HÉTFA Research Institute

Budapest,

3rd June 2019

Evaluation of family policy measures and their impact on fertility

This research was carried out under the agreement with the Representation of the European Commission in Hungary NP/2018-10/BUD

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Executive summary

In this analysis, we measure the effect of various economic factors and family policies on fertility in Hungary. In general, previous literature suggests that fertility decisions are affected primarily by employment, income and housing prospects. Our results clearly show that those elements of the family benefit system which target these areas have slight but significant fertility effect. We find that factors related to reemployment probability after childbearing, i.e. current female employment, nursery school availability and flexible work possibilities significantly increase birth probabilities. Also, the increase of disposable income due to family tax credit, as well as the better availability of housing due to home ownership support have a positive impact on fertility. The results of the macro model including 19 European countries support these findings with the key message that favourable economic and employment circumstances and decreasing old-age dependency positively affect total fertility rate while cash benefits altogether have no significant effect on fertility.

Non-technical summary

Global outlook. *The decreasing of total fertility rate in Hungary is part of a broader global trend. Low fertility rates raise concerns worldwide because they lead to a decreasing number of young people having to sustain an increasing number of the elderly in the future. This may bring about economic stagnation. However, in the longer run, it may be expected that the growth in human capital will counterbalance the negative economic impacts of the decreasing population.*

Summary of the theory. *According to the economic approach, families decide on the number of their children based on the expected joy and burden of parenting, the expenses of child raising (education, healthcare costs etc.) and the limitations of the family budget. Family income may have either a positive or a negative effect on the number of children, where higher income of the father probably increases, while higher income of the mother decreases this number. Nevertheless, living standard and income prospects of the family are utmost important factors for fertility decisions, similarly to availability to housing.*

In two-earner societies, female labour market participation is key to understanding the fertility decisions. Females (and families) suffer forgone earnings due to childbearing, which increases with the number of children and the time spent at home. Furthermore, maternal employment offers protection against the – rather significant – threat of poverty in case of divorce. Accordingly, we see higher fertility rates in countries where the conflict between maternal employment and childbearing is sufficiently resolved, e.g. by flexible work opportunities available for many, or affordable childcare services.

Child cash benefits may partly substitute for the foregone earnings, whereas job protection rules are supposed to ensure a smooth return to the labour market. It is not clear, however, whether fertility itself, or only the earlier timing of births (of same number of children) is affected by these policies.

Micro model. *Various elements of the family benefit system may exert different effects on the rate of fertility therefore the best approach is to analyse their combined effect. We study the effect of various policy measures on fertility, which may, as a primary goal or just a side-effect, have an impact on fertility decisions. The measurement dataset includes fertility and demographic background information for the years 2000 to 2015, divided to NUTS3 regions, municipality type, 10-year maternal age categories, the education level and labour market status of the mother. Along these dimensions, our database characterises the population and the family types in categories of nearly 10 thousand cells. We also include family policies in the database for the years 2000-2014, with the potentially available government incentives for each family type by incentive type and combined.*

We measure the combined and the separate effects of family policies, the effects by the order of birth, and an overall effect for birth of any order; furthermore, we allow for 1, 2 and 3 years for fertility to react to policy changes. This variety of regressions ensures that we get a broad understanding of the effects. The regression results show that the births of the first and second child are positively influenced by employment possibilities, availability of flexible work opportunities and nursery school coverage. The third births are affected negatively by maternal employment. Higher family cash benefits seem to delay first births and slightly increase third births.

In the detailed analysis of the family policies, we find a significant positive effect in the first to third year in case of three types of family policies. The results indicate that an additional birth costs HUF 7.6 million in case of family tax credit, HUF 5.6 million for nursery school development and HUF 1.2 million for home ownership support. The rest of the policies do not seem to significantly effect fertility decisions, nevertheless some of them play a crucial role in decreasing child poverty.

In general, previous literature suggests that fertility decisions are affected primarily by employment, income and housing prospects. Our results clearly show that those elements of the family benefit system which target these areas have the most significant fertility effect. We find that factors related to reemployment probability after childbearing, i.e. current female employment, nursery school availability and part-time work possibilities significantly increase birth probabilities. Also, the increase of disposable income due to family tax credit, as well as the better availability of housing due to home ownership support have a positive impact on fertility.

There are two important implications of this finding which may help policy makers increase the efficiency of the system of national pro-fertility policies. First, economic policies aiming to increase employment rates and wages are likely to belong to the most efficient pro-fertility policies. Second, the results point to affordable housing as a key factor of childbearing decisions. Rindfuss and Brauner-Otto[1] *claim that this goal may be achieved by easily obtainable and low-cost mortgage (which is supported by the current system) and the availability of affordable house rental, which highlights that the development of the house rental market and state-provided houses for rent could be a vital part of a pro-fertility strategy.*

Macro model. *In the macroeconomic model we utilize harmonized data and include as many countries as possible depending on data availability. In most of our models we include 19 countries and years 2001 through 2014, however, we also have a model specification including years 1997-2014. Among the countries in the database, Hungary is well comparable, and its figures lie within the 90% confidence band of the sample mean in mostly all dimensions, including the dependent variables (total fertility rate, woman's age at childbirth) and the most important explanatory variables (e.g. female unemployment rate or family benefits).*

We measure a standard first-differenced model and include year and country fixed effects to eliminate any year or country specific effects unexplained by the included explanatory variables. The results are in line with those estimated in the microeconomic model in Hungary. The estimation results show that economic and employment circumstances and old-age dependency affect most total fertility rate. Decreasing female unemployment rate by 1%point would increase total fertility rate (TFR) by 0.6%, and the same for old-age dependency ratio is 1.6%. Cash benefits have no significant effect on fertility and the point estimates are negative. This is intuitive, because the micro model also found negative effect on first births and TFR is comprised in a large part by first births.

The effect of cash benefits is significant and negative only in the youngest age group. It is possibly the result of delayed pregnancies to gain eligibility for high-amount cash benefits. The point estimates of in-kind benefits are mostly positive and for the 25-29-year-old group they are significant.

Összefoglaló

Nemzetközi kitekintés. *A Magyarországon tapasztalt születésszám-csökkenés egy nagyobb, globális trend részét képezi. Az alacsony születésszám azért ad okot aggodalomra világszerte, mert eredményeként a jövőben egyre csökkenő számú fiatalnak kell egyre nagyobb számú idős embert eltartania. Ennek következtében a gazdasági növekedés megtorpanhat, és jelentősen nőhet a munkanélküliség. Ugyanakkor hosszabb távon arra lehet számítani, hogy az emberi tőke növekedése képes lesz ellensúlyozni a csökkenő népességszám negatív gazdasági következményeit.*

Mit tudunk a fertilitásról. *A közgazdasági megközelítésben a családok úgy döntenek a tervezett gyermekek számáról, hogy figyelembe veszik a gyermekvállalás okozta előnyöket és örömöket, a gyermekvállalással járó költségeket (pl. iskoláztatás, egészségügyi kiadások stb.), valamint a család jövedelmi korlátait is. A jövedelem pozitív és negatív irányban is befolyásolhatja a tervezett gyermekek számát, ám az apa jövedelme valószínűleg növeli, míg az anya jövedelme valószínűleg csökkenti.*

Kétkeresős családmodellben a gyermekvállalási döntések megértésében kulcsszerepet játszik a nők munkaerőpiaci jelenléte. A nők (és családjaik) jelentős bevételektől esnek el a gyermekvállalás következtében, mégpedig minél több gyermeket vállalnak és minél hosszabb ideig terveznek otthon maradni a gyermekkel, annál nagyobb a kiesett jövedelem. A nők foglalkoztatottsága abból a szempontból is kiemelt szerepet tölt be, hogy a szülők válása esetére védelmet jelent – az igen jelentős – szegénységi kockázattal szemben. Ezzel összhangban nagyobb fertilitási rátákat mérnek azokban az országokban, amelyekben megnyugtatóan feloldható a gyermekvállalás és az anya munkavállalása közti ellentét, például sokak számára elérhető rugalmas foglalkoztatás vagy megfizethető bölcsődei férőhelyek segítségével. A pénzbeli gyermekellátások részben helyettesítik a gyermekvállalás miatt kieső bevételeket, míg a munkahelyvédelmi szabályok az előző munkahelyre való visszatérést hivatottak biztosítani. Ugyanakkor nem tudjuk, hogy ezen szakpolitikai beavatkozások magát a fertilitást, vagy csupán a születések időzítését befolyásolják.

