts combined, make the following budget constraint:

$$p_x x + p_n n = w(T - zn) + V \,,$$

where w is the wage, T is the total time that is available in a period, z is the time it takes to look after a child and V is the non-labour income. Looking at this constraint, it follows that an increase in the number of children influences both sides of this constraint. A rewritten version of this budget constraint captures the whole effect on one side:

$$p_x x + n(p_n + wz) = wT + V$$

In this rewritten budget constraint, it is evident that if the number of children increases, the amount of money that is spent on children also increases[4]. Apart from this effect, the effect regarding opportunity costs is also visible; if the number of children increases with one, the left-hand side will increase with wz, which means that, besides the increase in actual expenditures, this couple has wz less money to spend on their children or on other goods.

A rise in income will give the receiver the possibility to increase his number of goods or to increase the quality of his goods. The same is possible with children, but Becker noted that the quality elasticity should be high compared to the quantity elasticity (Becker, 1960). These elasticities mean that when the income of a person increases, he will spend more of this extra money on the quality of his children than on taking a new child, an effect that Hotz also noted in his research (Hotz, Klerman, & Willis, 1997).

[4] This also follows from the rise of npn on the left side of the constraint.

Like other consumer durables, children bring utility to their parents. How much utility a child brings, depends on the quality of the child and the utility function of the parents. The quality of a child is in its own way connected with the utility function of the parents. This determination of quality depends only on the amount of money that is spent on a child, which means that it does not say anything about the moral of the child, but also that more money only will be spent if it increases the amount of utility of the parents. Quality of a child is thus important to add to the utility function and budget constraint:

$$U = v(x) + b(n, q)\ ,$$

$$p_x x + n(p_n + wz + pq) = wT + V\ ,$$

where q is the quality of a child, p_n is the cost of expected expenditures that are independent of quality, p is the cost of expected expenditures that are dependent on quality, such as education and health. From the budget constraint, it follows that $p_n + wz + pq = \Pi_n$ is the marginal cost of an additional child, and $pn = \Pi_q$ is the marginal cost of higher quality.

Apart from the marginal costs of a child, the utility that is gained from having a child is also an important factor. Before a couple get a child, they do not know a lot characteristics of that child, and each attribute has its own value. The biggest difference at birth is that between a boy and a girl. Since this is the biggest distinction in life, Becker chose to pull these utilities apart and that resulted in the following expected utility (EU) from an additional child:

$$EU_{CH} = PU_M + (1 - P)U_F \cong \frac{U_M + U_F}{2}$$

Here it is important to make a distinction between actual utility and expected utility since there is a lot of uncertainty about the characteristics of a child. In the formula, P is the probability of a boy, and this probability is approximately a half.

The budget constraint mentioned before shows that income can be spent on children, the quality of children and on other goods. How this money is spent regarding these groups depends on the marginal cost and utility of each good. In the decision-making process, each person compares all marginal costs and utilities, and following those values will choose his goods (Frank & Cartwright, 2013).

D. Other literature

Becker and Malthus are not the only authors that have written about a possible connection. In 2016, Schaller tested a model where fertility depended on the unemployment rate of men and women. According to her, these rates are the proxy for local labour market conditions (Schaller, 2016). In her model, she noted that everyone has the option to control their fertility and to time each birth to their own individual preference. Due to these controls, parents can choose the number of children they want and, considering a given budget constraint, will choose the number of children that will lead to their highest possible utility. Other authors preferred to also consider the quality of children, such as Freedman & Coombs (1962), because a quality increase will lower the disposable income thus also the income that is taken into account for the decision about the number of children, but Schaller elected to keep that variable out of her model[5]. In the process of choosing the number of children, the price of children is an important variable and this price depends on monetary inputs and parental time. From Schaller's data, it follows that fertility is negatively influenced by unemployment rates. How much this negativity is, depends on the kind of study. Schaller did two kinds of studies with her data, an OLS study and an IV study. Concluding from her OLS data, a one percentage point increase in unemployment leads to a 0.8 percent decrease in fertility. The IV results show a stronger connection; a one percentage point increase in unemployment leads to a 2.2 percent decrease in fertility. This connection is the total connection when men and women are combined. Schaller also examined each gender separately and noted that a decrease in male unemployment was associated with an increase in fertility, whereas a decrease in female unemployment was associated with a decrease in fertility. From these results, it follows that the sexes have opposite effects on fertility. A mechanism that could explain a part of this difference is the availability and price of childcare (Schaller, 2016). Childcare is a working area where mostly women control the jobs, so when less women have the opportunity to work there, which is the case when the labour demand of women improves in other sectors, the prices of childcare will increase. Apart from the lowering of availability of women, the prices will

[5] According to Schaller, Becker made a strong distinction between the quantity and the quality of a child, and since Schaller wanted to focus purely on the quantity part, she chose not to include the quality part.