Mikro modell. *A családpolitikai eszköztár elemei elérő hatással lehetnek a születésszámra, ezért egy közös modellben lehet legjobban vizsgálni a hatásukat. Emiatt a mikro modellben együtt vizsgáljuk az összes hazai szakpolitikai változás hatását, amely akár közvetlen céljaként, akár csupán mellékhatásaként hatással lehetett a gyermekvállalási döntésekre.*

A mérési adatbázis részletes információkat tartalmaz megye, településtípus, anya korkategóriája, végzettsége és foglalkoztatottsága dimenziókra bontva. Az adatbázis ezen dimenziók mentén csaknem 10.000 cellára bontott kategóriákban, családtípusokban írja le a népességet. Az adatbázist családpolitikai adatokkal egészítjük ki a 2000-2014-es évekre vonatkozóan, amelyek az egyes családtípusok számára az adott évben elvileg igénybe vehető támogatásokat tartalmazza típusonként és összesítve.

A modellben a családpolitikai beavatkozások hatását becsüljük összesítve, illetve elemenkénti bontásban. Megvizsgáljuk a hatásokat születési sorrend szerint, valamint összesítve, illetve megengedünk 1, 2 illetve 3 évvel késleltetett hatásokat is. A regressziók ezen változatossága lehetőséget teremt arra, hogy minél jobban feltérképezzük és megértsük a hatásokat.

A regressziós eredmények azt mutatják, hogy az első és második gyermek vállalását jelentősen pozitívan befolyásolja az anya foglalkoztatása, a rugalmas munkaformák elérhetősége és a bölcsődei

lefedettség. A harmadik gyermek születésének valószínűségére az anya foglalkoztatása negatívan hat. Az eredmények arra engednek következtetni, hogy a családtámogatások az első gyermek születését későbbre tolják, míg a harmadik gyermek születésének valószínűségét némileg növelik.

A családpolitikák részletes elemzése azt mutatja, hogy a változásokat követő első három évben három szakpolitikai beavatkozás jár megfigyelhető pozitív hatással. A becslés alapján a családi adókedvezménnyel 7,6 millió forintba, bölcsődék építésével 5,6 millió forintba, míg az otthonteremtési támogatások növelésével 1,2 millió forintba kerül egy újabb gyermek születésének ösztönzése. A többi vizsgált beavatkozásnál nem mutatható ki szignifikáns fertilitási hatás, ugyanakkor ezek egyéb fontos funkciókkal is bírnak, például csökkentik a gyermekszegénység mértékét.

A szakirodalom eddigi eredményei alapján a gyermekvállalásra leginkább a foglalkoztatottság, a stabil megélhetési és lakhatási körülmények hatnak. Eredményeink világosan mutatják, hogy a hazai családtámogatási rendszer elemei közül is azoknak van kimutatható hatása, amelyek ezek egyikére irányulnak. Az eredményeink alapján azok a tényezők növelik a gyermekvállalási valószínűséget, amelyek a nők gyermekvállalást követő munkapiaci visszatérésének esélyeit növelik, például a nők foglalkoztatottsága a gyermekvállalási döntés időpontjában, a bölcsődei férőhelyek elérhetősége és a részmunkaidős foglalkoztatás elérhetősége. Emellett a rendelkezésre álló jövedelem növekedése a családi adókedvezmény segítségével, illetve a megfizethető lakhatás az otthonteremtési támogatások útján, szintén növelik a gyermekvállalási kedvet.

Mindezekből két fontos következtetés vonható le, amelyek segíthetik a családtámogatási rendszer hatékonyabbá tételét. Az egyik, hogy a foglalkoztatás és a bérek növelését célzó gazdaságpolitikai lépések nagy eséllyel egyben a leghatékonyabb születésszám növelő szakpolitikai intézkedések is. Másrészt, az eredményeink felhívják a figyelmet a megfizethető lakhatás kiemelkedő szerepére. Rindfuss és Brauner-Otto[1] szerint ennek egyrészt a könnyen elérhető és megfizethető lakáshitelek (melyeket a jelenlegi szakpolitika is erősen támogat), másrészt a megfizethető bérlakások adják az alapját. A fentiek tükrében egy erőteljes kormányzati bérlakásprogram fontos és hatékony részét képezhetné a kormány családpolitikai eszköztárának.

***Makro modell.** A makroökonómiai modellben országok között harmonizált adatokat használunk fel, és minél több országot igyekszünk bevonni a modellbe. Modelljeink nagy része 19 ország 2001-2014 közötti adataira támaszkodik, de bemutatunk egy 1997-2014 közötti időszakot magába foglaló modellváltozatot is.*

Magyarország adatai jól illeszkednek a többi ország adataihoz, az időszak nagy részében a magyar adat a mintaátlag 90%-os konfidencia sávján belül mozog a legtöbb dimenzióban, mint például a fertilitási ráták, vagy a legfontosabb magyarázó változók. Egy standard differencia modellt becslünk év és ország fixhatásokal, amelyek kiküszöbölik az év- és országspecifikus hatásokat, amelyekre nem kontrollál a modell. A kapott eredmények összhangban vannak a mikro modell eredményeivel. A gazdasági és munkapiaci körülmények, valamint az időskori-függőségi ráta nagymértékben befolyásolja a teljes fertilitási mutatót. A női munkanélküliség 1 százalékpontos csökkenése 0.6, míg a függőségi ráta hasonló csökkenése 1.6 százalékkal növelné a fertilitási mutatót. A készpénzes ellátások mért pontbecslései negatívak és

statisztikailag inszignifikánsak. Ez az eredmény a mikro modellben az 1. gyermek születési hatásaival állítható párhuzamba.

A készpénzes ellátásoknak negatív szignifikáns a hatása a legfiatalabb anyák körében, ami szintén a késleltetési hatásra utal. A természetbeni ellátások pontbecslései legtöbbször pozitívak, és a 25-29 éves korcsoport esetében szignifikánsak, ami a bölcsődefejlesztési kiadások fontosságára utalhat.

1. Introduction

Based on the agreement in December 2018 between the Representation of the European Commission in Hungary and HETFA Research Institute, this research work aims to assess fertility effects of various macroeconomic and microeconomic factors, with special regard to labour market and family policies implemented by the Hungarian Government in years 2000 through 2017.

It has a high policy relevance to study this topic, because falling fertility rates is a global phenomenon, which is also present massively in the Hungarian fertility trends. The problem with low fertility rates is that in the future few young people will have to support many old-age persons. This may undermine the sustainability of the pension and the health care system and lead to a stagnating economy, at least in the short run. Several European governments initiated steps to increase fertility rates, many of them (including Hungary) spends enormous amounts on pro-fertility policies. Thus, it is of high importance to gain ever clearer insights on what factors affect fertility rates, which policies work best and under which circumstances.

To achieve this goal, we present a microeconomic model based on Hungarian microdata available at the secure data room of the Hungarian Central Statistical Office and the Centre for Economic and Regional Studies of the Hungarian Academy of Sciences. We use the CSO Demographic database, the CSO Live Birth database, the Hungarian Labour Force Survey, the Wage Survey data of the National Employment Office, 2011 Census data and CSO T-STAR time series which enables us to perform the analysis based on data referring to the whole Hungarian population. We supplement the micro database with family policy data which includes the most important labour market and family policies in Hungary for years 2000 through 2014 referring to different types of Hungarian families and mothers, along several dimensions, like county, settlement type, mother's age and education, family income and number of children. This high-quality detailed database ensures that the fertility effects can be broken down to subpopulations by these dimensions.

To gain a deeper understanding of the factors affecting fertility in Hungary, we develop a multicountry macroeconomic model with 19 countries using data sources of the Eurostat, OECD, ILO, IMF-IFS (International Financial Statistics). This model utilizes harmonized data for years between 1997 and 2014, although some model varieties may include less years due to data availability constraints for Hungary. Based on previous articles, we include several macroeconomic variables which may influence country-specific fertility rates related to female labour market prospects, overall economic activity and variables related to the composition of the population, e.g. the ratio of higher educated people. We present several models to check for the robustness of the results. Based on the parameter estimates from the macroeconomic model, we use simulation techniques to demonstrate the partial effect of the factors on the total fertility rate in Hungary.