also increase if the overall unemployment decreases. This happens due to the higher demand for childcare, since less people are staying home and thus less can take care of their children themselves. A higher price will lead in turn to a lower fertility, so if the unemployment of women decreases, fertility will also decrease. Going back to the results of the study, the connection between women and fertility is smaller than the connection between men and fertility. This means that the overall effect between unemployment and fertility is dominated by the connection from men. The overall effect will become more negative if the employment in men-dominated markets decreases more than the employment in women-dominated markets, an effect that occurred in previous recessions (Hoynes, Miller, & Schaller, 2012). That recessions have a distinct effect on to be born babies is something Dehejia and Lleras-Muney also discovered. In 2004, they did research on the relationship between unemployment and fertility and the health of babies. With their study, they found numerous connections, one of them being that the fertility regarding less-educated black mothers suffered less from a regression than the fertility regarding less-educated white mothers (Dehejia & Lleras-Muney, 2004). This conclusion means that it could be relevant for a model of fertility to make a distinction based on race.

A few years earlier, in 1982, Freedman and Thornton were also considering a distinction between a male variable and a female variable regarding their research on fertility. They specifically looked at the income of a husband in respect to expected fertility, and they found that their data did not support a strong relationship between these two variables (Freedman & Thornton, 1982). Considering that the model of Becker concludes that income and fertility are connected, it follows that fertility should then be strongly connected with the income of women. This effect is noteworthy because, even though it is natural that a woman cannot work for a couple of months, after childbirth the partners can decide either who will stop with their job, or who will work less. In the last thirty years, the labour participation rate of women has increased a lot, so the effect might be smaller today than it was in 1982 (Frank & Cartwright, 2013).

Aside from the distinction between male and female income, the difference between wage and constant income is also important, since not all increases in income will result in a decrease in fertility. If the constant income of a couple were to increase, for instance due to an increase in the value of their house or by winning a lottery, then their wages

would become less important and thus the opportunity costs of having children would also decrease. It is therefore important to distinguish a one-time change in income from a change in wage, since a one-time increase in income will result in a higher fertility, whereas a wage increase will lead to a lower fertility (Lovenheim & Mumford, 2013) (Schulz, 2005).

In its own way, an increase in wage has two kinds of effects on the allocation of time and purchase of goods; a substitution effect and an income effect (Frank & Cartwright, 2013). The substitution effect works together with opportunity costs; if someone allocates some time to an activity, they cannot use that time for a different activity and the gains of that other activity are then called opportunity costs. Work also qualifies as a different activity and thus a higher wage will increase the opportunity costs of every time-allocation that is not work. This substitution effect is included in the model of Becker; a higher wage leads, through higher opportunity costs, to a lower fertility. However, the income effect is not included in this model. This effect consists of the idea that when the wage increases, a person needs less working hours to gain the same standard of living as before (Borjas, 2016). It also means that if a person would like to improve their standard of living, they would need less extra working hours than before. Thus, when the wage increases, due to the income effect, more time becomes available for the use of goods. If this effect is related to the model of Becker, the income effect could imply that a higher wage leads to higher fertility, and therefore it could be relevant to consider this effect in Becker's model.

Adsera also noted that it is important to consider an income effect in a model of fertility. A standard microeconomic model of fertility will consider opportunity costs and will conclude that a temporary unemployment spell will increase fertility, whereas a longer period of unemployment will decrease fertility because this unemployment is associated with a decrease in human-capital accumulation and this significantly increases the risk of future unemployment and leads to lower future wages (Adsera, 2005). The lower wage leads to the income effect that people need more working hours than before to improve their standard of living, and that it is therefore less interesting to take children. This income effect is thus a meaningful part of a model of fertility.

III. Data and empirical model

A. Data information

To construct a model of fertility, data from OECD countries is used. The OECD collects data regarding several topics from each member and this data can be downloaded from their website, which gives the possibility to create a model with enough data. The first variable that is used for this model is data regarding fertility rates, which is constructed yearly and defined as "the total number of children that would be born to ten thousand women if each woman were to live to the end of her child-bearing years and give birth to children in alignment with the prevailing age-specific fertility rates"[6]. The second variable consists of data regarding average wages. These wages are constructed yearly and obtained by "dividing the national-accounts-based total wage bill by the average number of employees in the total economy, which is then multiplied by the ratio of the average usual weekly hours per full-time employee to the average usual weekly hours for all employees"[7]. It is important to note that these wages are measured in USD, and also that 2012 is used as base year to control for purchasing power parity. In line with the literature discussed earlier, this model uses wages as its primary independent variable. The third variable consists of data regarding public spending on family benefits, which refers to "public spending on family benefits, including financial support that is exclusively for families and children"[8]. It is important to note that only the total benefits are used in this study and these benefits are measured in percentage of GDP. The fourth variable is the unemployment rate, which is defined as "the number of unemployed people as a percentage of the labour force, where the latter consists of the unemployed plus those in paid self-employment"[9]. The last variable is the net worth of a household, which is measured as a percentage of net disposable income. This variable is defined as the "value of total assets (the total amount of financial assets plus the total amount of