We are thankful for the constant support and constructive comments of the Hungarian Representative of the European Commission along our research work. We owe special thanks to the Databank of the Research Centre for Economic and Regional Studies, Hungarian Academy of Sciences, for their great amount of support and rapid answers to our questions and requests, especially to Melinda Tir and Eszter Orosz, as well as the Central Statistical Office for providing us with necessary data and working with security checking of our calculation output. We are indebted to the Ministry of Finance, the National Tax and Customs Administration, the Hungarian State Treasury, and the National Infocommunications Service Company Ltd. for providing detailed data broken down to county and township size on the yearly budget and the number of beneficiaries of the policy instruments included in the analysis. We are obliged for real estate price data to Eltinga Center for Real Estate Research. Last, but not least, we are grateful for all helping comments and suggestions that we received from Márton Csillag, Róbert Iván Gál and the researchers at the Institute of Economics Centre for Economic and Regional Studies of the Hungarian Academy of Sciences and HÉTFA Research Institute.

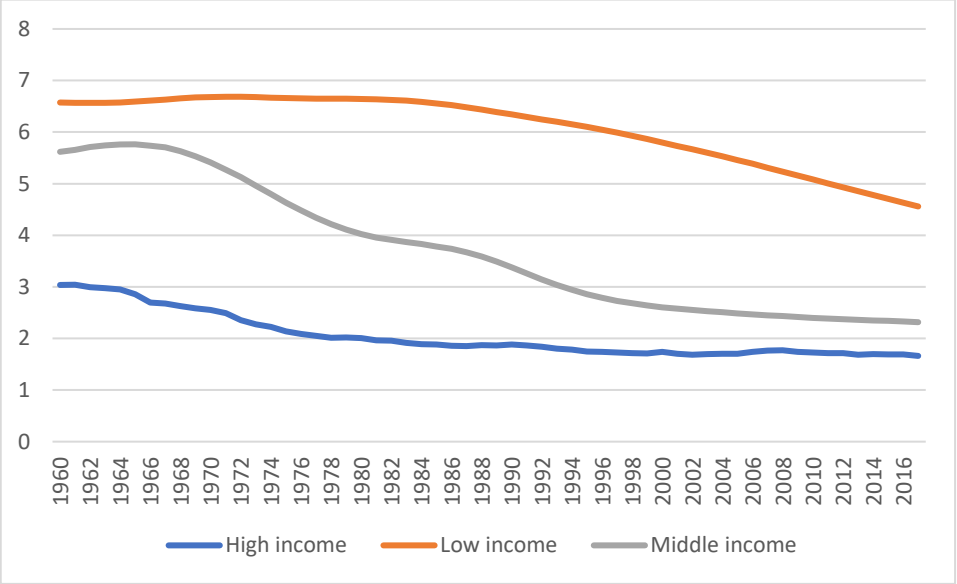
2. Global outlook

The decreasing of total fertility rate in Hungary is part of a broader global trend. Low fertility rates raise concerns worldwide because they lead to a decreasing number of young people having to sustain an increasing number of the elderly in the future. This may bring about economic stagnation. However, in the longer run, it may be expected that the growth in human capital will counterbalance the negative economic impacts of the decreasing population.

The fertility rates are **decreasing** throughout the **whole globe**, as shown on Figure 1. High income countries such as those in Europe and Northern America have started the decrease even before 1960, the first data point available at the World Bank, and their fertility rate stagnated a bit below 2 on average since the 1990s. The middle-income countries followed in the 1960s and in 2000 this group approached TFR 2 from above and the decrease slowed down. Low-income countries joined the global trend in the 1980s and their fertility rates are still dropping dynamically these years.

As we see, **Hungary belongs to this global** trend which seems to be very powerful and hard to fight against. However, there is significant variation in fertility rates within these groups, and it is crucial point for a country's sustainable growth whether the fertility rate is 1.3 or 1.8, for instance.

Figure 1 Total fertility rates around the world



Data source: World Bank

The basic **problem with low fertility rates** is that in the future **a decreasing number of active people** will **have to sustain a high number of elderly people**. Healthcare costs and pensions payable for the retired will rise, and at the same time, ever smaller working-age population will have to produce the necessary financials. This may undermine the sustainability of the pension and healthcare systems. Rising tax rates will most likely decrease purchasing power, which in turn may result in a **stagnating economy**.

However, in the longer run, the human capital growth may soothe these negative effects, and a new local optimum is likely to be found with high education levels, high life expectancy and low fertility rates[2–4]. As Ashraf, Weil, & Wilde [2] summarize the results of the previous literature, sluggish population growth exerts no significant detrimental effect on economic growth, mainly because **human capital growth greatly offsets** the negative effect of declining population size.

3. What we know about fertility decisions

According to the economic approach, families decide on the number of their children based on the expected joy and burden of parenting, the expenses of child raising (education, healthcare costs etc.) and the limitations of the family budget. Family income may have either a positive or a negative effect on the number of children, where higher income of the father probably increases, while higher income of the mother decreases this number. Nevertheless, living standard and income prospects of the family are utmost important factors for fertility decisions, similarly to availability to housing.

In two-earner societies, female labour market participation is key to understanding the fertility decisions. Females (and families) suffer forgone earnings due to childbearing, which increases with the number of children and the time spent at home. Furthermore, maternal employment offers protection against the – rather significant – threat of poverty in case of divorce. Accordingly, we see higher fertility rates in countries where the conflict between maternal employment and childbearing is sufficiently resolved, e.g. by flexible work opportunities available for many, or affordable childcare services.

Child cash benefits may partly substitute for the foregone earnings, whereas job protection rules are supposed to ensure a smooth return to the labour market. It is not clear, however, whether fertility itself, or only the timing of births (of same number of children) is affected by these policies.

3.1. The decision problem

The seminal work of Becker[5] establishes the theoretical background for studying fertility decisions as an economic problem. In his model, children are modelled as durable goods, which impose certain **costs to family** (money spent on food, healthcare, clothes etc.), but provide a certain amount of **utility to parents** (joys of parenthood, feeling of pride etc.). The parents' tastes determine the indifference curves (having spending on children on the one side and spending on anything else on the other), which in turn might be shaped by religion, age and many other factors. In this early model, the **quality vs. quantity trade-off** of the children is already discussed, which refers to the dilemma of the parents whether to have more children, or have less and spend more on each. In this model the demand for children is a function of preferences and costs, subject to an income constraint (parents decide on the number of children taking into account the expenses and the available income).

An important observation of the model is that **richer families spend more on children** (healthcare, preschool, education etc.), that is, children of wealthier families cost more, which makes the **effect of income on fertility ambiguous**. On the one hand, higher family income may increase demand for children due to increased means of spending on goods (income effect). On the other hand, higher income may be the consequence of higher hourly wages, which means a higher alternative cost of time spent away from paid work, with raising children, for instance. Thus higher income may as well decrease the demand for children (substitution effect)[6]. Moreover, taking into account that most of the time females stay home with the newborn child, men's wages may have a positive effect on fertility due to higher family income, whereas women's wage may have a negative effect on the demand for children, through a higher opportunity cost of children. Consequently, the **family wage gap may be a relevant** influencing **factor**[5,7].

Spéder and Kapitány[8] highlight that the decision problem and the influencing factors are way **different for the first child versus second and more children**. In the analysis of two Eastern European countries, for instance, most individual in the sample wanted to have at least one child. However, they report that religiousness and preference towards work compared to childbearing significantly

influence fertility intentions. Also, the authors refer to the **changing values**[9] and the **chances of realizing childbearing intentions**[10] as a potential influencing factor behind falling fertility rates.

3.2. Opportunity costs and employment

In the realm of two-earner societies, **female labour market participation is key to understanding the fertility decisions**. Probably the most important element of a family's child-related costs is forgone earnings of women as a result of having a child. This cost not only includes the **wages not earned during** the period of **staying home** after birth. It also includes the wage loss because mothers usually reach a **lower than pre-birth wage** when returning to the labour market, especially if one compares to the hypothetical wage that could have been reached in absence of the child birth. This wage loss is higher if the woman spends more time at home as well as if her job protection period is over (due to loss of human and network capital). Additionally, the forgone earnings include all wage losses because of lower availability for work due to family tasks.

Maternal employment does not only matter for the family income and the opportunity cost of childbearing, but it also serves as an important **protective factor** for mothers' financial stability in case of divorce. According to the analysis of the CSO[1], the **risk of poverty is 40% for single parents**, which is huge compared to 17.4% of married couples without a child, 25.5% of married couples with three children, or even 35% of those with 8 years of education. In poor families more divorces take place, but the raw figures are still indicative of the problem. Nevertheless, females need to seriously consider the risk of divorce while forming their preferences for children.

In line with these, we see **higher fertility rates** in countries, where the **conflict between maternal employment and childbearing is sufficiently resolved**[11–14]. Certain policies boost fertility and female employment at the same time, such as policies that ease **reconciliation** of work and family duties[15], specifically increasing **flexible employment** possibilities[16,17]. Similarly, the **availability and affordability of childcare** increase young mothers' employment possibilities by ensuring mothers can return to the labour market at a suitable time. As a consequence, a positive fertility effect is expected, which is found by many research works[12,18–22].

3.3. Policies for direct costs

Policies related to **family benefits**, such as maternity leave, **theoretically have a positive effect on childbearing** due to decreasing the child-related direct costs. However **it is not clear whether fertility or only timing of births** (of the same number of children) is affected.[23–25] In the short run, both increased fertility and the earlier births result in increased number of births. But in the longer run, if only the timing of deliveries is affected by the policies, then the total fertility rate will not change. First,

[1] https://www.ksh.hu/docs/hun/xftp/idoszaki/hazteletszinv/hazteletszinv17.pdf

the **maternity leave will substitute for the foregone earnings** of the mother for the time of staying home with the child. Second, **job protection ensures a smooth return** to the labour market after having a baby. If the leave and the protection is too short, it makes maternal labour market return troublesome. In turn, if they are too long, these provide an incentive to mothers to stay home for too long a time period, which could deteriorate their human and social capital making return difficult or even impossible. The effects of cash benefits are slightly positive, for instance, according to French data, an unconditional child benefit which would cost the government 0.3% of the GDP, would increase TFR by 0.3 percentage point[26]. Gábos and co-authors[27] finds that a one percent increase in child benefits would increase total fertility by 0.2 percent. According to Ang[28], the Canadian government would have had to spend 15 thousand Canadian dollars on parental leave or 223 thousand Canadian dollars on cash transfers to increase the number of births by one in 2008.

The tax system and **tax incentives** seem to have a minor effect on fertility[29], however, Apps and Rees [30] indicate that both fertility and female labour supply are higher in countries with individual rather than family taxation scheme. The reason behind this is that family taxation imposes higher marginal taxes on the employment of the second person in the family (mostly the female), which makes employment less attractive for females.

According to Gábos et al.[27], **pay-as-you-go pension systems** increase moral hazard in the decision of childbearing, as the pension of those (voluntarily or involuntarily) childless are paid by others' children. Indeed, the authors find a significant negative effect of the expansion of the PAYG pension system in Hungary on fertility.

Contrary to the previous literature, Kalwij[31] assumes that instead of the single family policy elements, it is the **overall volume** of government spending on family benefits is what matters for fertility, and the study finds positive fertility effects.

3.4.Society

The societal environment greatly influences fertility behaviour through various channels. First, the model of Becker and Tomes[32] on the relation between social mobility (the change in social status of children relative to parents) and fertility implies that **socially upward mobile families invest more in children but have fewer children in turn**. (see also Kantner & Kiser[33]). The possible reason is that families experiencing a social status increase in the past, invest in children (spend more money and parental time on increasing their human capital) as an insurance against the family's returning to lower social status. On the contrary, in case of general economic prosperity, families demand more children. Thus, if a family's income increases relative to other families in the country, it will not increase fertility as much as an income increase commonly experienced by everyone else.

Second, the probability and timing of transition into parenthood and the planned number of children is affected by the **social network (friends, siblings)** of young couples in three ways according to Harknett and co-authors[34]. First, the couples observe the joys of parenthood in the network which

increases their expected utility from childbearing. Second, couples may feel a peer pressure in the network to become parents. And finally, if the ratio of couples with child in the network increases, it will likely decrease the social opportunity costs of becoming a parent, as the risk of loss of social ties in the network related to childbearing will diminish. These imply that there is a substantial **contamination effect of fertility** in the society, and that policies which increase the fertility of a specific group, would indirectly increase that of other groups, provided that these have direct social links to each other.

Third, Harknett and co-authors[34] examine whether an **extended family** increases the number of children. In theory, an extended family would **help in caring** for the children, thus diminishing opportunity costs of childbearing. However, the presence of grandparents may as well **generate obligations to support** in case of health problems. This could work in the other direction, and the family may decide to limit number of children to diminish support obligations. The estimation results show that the extended family has insignificant effect on the first child but lowers the number of subsequent children. This result suggests that caring obligations towards elderly family members indeed limit the number of planned children. Additionally, support from the male partner in family related tasks, gender equity in the households and fathers' use of parental leave are positively related to childbearing.

3.5. Other factors

The fertility rates are undoubtedly influenced by further general circumstantial factors in European countries. According to Rindfuss and Brauner-Otto[1], the most important factor in declining fertility rates is delayed childbearing (see also Kapitány and Spéder[35]). They claim that an open education system which can easily handle child-related exits and returns, smooth school-to-work transition possibilities, as well as a flexible labour market with easy return possibilities for young mothers are excellent institutional factors to facilitate earlier childbearing. Furthermore, they suggest that an environment which enables females to reconcile family and work obligations would also help. Last but not least, as available housing is also an important factor, easily obtainable mortgage or low-price flat renting possibilities could help couples to bear a child at an earlier age.

Contraceptive knowledge[5] as well as access to advanced artificial insemination technologies (IVF) could reduce the gap between planned and actual number of children. Becker[5] argues that if contraceptive knowledge spreads gradually from the upper classes in the society to the rest, and knowledge is correlated to family income, this would lead to an observation that higher income families have lower number of children, but this gap narrows as the knowledge becomes general in the society. The expected effect of in vitro fertilization is not that straightforward. It would increase number of children, in some cases even over to the number of planned children, because of the high incidence of twin births. As IVF is a high-cost medical intervention, it would probably increase fertility rates more for higher income families. On the other hand, Gershoni and Low[36] draws the attention to

the countereffects of subsidizing IVF, as affected females may delay marriage and childbearing to later ages, which would in turn decrease their expected number of children.

In countries with high child mortality rates, higher number of children would serve as an insurance against childlessness. However, in modern societies child mortality rates are under 5 per 1000 births, thus this factor should not have a significant effect on fertility.

4. Microeconomic model

Various elements of the family benefit system may exert different effects on the rate of fertility therefore the best approach is to analyse their combined effect. We study the effect of various policy measures on fertility, which may, as a primary goal or just a side-effect, have an impact on fertility decisions. The measurement dataset includes fertility and demographic background information for the years 2000 to 2015, divided to NUTS3 regions, municipality type, 10-year maternal age categories, the education level and labour market status of the mother. Along these dimensions, our database characterises the population and the family types in categories of nearly 10 thousand cells. We also include family policies in the database for the years 2000-2014, with the potentially available government incentives for each family type by incentive type and combined.

We measure the combined and the separate effects of family policies, the effects by the order of birth, and an overall effect for birth of any order; furthermore, we allow for 1, 2 and 3 years for fertility to react to policy changes. This variety of regressions ensures that we get a broad understanding of the effects. The regression results show that the births of the first and second child are positively influenced by employment possibilities, availability of flexible work opportunities and nursery school coverage. The third births are affected negatively by maternal employment. Higher family cash benefits seem to delay first births and slightly increase third births.

In the detailed analysis of the family policies, we find a significant positive effect in the first to third year in case of three types of family policies. The results indicate that an additional birth costs HUF 7.6 million in case of family tax credit, HUF 5.6 million for nursery school development and HUF 1.2 million for home ownership support. The rest of the policies do not seem to significantly effect fertility decisions, nevertheless some of them play a crucial role in decreasing child poverty.

In general, previous literature suggests that fertility decisions are affected primarily by employment, subsistence and housing prospects. Our results clearly show that those elements of the family benefit system which target these areas have the most significant fertility effect. We find that factors related to reemployment probability after childbearing, i.e. current female employment, nursery school availability and part-time work possibilities significantly increase birth probabilities. Also, the increase of disposable income due to family tax credit, as well as the better availability of housing due to home ownership support have a positive impact on fertility.