[6] The data and description are gathered from: OECD (2017), Fertility rates (indicator). doi: 10.1787/8272fb01-en (Accessed on 18 January 2017)
[7] The data and description are gathered from: OECD (2017), Average wages (indicator). doi: 10.1787/cc3e1387-en (Accessed on 18 January 2017)
[8] The data and description are gathered from: OECD (2017), Family benefits public spending (indicator). doi: 10.1787/8e8b3273-en (Accessed on 18 January 2017)
[9] The data and description are gathered from: OECD (2017), Unemployment rate (indicator). doi: 10.1787/997c8750-en (Accessed on 18 January 2017)

non-financial assets) minus the total value of outstanding liabilities"[10]. This variable is included in the attempt to divide the effect between wages and constant income, because, as described in the literature, it is important to distinguish a one-time change in income from a change in wages.

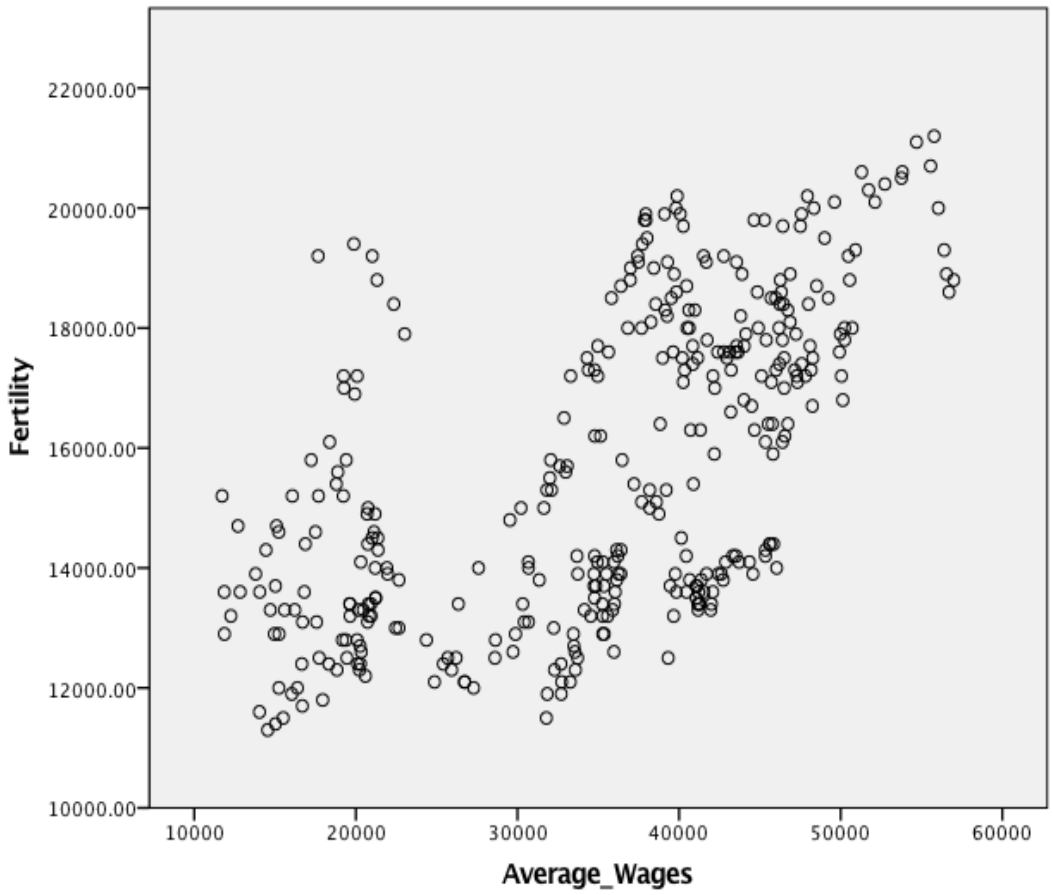
All these variables are collected from the following 32 countries for the years 1995 until 2014: AUS, AUT, BEL, CAN, CHE, CHL, CZE, DEU, DNK, ESP, EST, FIN, FRA, GBR, GRC, HUN, IRL, ISL, ITA, JPN, KOR, LUX, LVA, NLD, NOR, NZL, POL, PRT, SVK, SVN, SWE, USA. However, not every country provided data for each year, so the dataset is unbalanced.[11] Since the data is collected per country and per year for each country, the dataset is also called a panel dataset. Table 1 shows the number of observations, mean, standard deviation, minimum and maximum value of each variable, whereas figure 1 shows the graph of a scatterplot regarding the fertility rates and average wages.

Table 1: Summary statistics	Obs	Mean	Std. Dev.	Min	Max
Fertility rate *(births per ten thousand women)*	360	15655,28	2547,02	11300,00	21200,00
Average Wage *(amount per employee)*	360	34951,00	11355,61	11720	56995
Unemployment rate *(percentage of the labour force)*	360	7,75	3,45	2,25	24,44
Household net worth *(percentage of net disposable income)*	360	391,27	101,69	130,03	671,27
Public spending on family benefits *(percentage of GDP)*	360	2,06	0,92	0,41	3,99

[10] The data and description are gathered from: OECD (2017), Household net worth (indicator). doi: 10.1787/2cc2469a-en (Accessed on 18 January 2017)

[11] Only the years which had data for all the variables were included in the regression, so table 1 and figure 1 show the statistics for these years.

Figure 1: Graph of Fertility and Average Wages



B. Building a model

For this study, data is collected regarding four independent variables, and one dependent variable, the fertility rate. These four independent variables give the possibility to make a regression model regarding fertility. In this regression model, it is important that there are no large outliers in the data (Stock & Watson, 2015). Considering the mean, standard deviation, minimum and maximum value of each variable in table 1, it can be concluded that the problem of large outliers is not the case in this dataset. While this assumption does not create a problem for the model, it is also important to examine the assumption regarding perfect multicollinearity (Stock & Watson, 2015). This assumption is violated if a regressor is a perfect linear function of one of the other regressors. A table of correlations between all the variables is included in the appendix, table 2, and this table shows that 0,6152 is the largest correlation between two variables, which means that none of the variables is a perfect linear function of one of the other variables. So, perfect multicollinearity does not prove to be a problem for this model.

Besides the assumptions regarding outliers and multicollinearity, it is also relevant that a regression model does not have an omitted variable bias. The problem from this bias is that variables that are important for the dependent variable are not included in the model. In this dataset four variables are included, but it is likely that fertility depends on more variables than those four. Since it is difficult to include all the variables that might influence fertility, a fixed effect regression regarding panel data is a solution for this bias, if the omitted variables are fixed over time (Stock & Watson, 2015). This fixed effects model controls for omitted variables that are different between countries, but these variables need to be constant over time. In the model for this study, data regarding countries is used, whereby countries have their own cultural and ethical standards. Since countries have their own standards, it is not very improbable that the fixed regression model is relevant. Apart from these fixed effects, it is also possible to use time fixed effects for variables that do not differ between countries but vary over time. For the implementation of a fixed effects regression, STATA gives the possibility to run a regression where the regression also controls for fixed effects. It is nevertheless not possible to do the same for time fixed effects, so to use these kind of effects, break variables will be added to the model in a later stage and the significance of these variables will then be examined. However, the regression that will be used from the start is a fixed effects regression.

STATA is used to run the regression model, whereby the model starts with only one independent variable, average wages:

Table 2: Fixed effects regression on Fertility

	Coef. (Std.Err.)
Average wages	0,037 (0,010)**

**significant at p < 0,05; ** significant at p <0,001*
F-value = 12,83

Following table 2, average wages have a significant positive effect on fertility. However, average wages only explain a part of the dataset regarding fertility, so to get a clearer picture of how fertility changes, it is necessary to add more variables to the model, where it is possible that these added variables change the observed effect of the average wages. When other variables are added, it is relevant to check whether the model gets a better

fit to the actual data. One way to measure the fit of a model is to look at the R squared of this model, but the R squared in a multiple regression always increases whenever a regressor is added, so the R squared might not be the best measure in a multiple regression model (Stock & Watson, 2015). Meanwhile, according to Field, the F-ratio is an appropriate measure of how good a model is, thus in this model regarding fertility, the F-ratio will be used to examine the fit of a model (Field, 2013). Besides the F-value, the coefficients and p-values of the independent variables will also be taken into consideration regarding the fitness of the model[12].

As stated, a second independent variable will be added to the model:

Table 3: Fixed effects regression on Fertility

	Coef. (Std.Err.)
Average wages	0,180 (0,015)**
Net worth of a household	0,315 (0,981)

**significant at p < 0,05; ** significant at p <0,001*
F-value = 77,53

Following table 3, the net worth of a household is added to the model, which cannot be considered significant. However, due to this new variable, the coefficient of average wages has changes greatly, whereby it kept its significance. Considering the change of the coefficient with the great increase in the F-value, it can be concluded that this model has a better fit than the previous model.

Starting with the model from table 3 and adding a third independent variable:

Table 4: Fixed effects regression on Fertility

	Coef. (Std.Err.)
Average wages	0,150 (0,017)**
Net worth of a household	-0,151 (1,062)
Unemployment rate	-53,523 (17,679)*

**significant at p < 0,05; ** significant at p <0,001*
F-value = 33,80

[12] It was also possible to use adjusted R^2 values, but these values are not automatically given by STATA for each regression. Since the F-value is always given for each regression, the decision was made to examine the fitness of a model based on the F-values, coefficients and p-values.