There are two important implications of this finding which may help policy makers increase the efficiency of the system of national pro-fertility policies. First, economic policies aiming to increase employment rates and wages are likely to belong to the most efficient pro-fertility policies. Second, the results point to affordable housing as a key factor of childbearing decisions. Rindfuss and Brauner-Otto[1] *claim that this goal may be achieved by easily obtainable and low-cost mortgage (which is supported by the current system) and the availability of affordable house rental, which highlights that the development of the house rental market and state-provided houses for rent could be a vital part of a pro-fertility strategy.*

It is methodologically challenging to measure the fertility effect of the change of one single policy measure. For instance, **quasi-experimental methods are likely to fail**, as the response to a jump in family tax breaks, the fertility rate will likely not jump and show significant change in a 1-3 months observation period. Rather, it will adjust gradually, through a longer period of at least 9 months, but most probably 1 to 3 years. This would make the estimated effects insignificant in the narrow neighbourhood of the policy change. Thus, the estimation of the effect of one single family policy measure should cover a longer time period. The problem with this is that in Hungary, like in many other EU countries, usually there are various elements in the family policy mix in a few years' time span which might change and affect the fertility rate differently. As a result, **the elements of the family policy mix are best analysed together** to avoid omitted variables bias.

Consequently, we propose an estimation method where the elements of the family policy are represented with a complete set of variables and their effect on fertility rate is estimated simultaneously in **one comprehensive model**.

It is important to note that some policies are targeting the families, but other policies are targeting various other policy goals (like combatting child poverty) and still may have fertility effects. Thus, we include not only policies strictly targeting fertility, but any policies which may affect fertility. As a result, we consider the following measures in the analysis.

Table 1 Policy measures included in the analysis

Groups of policy measures	Policy measures
Financial policy measures	• Family tax credit system • Family allowance sum • Home ownership support (CSOK) • Marriage support • Baby-care allowance (TGYAS / CSED) • Childcare benefit (GYED) • Childcare allowance (GYES) • Stability of financial measures in past 3 years
In-kind family policy measures	• Childcare coverage
Labour market measures	• Flexible work • Re-design of maternity and parental leave: rules of working besides GYED, GYES • Re-design of maternity and parental leave: university enrolment qualifies for GYED (GYED EXTRA) • Contribution allowances (START card)

4.1. Data

4.1.1. Measurement data

The source of our measurement database is individual-level data from various sources, aggregated into year and 'type of woman' cells. Type of woman is defined based on 1.) the woman's place of living (NUTS-3 regions/counties and type of settlement in each county); 2.) the woman's age category in 10-year buckets; 3.) the woman's highest level of education (having an upper-secondary school degree or not)[2]; 4.) labour market status (employed or non-employed). For the exact description of the categories see Table 2. The final database includes 9,984 cells for the 16 years, which means there are 624 'type of woman' cells in each year.

Table 2 Definition of cells

Variable	No. of categories	Values
Year	16	2000-2015
Place of living – county	20	NUTS-3 level areas: 19 counties + Budapest
Place of living – type of municipality	3 (1 in Budapest and 2 in other counties)	Village / town or city / capital (Budapest) (conforming to the Hungarian administrative and legal definitions)
Age of woman	4	10-year groups (5-year group for the lowest category): 15-19 / 20-29 / 30-39 / 40-49 years
Woman's level of education	2	Low (no upper-secondary degree / ISCED levels 0-2) / high (at least upper-secondary level / ISCED level 3 or higher)
Woman's labour market status	2	Employed / not employed (unemployed, or inactive)
Total number of cells: 16*19*2*4*2*2 (counties) + 16*4*2*2 (capital) = 9,984		

The dependent variable is the cell-specific fertility rate. The fertility rates are defined for each cell by dividing the number of births (relevant to given cell) by the number of women (relevant to given cell). Since neither the data for the numerator nor for the denominator is publicly available for Hungary for our specific aggregates, neither does a micro level database that contains all necessary information exist, three micro level data sources are needed to compile the appropriate data.

[2] The granularity of the categories is restricted by the number of observations in the wage database. To increase the number of observations in each type of women cell, we had to aggregate education level into two categories.

For the information on the number of births, we rely on the **CSO Birth Registry** (CSOBD; KSH Születési Adatbázis). The Birth Registry includes all birth events between 1971 through 2016. In this database, along each birth events, very detailed demographic information is included about the mother, like level of education, number of children, occupation, labour market status, exact date of birth, zip code of mother's place of living, marital status, age of mother, age of father, education of father, occupation of father. The database also includes information on the parity of each birth event (whether the infant was a first-born, second-born etc. to its mother).

The number of women in cells was based on the **CSO Demographic Yearbook** data. The CSO Demographic Yearbook data provide information on the exact number of males and females of a given age for each place of living (settlement), the actual number of residents. However, it does not contain data on the level of education or the labour market status of the residents. Therefore, to calculate the number of females in each cell, the ratio of different education levels as well as the share of employed and not employed women must be estimated. For this, the **Hungarian Labour Force Survey (LFS)** is used: after calculating the joint distribution of education level and employment status of women in each cell using the H-LFS data, we use these shares to divide the total number of women belonging to a given cell of the Demographic Yearbook. Annex 3 presents tests about the appropriateness of LFS data for such purposes, where we compare relevant LFS ratios with Census ratios for 2011.

4.1.2. Family policy data

The variables in the family policy database are based on the eligibility of women (and families) for several types of supports and benefits each year. We also have data on actual utilization of these benefits, but the utilization rate is already influenced by fertility rates, thus it is not included in the analysis, we calculate intent-to-treat effects of the policy mix.

More specifically, considering the eligibility rules, the maximum duration and the legally set amount of each benefit, we calculate the amount a mother can expect until the newborn child's 18th birthday, assuming that the eligibility rules, the maximum duration and the amount of benefits (as well as her place of living, her education level and her employment status) would remain the same for the next 18 years. For the calculation of the net present value, a discount rate of 3 percent was used. For a comprehensive overview of the Hungarian family benefit landscape, see Makó[37]. In the model, we consider the following benefits. The Family Policy Database is available in the Online Appendix[3].

Table 3 Family Policy Database

Family Policy	Description	Data

[3] https://www.dropbox.com/sh/jtviy0e92g63o99/AABkor0NztaokaEDpE5C47KCa?dl=0

Family allowance (családi pótlék)	flat-rate, universal benefit, received until the 18th birthday of the child (by default). Amount is based on the number of children and the marital status of the recipient parent.	Exact amount based on type of woman
Childcare allowance (GYES)	a flat-rate, universal benefit, received until the 3rd birthday of the child (by default).	Exact amount based on type of woman
Child raising support (GYET):	a flat-rate, universal benefit, received until the youngest child's 18th birthday. Only non-working or part-time working mothers with at least 3 children are eligible.	Exact amount based on type of woman
Birth grant (anyasági támogatás):	a lump-sum payment received universally when a child is born.	Exact amount based on type of woman
Baby-care allowance (TGYÁS/CSED):	a benefit based on the compulsory social insurance scheme. Only those with a previous record of employment can be eligible, and the amount depends on the mother's previous work income. Received for a maximum of 6 months	Estimated amount based on type and wage of woman
Child care benefit (GYED):	a benefit based on the compulsory social insurance scheme. The amount depends on the mother's previous work income. Can be claimed after the exhaustion of the baby-care allowance, until the child's 2nd birthday.	Estimated amount based on type and wage of woman
Family tax credit system (családi adókedvezmény):	provides a discount on the parents' personal income tax, thereby increasing net salaries. Depends on the number of children and can only be claimed by employed parents. The available amount is constrained by the income tax base of the families, which is taken into account in the policy database.	Estimated amount based on type and wage of woman
Home ownership support (szocpol/LÉT) and interest subsidies:	a scheme with a non-refundable grant for families that must be used for buying an own house; can also include a loan with a fixed and state-supported interest rate. The amounts of the grant and the loan depend on the number of children and, in some years, the size and state (whether newly built or used) of the house or flat in question. CSOK was introduced in 2015, thus we cannot study its effect with our current database, we would need to collect a few more years' observations.	See Annex 9 for details
Contribution allowances (START PLUSZ card/Munkahelyvédelmi Akció):	a hiring tax credit program to increase maternal employment.	Dummy variables for available years

Marriage support (első házasok adókedvezménye)	Discount on the tax base for newly married couples for 24 months	Estimated amount
Return to labour market	Age of child when mother is first allowed to work 1.) part-time 2.) full-time without losing any benefit	Exact age depending on type of benefit (GYES or GYED)
Stability of financial measures in past 3 years		See Annex 10 for details
Nursery school coverage	Number of nursery school slots available in a given area divided by the number of 0-2-year-old children.	