Following table 4, the unemployment rate is added to the model, which can be considered significant at a 0,05 level. However, considering that the coefficient of the average wages did not change much, and the F-value dropped substantially, it can be concluded that this model has a worse fit to the actual data than the model of table 3.

Starting again with the model from table 3 and adding a different third independent variable:

Table 5: Fixed effects regression on Fertility

	Coef. (Std.Err.)
Average wages	0,146 (0,016)**
Net worth of a household	0,685 (0,990)
Public spending on family benefits	1294,676 (171,376)**

**significant at p < 0,05; ** significant at p <0,001*
F-value = 81,65

Following table 5, public spending on family benefits is added to the model, which shows to be significant. Due to this extra variable, the coefficient of the average wages changes slightly, and it keeps its significance. However, this change is very small, so that alone would not be sufficient reason to include this extra variable. Nonetheless, since public spending on family benefits has a significant effect on fertility, and the F-value of this model is slightly higher than that of the model of table 3, it can be concluded that the model of table 5 has a better fit than the model of table 3, and that this model looks to be the best model for the examination in this study.

When the choice about regressors is made, it is also relevant to examine whether there exists a certain variable that is constant between the regressors, but changes over time. This variable is called a time fixed effect variable and this might include multiple variables (Stock & Watson, 2015). The dataset has a relatively short time period, but even in this short period it is probable that certain variables changed over time. An example for such a variable might be technology, which has changed greatly over the last twenty-five years, and through which people might have been influenced to get more or less children.

For the examination of time fixed effects, a dummy variable is created for each year. This dummy variable of year t is assigned the number 0 if it is year t or a year prior to year t,

and assigned 1 if it is a year after year t. The thought behind this allocation is that in year t a variable that influences fertility changes, through which people decide to get less or more children, and thus at least 9 months after this change in variable, a change in fertility is witnessed. For this determination of a break, no specific test is available for panel data, whereas for time-series the QLR test is convenient (Stock & Watson, 2015). This test compares a model without a break with a model with a break and if the F-value of a model with a break is the highest of the two, then a break is very likely. As written above, this test is not possible for a panel data regression, but the test can be manually done in the same way. To examine whether a break variable in year t is useful for the study, two models, one with and one without the break variable in year t, are constructed and compared. For this comparison, a likelihood test is used, which calculates a chi2-value and a corresponding p-value. The chi2 distribution follows the same distribution as the f-value, so a larger chi2-value means that a break is more likely. If the p-value is lower than 0,05, then it means that a break is likely in this year. This process of doing a likelihood test was done for each year, but since every year was examined individually, also years that were not breaks followed as a break, since a model without a break variable might be worse than a model where the break variable is close to the real break. To make sure that every real break had only one break variable, the chi2-values of each year were examined to see which periods in time had a break. After this examination, the break variable in each period with the highest chi2-value was chosen as a real break. After this, the likelihood tests were run again and the chi2-values were again examined for a possible break. This process was repeated until all the significant break variables were included in the model. From the first round of examination, it followed that a break needed to be implemented in 1997, 2005 and 2012. These years were added to the model, and the second round of examination showed that 2010 also needed to be included as a break. In this round, it was also possible to conclude that 2003 and 2013 were relevant breaks, but since these possible breaks were very close to other included breaks, the choice was made to test them again in the third round. In the third round, 2010 was added and the result showed that 2003, 2006 and 2013 also needed to be included in the model. These three years were included and in the fourth round, no other break variable was significant any more. So, after this examination it was concluded that the model had the best fit if break variables for the years 1997, 2003, 2005, 2006, 2010,

2012 and 2013 were included. A table of chi2-values and p-values of each round is included in the appendix[13].

After this examination, the following regression model was the outcome:

Table 6: Fixed effects regression on Fertility

	Coef. (Std.Err.)
Average wages	0,083 (0,0234)**
Net worth of a household	1,651 (1,009)
Public spending on family benefits	1135,919 (160,208)**
Break in 1997	-548,038 (135,425)**
Break in 2003	251,004 (126,853)*
Break in 2005	413,327 (171,871)*
Break in 2006	339,139 (158,305)*
Break in 2010	-373,057 (115,696)*
Break in 2012	-292,537 (166,440)
Break in 2013	-780,531 (413,071)

**significant at p < 0,05; ** significant at p <0,001*
F-value = 41,98

IV. Interpretation

I. Outcomes from the model

The regression output in table 6 shows that average wages have a significant effect on fertility, which means that the average wage is correlated with the fertility rate. It also shows that the correlation between these two variables is positive, which means that a higher wage is correlated with a higher fertility. The model further shows the significance of the effect of public spending on family benefit, whereas the effect of the net worth of a household is not significant. These effects show that fertility also is positively correlated with the amount that is spent on family benefits, but that fertility is not correlated with the value of the financial and non-financial assets of a family.

[13] Tables 8, 9, 10 and 11 in the appendix

Apart from these findings, the results also show significant breaks in the years 1997, 2003, 2005, 2006 and 2010. It is difficult to find an economic reason for each of these years, since the timespan between the break years is very short. However, considering the coefficients of these break years, it stands out that the breaks in 2003, 2005 and 2006 all have positive coefficients, whereas 1997 and 2010 are negative. Due to these groups, it might follow that in 1997, 2003 and 2010 some omitted variables changed, whereby the effect from 2003 grew stronger in 2005 and weaker in 2006. Regarding the years 1997, 2003 and 2010 it is hard to say which developments drove these breaks, but the dot-com bubble, establishment of the European Union and the financial crisis might have played a role in these years[14].

At first sight it is not possible to conclude that the effect from wages is causal, this model only shows that there is a correlation. However, following the literature mentioned above, it is very likely that wages are an important part in the decision whether to take children. Since a theoretical foundation and an empirical model lead to the consideration that wages have an effect on fertility, it is probable that a causal relationship exists between wages and fertility. According to the regression model, this relationship works in a positive way, which differs from the opinion of Becker, but follows the reasoning of Malthus.

In this study, panel data is used for a model regarding fertility. An advantage of this kind of data, when it is used in combination with fixed effects and time fixed effects - as it is in this study - is that the regression is controlled for omitted variables that are constant over time or constant over regressors. This means that it is not likely that the robustness of this study is threatened by an omitted variable bias.

A different bias that likely does not form a threat is simultaneous causality bias. This bias takes effect if two independent variables causally explain each other, which is not probable in this dataset due to the facts that the correlations between the variables are relatively low and that it is not expected that these independent variables are causally linked.

[14] The purpose of the breaks is merely to form a better model regarding the examination of the effect of income on fertility. Therefore, regardless of the weak economic reasons for these breaks, the breaks are still relevant to include in the model.

Apart from these biases, an overall way to test the robustness of results, is to add a seemingly unimportant variable to the model and examine if the results change much due to this adjustment. In the case of this study, two tests were done; one where a break in 2000 was added, and one where a break in 2008 was added. Both tests showed no big differences in output; the coefficients and significance levels of the independent variables stayed about the same. Although it is still possible that flaws like a measurement error exist, it causes a bit more certainty that a random variable does not cause a big change in the output[15].

II. Discussion

Following the results, a couple with higher income should have more children than a couple with lower income. However, choices are hardly so black and white, and in this case, numerous variables influence this decision. People rarely only consider their income when they decide if they want to get children, as it is also important for example how stable their lives are, how likely it is that they keep their jobs and how their personal preferences regarding children relate to each other. Apart from these examples, it is also relevant how old someone is and what they expect of their future. For instance, regarding someone who is living in their mid-twenties, an increase in wage is not likely to be used for children, since they more likely want to see more of the world or want to work on their career first. At a later stage in their lives, it is more likely that a higher wage will result in more children. So not all wage increases will result in more children, however, if the case of ceteris paribus is considered, then it is likely that a higher income does result in a higher fertility.

At first sight it looks like the results follow the ideas of Malthus, however, I think it is not that simple to state that his reasoning is still applicable in the 21st century. His arguments that find their basis in the age of marriage and the frequency of coitus are not as relevant today as they were during his time. The same goes for his argument regarding the fact that people who have a too low income, will not get any children because they cannot take care of them. In the modern western society, the average couple has the financial means to support a child, so for this couple the argument of not having enough money to take care of a child is not a reason to wait with having children. I believe it is nowadays

[15] The results are listed in table 12 in the appendix

more likely that the price effect and substitution effect of income are important for the consideration of having a child. These effects work as counterparts of each other and the height of income should be an essential part in the battle of which of the two effects is the strongest (Frank & Cartwright, 2013). Since the regression model shows that wages have a positive effect on fertility, it follows that nowadays the income effect is stronger than the substitution effect. Becker focused mainly on the substitution effect, and until a certain amount of income I think Becker was considering the right effect, but nowadays the average wage has crossed that amount and thus the income effect has defeated the substitution effect as the strongest effect.

Moreover, the results put extra emphasis on the consequences of a crisis. During a crisis, the unemployment will increase and the average wages will decrease. Due to this lower wage, it follows that less children are one of the consequences of a crisis.

V. Conclusion

I. Concluding remarks

Many authors have written about the connection between income and fertility, and Becker and Malthus are two who differ strongly. Malthus thought that income had a positive effect on fertility, whereas Becker stated that income had a negative effect. Malthus considered that the decision to get children depended on the age at marriage, the frequency of coitus and a minimum income to support a child. The meaning of these variables has changed greatly over time, so it can be questioned how relevant these variables are in the 21st century. This, however, does not render the theory of Malthus useless, since the connection of Malthus is the one that is consistent with the results from the regression model that is used in this study.