4.1.3. Wage data

Since some of the benefits above (specifically, the baby-care allowance and the child-care benefit) can only be claimed by working parents, and their amounts depend on the previous work income, in order to calculate the net present value, we had to estimate an average work income for each cell with labour market status 'employed'. For this, we used the full sample of the **Hungarian Wage and Employment Survey** (WES; ÁFSZ Bértarifa felvétel). This database consists of detailed data on employee wages for years 2000 through 2016, including year, gender, place of living, level of education, occupation, age. (This database does not include incomes, consequently we have to use wages instead of incomes in the analysis.) Thus, in our final database, the imputed wages of the females (as well as imputed total family wages) can be calculated for each cell. We use these imputed wages to calculate the expected amount of the baby-care allowance and the child-care benefit, received by employed mothers.

The tax credit can be claimed by either parents or split between them. Since it is much more common among fathers to claim the tax credit compared to claiming the baby-care allowance or the child-care benefit, we considered not only the mother's wages, but rather the whole family income to determine the amount of tax credit available. To calculate the family income, we had to merge an expected value of a husband's wage to each type of women (cell). See Annex 11 for details of the imputation. In the LFS database, the unit of observation is a household, which allows us to link partner's gross wage in case of each female, if she lives in a common household with a partner (marriage or cohabitation). Thus, family gross wage can be also calculated.

For each cell, some additional variables are also calculated from the database, such as employment rate of partners (husbands or cohabiting partners), second job (female and partner), ratio of part-time employment (female and partner), ratio of working at unusual times (female and partner), marriage rate. Female employment rates and female unemployment rates are calculated on the aggregation level [Year - County - City type - Age of female - Number of children in the family - Level of

education of female]. Finally, the supplemented LFS data is merged to the measurement database in the exact same level of aggregation as shown in Table 2.

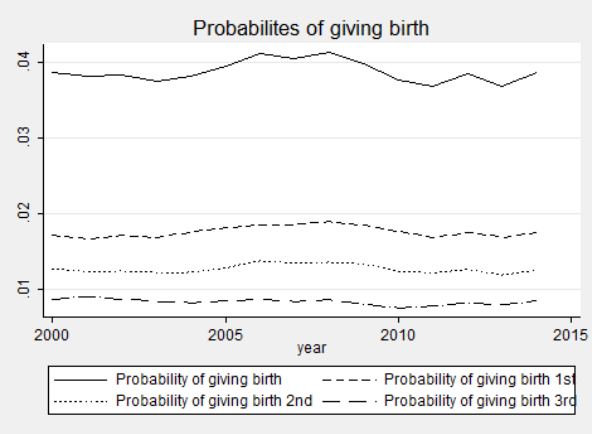
4.2. Descriptive analysis

Before turning to the regression analysis, we provide an overview on general fertility patterns in Hungary. The most comprehensive overview about the Hungarian demographic situation is provided by the Demographic Portrait[38] of the Hungarian Demographic Research Institute. According to the study, the number of births has been steady in the past years because, though the number of females in childbearing age have decreased significantly, the childbearing intentions have increased in this period. Total fertility rate increased from 1.24 in 2011 to 1.5. The increase was due to the higher fertility of low educated groups and the youngest age groups, and the probability of an additional birth in families with two children also rose. At the same time, the ratio of childless and the ratio of families with only one child have increased.

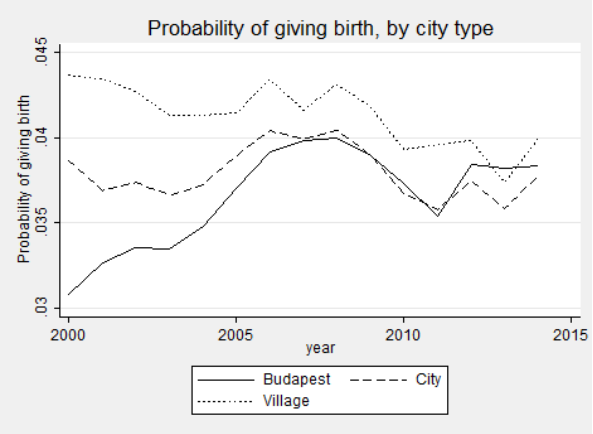
Figure 2.e depicts the evolution of total fertility rate and birth probability. Total fertility rate is the mean number of children born to a woman, provided she survives until the end of her reproductive life and that she experiences age-specific fertility rates through the years as calculated in a specific year. In Hungary TFR was 1.31 on average in the period of our analysis. In contrast, birth probability is the simple ratio of females giving birth in a given year relative to the total number of females of reproductive age. The average probability of giving birth was 3.87% in the same period. As it is seen on Figure 2.e, birth probability is a good measure of fertility, and we are going to use throughout the whole micromodel analysis.

Figure 2 Probabilities of giving birth

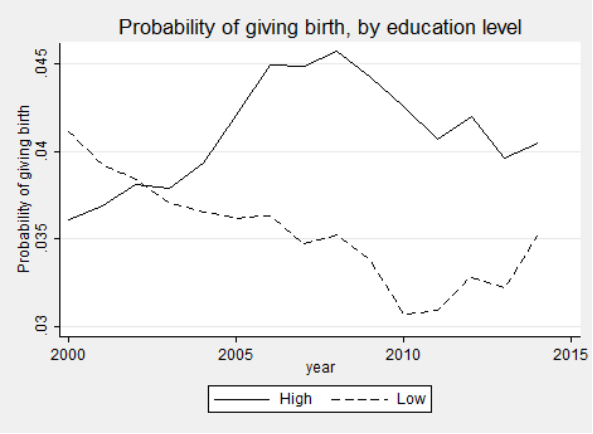
a 1st – 2nd – 3rd and higher order births and total



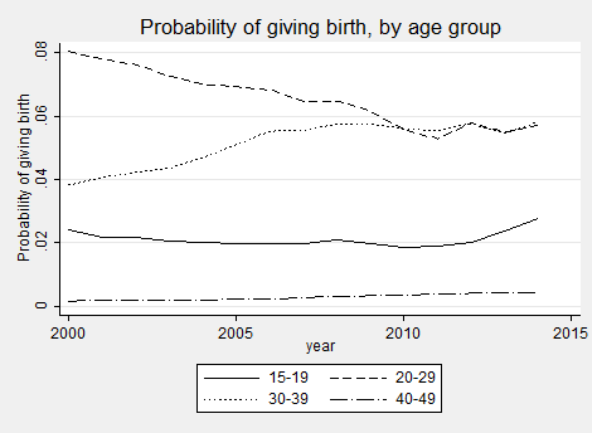
b By city type



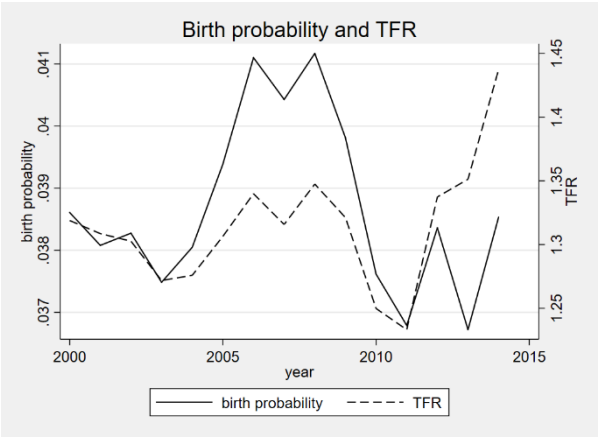
c By level of female education



d By age group



e Birth probability and total fertility rate

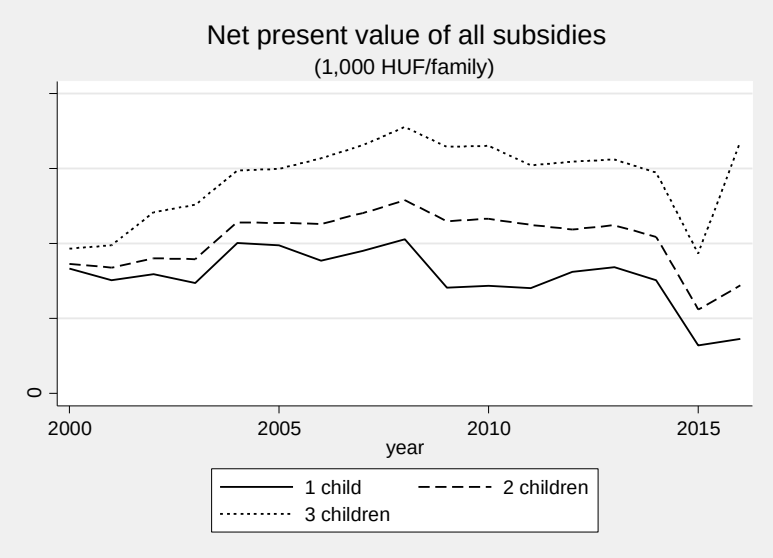


As depicted in Figure 2, probabilities of giving birth **did not change significantly** in the period between 2000 and 2014, nevertheless, significant changes occurred in several subgroups of the population. The fertility in different city types converged, with increasing fertility in Budapest and decreasing fertility in villages. **Fertility of low educated** gradually **decreased** until 2010, when the **trend reversed**. On the contrary, **fertility rose constantly in the high educated group** until 2008, but it has

been **decreasing since then**. There are two important phenomena depicted on Panel d there are two important phenomena depicted. One of them is the **increasing female age** at birth which is indicated by dropping fertility in the twenties age group and a similar increase in the thirties group and the other is the **steep rise in teenage fertility** from 2011 on.

Figure 3 demonstrates the average net present value of subsidies is depicted, as calculated based upon the eligibility criteria. It shows that if an average family with 3 children was to take all subsidies and allowances available, they would have collected approximately HUF 10 million until age 18 of the child, provided that regulations, wages and subsidy values remained the same for the whole period. We assumed a 3% discount rate in present value calculations. As the figure shows, **the wedge between families of different numbers of children increased** significantly through time.

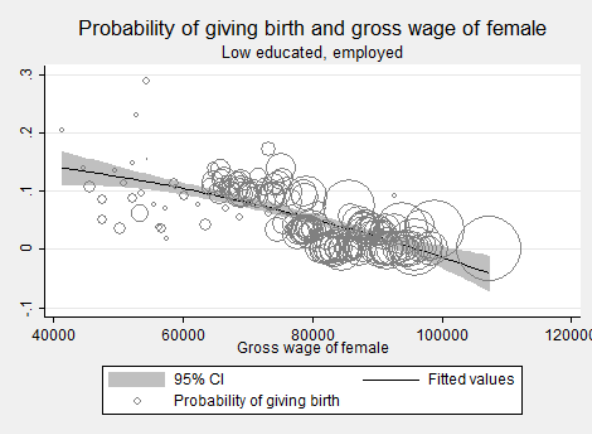
Figure 3 Average net present value of subsidies, as calculated based upon eligibility criteria



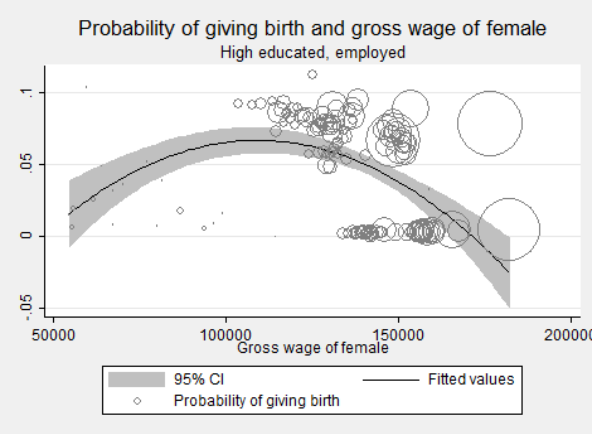
In Figure 4, the relation of fertility and different wages are depicted. Each circle depicts cell, the larger circles express higher population in a given cell. The figures show average gross wages and fertility rates through the whole observation period. As expected, an **increase in female wages affect fertility negatively**. In case of higher educated females, the section above HUF 100.000 is relevant. For higher educated females, **husband's wage increases fertility**, which is also expected based on the previous literature. Fertility of the low educated is flat in husband's wages.

Figure 4 Gross wages probability of giving birth

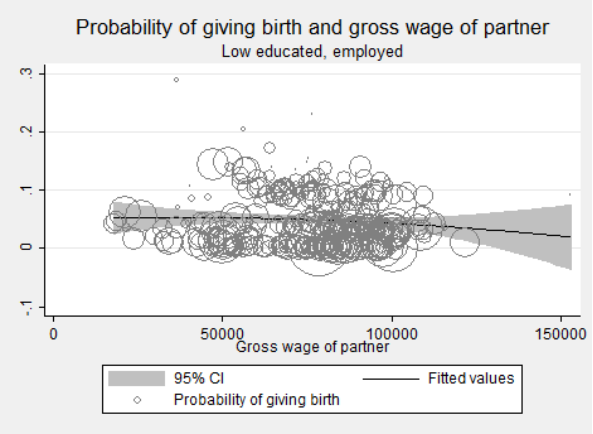
a Female gross wage, low educated



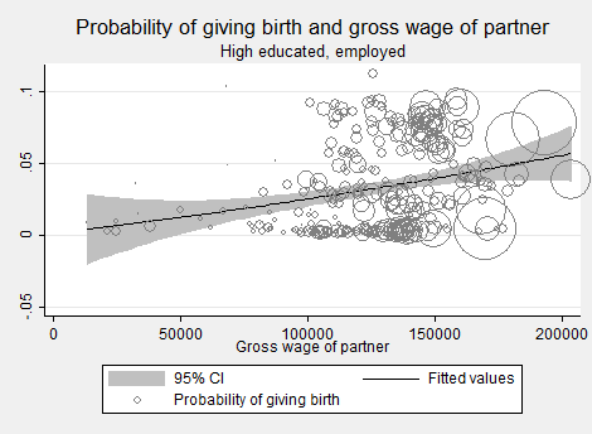
b Female gross wage, high educated



c Partner gross wage, low educated



d Partner gross wage, high educated



In Table 4 the summary statistics of the most important variables are reported.

Table 4 Summary statistics of the main variables in the microeconomic model

Variable	Obs	Mean	Std. Dev.	Min	Max
population	7737	4590.50	6970.39	17.35	100848.70
birth (1st child)	7737	80.84	241.46	0.00	4330.00
birth (2nd child)	7737	58.31	140.19	0.00	3042.00
birth (3rd and higher order child)	7737	38.44	74.65	0.00	1144.00
dependency ratio (total)	7737	0.58	0.04	0.50	0.68
dependency ratio (child)	7737	0.24	0.03	0.19	0.35
dependency ratio (old-age)	7737	0.34	0.04	0.24	0.46
nursery school coverage	7737	0.10	0.08	0.00	0.29
pre-school coverage	7214	1.13	0.09	0.90	1.36
Income Tax per capita	7737	602.10	216.92	151.92	1197.50
Regional unemployment rate	7737	0.08	0.04	0.02	0.21
Gross wage (female)	7737	51730.54	62146.90	0.00	276641.40
Gross wage (partner)	7737	102846.10	49018.66	0.00	376036.50

Gross wage (family)	7737	154576.70	92582.73	0.00	552202.80
Partner employment rate	7695	0.83	0.19	0.00	1.00
Moved last year	7737	0.01	0.05	0.00	1.00
Ratio of part time jobs	6444	0.10	0.18	0.00	1.00
Ratio of night shift	6444	0.33	0.29	0.00	2.67
Ratio of part-time jobs (partner)	7593	0.04	0.08	0.00	1.00
Ratio of second job (female)	6444	0.01	0.04	0.00	1.00
Ratio of second job (partner)	7593	0.02	0.05	0.00	1.00
Ratio of night shift (partner)	7593	0.54	0.28	0.00	2.80
Ratio of marriages	7737	0.64	0.25	0.00	1.00
Ratio of married or cohabitating	7737	0.87	0.12	0.00	1.00
Female employment rate	7737	0.54	0.24	0.00	1.00
Female unemployment rate	7365	0.14	0.15	0.00	1.00
Number of children in the households (top coded at 3)	7737	0.45	0.52	0.00	3.00

4.3. Methodology of the econometric analysis

The econometric analysis on the causal effects of family policy measures on total fertility rate is executed on the merged database. The estimation methodology is based directly on the theoretical model explained in Annex 11. A **panel fixed effects model** is calculated with county fixed effects to control for any time-invariant location specific fertility differences; year fixed effects to control for the timely evolution of the macroeconomic environment which affects all locations. This means that we control for any unobserved differences that are not controlled for in the regressions, for instance regional differences in industry structure, ethic composition or local cultural specificities and initial differences of fertility rates.