Becker considered that a higher income would mean that people had to give up more income if they decided to get children, and thus it followed that people would be less inclined to get a child if their income increased. This effect is called the substitution effect, and, although it is not consistent with the findings of this study, it is still a relevant effect in the decision to get a child. However, this effect is overshadowed by an effect called the income effect, which means in the end that if the income of a person increases, they will be more inclined to get children. This is the conclusion that is coherent with the fixed effect regression model, that is used in this study. For this model, data regarding

OECD countries is used to examine the connection between fertility and wages. The conclusion that follows from this model is that income has a significant positive effect on fertility. Since it is theoretically logical that fertility depends on income, the conclusion that income has a causal effect on fertility, might also be drawn.

II. *Reservations*

This paper has examined a number of papers and several data regarding OECD countries. For this study, certain choices were made and it is important for further research to state a few suggestions regarding this paper.

First, for the regression model, data regarding OECD countries is used. These countries, however, do not make a random sample from all the countries in the world, so the conclusions regarding this dataset cannot be used for anything else than drawing conclusions for the countries in the dataset. In other words, where the regression model is internally valid, it is not externally valid. So, if the desire was to draw a conclusion for the whole world, at least a random sample of all the countries in the world is necessary.

Second, the model only explains 53% of the data, which means that if some other variables are added to the model, they might be of some importance for the explanation of fertility and this might change the significance and coefficient of wages. One variable that might be relevant, according to the literate discussed earlier, is a variable regarding the quality of children. Besides the quality variable, a constant income variable might be relevant to consider, since some literature stated that this kind of income has a different effect on fertility than wages. Through the net worth of a household, this paper tried to include this constant income variable in the regression model, however this variable was not significant. Another variable that might be relevant is a variable regarding the participation of women in the job market. If this participation increased, it might mean that the income of a couple increases and thus fertility also increases, however it might also mean that more women are not interested in having children and thus that the fertility of a country decreases. It is hard to say which effect might dominate, thus this variable is relevant to include for further examination.

Moreover, the model of this paper does not make a distinction between male income and female income. From the literature that is discussed, it follows that this is an important distinction, however, OECD data regarding wages is not collected per gender,

so it was unfortunately not possible to make this distinction. For a better understanding of the effect between income and fertility, this distinction needs to be included in the model.

Furthermore, this study uses aggregated data for its examination, where it also might be illuminating to use household data. When household data is used, the research focuses more on the level of a household, so it is possible to examine households with their own income and fertility rates. In this kind of research, the research question can question if a household with a higher income also has a higher fertility rate. Such a question is quite different from the question used in this paper, since this paper examined how an increase of the average wage of a country related to the fertility of a country. So, to get a more complete image of how fertility and income are connected, a study based on household data is relevant to conduct.

Bibliography

Adsera, A. (2005). Vanishing Children: From High Unemployment to Low Fertility in Developed Countries. *The Americaon Economic Review*, 189-193.

Becker, G. S. (1960). An Economic Analysis of Fertility. In U.-N. Bureau, *Demographic and Economic Change in Developed Countries* (pp. 209-240). New York: Columbia University Press.

Becker, G. S. (1992, Aug). Fertility and the Economy. *Journal of Population Economics , 5*(3), 185-201.

Becker, G. S., Murphy, K. M., & Tamura, R. (1994). Human Capital, Fertility, and Economic Growth. In G. S. Becker, *A Theoretical and Empirical Analysis with Special Reference to Education* (pp. 323-350). Chicago: The University of Chicago Press.

Bloom, D. E., Canning, D., & Fink, G. (2010). Implications of population ageing for economic growth. *Oxford Review of Economic Policy, 26*(4), 583-612.

Borjas, G. J. (2016). *Labor Economics, International Edition* . New York: McGraw-Hill Education .

Brue, S. L., & Grant, R. R. (2013). *The Evolution of Economic Thought, International Edition.* Boston: South-Western Cencage Learning.

Clark, G. (2007). *A farewell to alms: A brief economic History of the world* . Princeton: Princeton University Press.

Dehejia, R., & Lleras-Muney, A. (2004, Aug). Booms, Busts, and Babies' Health. *Quarterly Journal of Economics*, 1091-1130.

Field, A. (2013). *Discovering Statistics using IBM SPSS Statistics.* London: SAGE Publications LTD.

Frank, R., & Cartwright, E. (2013). *Microeconomics & Behaviour.* New York: McGraw-Hill Irwin.

Freedman, D. S., & Thornton, A. (1982, 2). Income and Fertility: The elusive relationship. *Demography*, 65-78.

Freedman, R., & Coombs, L. (1962, 10). Childspacing and Family Economic Position . *American Sociological review, 31*(5), 631-648.

Hoechle, D. (2007). Robust standard errors for panel regressions with cross-sectional dependence. *The Stata Journal, 7*(3), 281-312.

Hotz, J. V., Klerman, J. A., & Willis, R. J. (1997). The Economics of Fertility in Developed Countries. In M. R. Rosenzweig, & O. Stark, *Handbook of Population and Family Economics* (pp. 275-348). Amsterdam: Elsevier Science B.V.

Hoynes, H. W., Miller, D. L., & Schaller, J. (2012). Who Suffers During Recessions? *Journal of Economic Perspectives* , 37-48.

Lovenheim, M. F., & Mumford, K. J. (2013). Do Family Wealth Shocks Affect Fertility Choices? Evidence from the Housing Market. *The Review of Economics and Statistics* , 464-475.

Malthus, T. R. (1798). *An Essay on the Principle of Population.* London: J. Johnson.

Schaller, J. (2016). Booms, Busts, and Fertility. *The Journal of Human Resources, 51*, 1-29.

Schulz, T. P. (2005, 10 28). *Yale University* . Retrieved from Yale University Economic Growth Center Discussion Paper No. 925: http://www.econ.yale.edu/~pschultz/cdp925.pdf

Stock, J. H., & Watson, M. W. (2015). *Introduction to Econometrics.* Essex: Pearson Educated Limited.

Appendix

Table 7: correlations	Year	Country	Fertility rate	Average wages	Unemployment rate	Household net worth	Public spending on family benefits
Year	1,0000						
Country	0,0896	1,0000					
Fertility rate	0,1533	-0,0565	1,0000				
Average wages	0,0470	-0,1963	0,6152	1,0000			
Unemployment rate	0,0567	0,1961	-0,3076	-0,5453	1,0000		
Household net worth	0,0161	-0,0849	0,3845	0,6357	-0,3320	1,0000	
Public spending on family benefits	0,0095	-0,3475	0,3391	0,1447	-0,1023	-0,0283	1,0000

Data regarding year 1990 until 2015

Table 8: Break test for a break in year t

Year (t)	chi2	prob
1995	8,99	0,0027
1996	17,79	0,0000
1997	21,60	0,0000
1998	12,90	0,0003
1999	2,56	0,1098
2000	0,67	0,4138
2001	1,27	0,2602
2002	9,95	0,0016
2003	29,25	0,0000
2004	45,90	0,0000
2005	54,04	0,0000
2006	38,23	0,0000
2007	17,52	0,0000
2008	0,47	0,4925
2009	0,40	0,5272
2010	3,63	0,0566
2011	4,38	0,0364
2012	8,61	0,0033
2013	7,86	0,0051

Table 9: Break test for breaks in 1997, 2005, 2012 and year t

Year (t)	chi2	prob
1995	0,91	0,3410
1996	1,22	0,2697
1997		
1998	0,12	0,7249
1999	0,01	0,9427
2000	0,02	0,8807
2001	0,78	0,3774
2002	2,14	0,1434
2003	4,61	0,0317
2004	3,39	0,0656
2005		
2006	1,82	0,1772
2007	0,28	0,5977
2008	5,40	0,0201
2009	6,64	0,0100
2010	8,94	0,0028
2011	3,50	0,0615
2012		
2013	4,04	0,0440

Table 10: Break test for breaks in 1997, 2005, 2010, 2012 and year t

Year (t)	chi2	prob
1995	1,03	0,3112
1996	1,39	0,2390
1997		
1998	0,23	0,6294
1999	0,78	0,3765
2000	0,00	0,9791
2001	0,54	0,4614
2002	1,65	0,1993
2003	3,92	0,0479
2004	2,89	0,0892
2005		
2006	4,66	0,0309
2007	3,44	0,0637
2008	0,75	0,3857
2009	0,38	0,5382
2010		
2011	0,00	0,9576
2012		
2013	4,19	0,0406

Table 11: Break test for breaks in 1997, 2003, '05, '06, '10, '12, '13 and year t

Year (t)	chi2	prob
1995	0,90	0,3432
1996	1,21	0,2716
1997		
1998	0,47	0,4928
1999	0,10	0,7536
2000	0,43	0,5144
2001	0,04	0,8392
2002	0,00	0,9708
2003		
2004	0,43	0,5125
2005		
2006		
2007	0,52	0,4692
2008	3,03	0,0818
2009	1,11	0,2913
2010		
2011	0,01	0,9314
2012		
2013		

Table 12: Fixed effects regression on Fertility

	Additional break in 2008	Original model	Additional break in 2000
	Coef. (Std.Err.)	Coef. (Std. Err.)	Coef. (Std. Err.)
Average wages	0,087 (0,023)**	0,0829 (0,023)**	0,086 (0,024)***
Net worth of a household	1,735 (1,008)	1,651 (1,009)	1,594 (1,014)
Public spending on family benefits	1207,271 (165,494)**	1135,919 (160,208)**	1140,281 (160,497)

**significant at p < 0,05; ** significant at p <0,001*