The identification of the parameters is based on the timely variation of the family policy variables and the related variability in fertility rates.

In Specification 1 linear probability regression takes the following form:

$$\Pr\left(B_{c,t}^{o}=1\right)=\mu_{t-1}+\theta_{r}+\beta' X_{c,t-1}+\delta' NCB_{c,t-1}^{o}+\gamma'\left\{CB_{c,t-1}^{o}-CB_{c,t-1}^{o-1}\right\}+\epsilon_{c,t-1}$$

Where $NCB_{c}^{0}=0$ and $CB_{c}^{0}=0$ by definition (available cash and non-cash benefits for zero children is zero).

Where $\Pr(B_{c}^{o}=1)$ is the probability of birth of order o (where $o=\{1,2,3\ or\ more\}$) in year t in cell c which is measured by the cell means of fertility rates. The parameters of interest are included in vectors δ and γ, the parameter estimates of non-cash benefits (NCB^{o}) and cash benefits (CB^{o}) available at birth order o. As in this model the probabilities of 1st, 2nd or higher order births are estimated, cash benefits (CB) are included in the form of available additional resources if current number of children increases by 1, which is included in matrix $\left\{CB_{c,t-1}^{o}-CB_{c,t-1}^{o-1}\right\}$. μ_{t} is year fixed

effects, θ_r is county fixed effects. X_{ct} is a matrix of relevant micro and macro level variables as well as government policy variables which may affect fertility decisions, for instance maternal age, education, employment, old-age dependency ratio, type of municipality, income tax per capita, ratio of females (of similar type) working part-time, night shifts and having a second job. We allow 1, 2 and 3 years for the factors to affect fertility to study the dynamics of the fertility reactions to various factors. In the regressions the exact number of females belonging to each cell is used as weights.

In Specification 2 the probability of birth (of any order) is estimated in the following regression:

$$\Pr(B_{c,t}=1) = \mu_{t-1} + \theta_r + \beta' X_{c,t-1} + \delta' \frac{1}{3}\sum_{o=1}^{3} NCB^{o}_{c,t-1} + \gamma' \frac{1}{3}\sum_{o=1}^{3}\{CB^{o}_{c,t-1} - CB^{o-1}_{c,t-1}\} + \epsilon_{c,t-1}$$

Where the dependent variable is probability of giving birth (of any order) and the policy measures are included averaged over different numbers of children.

		Model 1	Model 2	Model 3
Benefits	Total effect of benefits	✓	✓	
	Separate effect of benefits			✓
Lags	1 year lag	✓	✓	✓
	2 and 3 year lag	✓		✓
Sample	Total sample	✓		✓
	Break-downs		✓	
Births	Birth probability (1st 2nd or 3rd child) – Specification 1	✓	✓	
	Birth probability (any child) - – Specification 2			✓

4.4. Results

The results of our model indicate that the **overall effect** of the family benefit system **is very low**; the only significant effect we found is the increasing of the probability of the third births. However, **certain elements of the system exert significant fertility effect**. We find that **factors related to reemployment probability after childbearing**, i.e. current female employment, nursery school availability and part-time work possibilities significantly increase birth probabilities. Also, the **increase of disposable income** due to family tax credit, as well as the **better availability of housing** due to home ownership support have a positive impact on fertility.

In general, previous literature suggests that **fertility decisions are affected primarily by employment, subsistence and housing prospects. Our results clearly show that those elements of the family benefit system which target these areas have the most significant fertility effect.**

There are two important implications of this finding which may help policy makers increase the efficiency of the system of national pro-fertility policies. First, **economic policies aiming to increase employment rates and wages are likely to belong to the most efficient pro-fertility policies**. Second, the results point to **affordable housing as a key factor of childbearing decisions**. Rindfuss and Brauner-Otto[1] claim that this goal may be achieved by easily obtainable and low-cost mortgage (which is supported by the current system) and the availability of affordable house rental, which highlights that **the development of the house rental market and state-provided houses for rent could be a vital part of a pro-fertility strategy**.

The results of the regression are presented in Table 5; for the full table on first births see Annex 7. As expected, first-order births (Model 1) are determined by way different factors compared to later births. In case of **first-order births, fertility decisions are mostly influenced by labour market opportunities** such as employment status, which is important for baby-care allowance (TGYAS/CSED) and child care benefit (GYED) eligibility. The results suggest that females delay first birth in case of non-employment. On the other hand, an **increase in family benefits available would also induce a delay in first births**. The negative effects for the first child are most probably due to the delay of childbearing, and the results are driven by GYED and CSED, which are highly correlated with wages (see Table 7). In case of **third births, family cash benefits exert a positive effect and employment is negatively related to birth probability**. Looking at the effects of the various policies two years later (Models 4 to 6), one can see that the 1st and 2nd birth effects are just the opposite, and three years after the policy changes (results omitted) the effects vanish entirely. These results point to a mere timing effect in case of first and second births. For third births, the positive effect of family cash benefits seems to be a lasting effect, as it is not offset by later decreases in third birth probabilities. In general, the effects on second births are the mean of those on first and third births.

In this part of the analysis we combine the effect of all family-related policies which may be of any effect on fertility and we find that the **system of benefits as a whole, exerts a slight positive effect on fertility through increasing third births**. These are mostly in line with the previous results of the literature, which find small positive effects of family policies. As we will show in the next section, this combined effect is comprised of significant positive effects and zero effects of the various pieces of the family policy system.

The **effect of nursery schools** is zero in the first year, but **positive in the second year**. Also, availability of nursery school slots is **more relevant for first births, and the effect decreases with birth order**. This is in line with the observation that first mothers are more attached to the labour market, their fertility is most affected by employment and probably they are the most concerned with returning to the labour market after giving birth. In turn, those giving birth to the third child are less concerned by these issues and probably less affected by nursery school availability.

The results suggest that the age of the child at which females are allowed to work at part-time without losing cash benefits, would increase fertility, which seems counterintuitive. In this model, the stability of the family benefit rules does not have a significant effect.

The estimated coefficients for the rest of the variables (reported in Annex 7) are meaningful and point to the expected direction. Higher educated females deliver higher order births with lower probability, and first order births occur in younger age categories. The share of women in part-time jobs increase the probability of first-births, whereas night shifts and second jobs decrease that of third births.

Table 5 Micro model regression results: Model 1

	(1) 1st child	(2) 2nd child	(3) 3rd child	(4) 1st child	(5) 2nd child	(6) 3rd child
	Fertility 1 year later			Fertility 2 years later		
Change in total amount of family cash benefits if having an additional child	-0.003***	0.001*	0.006***	0.004***	-0.001**	0.002
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)
Labour market status: employed	0.026***	0.003***	-0.012***	0.018***	0.002*	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Part-time work allowed (age of child)	0.001	0.000	0.003**	0.004**	0.002**	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
No. of children in nursery school/no. of children aged 0-2	0.003	-0.004	0.007	0.028***	0.010**	0.002
	(0.011)	(0.007)	(0.007)	(0.007)	(0.003)	(0.002)
Instability of family benefit rules in past 3 years	0.001	-0.000	-0.001	0.000	0.000	-0.000
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Year effects	✓	✓	✓	✓	✓	✓
County effects	✓	✓	✓	✓	✓	✓
Additional controls	✓	✓	✓	✓	✓	✓
Observations	6078	6078	6078	5190	5190	5190
Adjusted R^2	0.681	0.523	0.468	0.678	0.684	0.620
AIC	- 35451.764	- 39985.995	- 40012.942	- 30890.636	- 37554.364	- 39436.888

*Huber–White heteroscedasticity-robust standard errors in parentheses. Indication of significance: * p < 0.05, ** p < 0.01, *** p < 0.001*

4.5.Break-downs

The comprehensive database allows for calculating the effects in terms of subgroups as well. The regression results for the subgroups are presented in Table 6. In this table, each presented parameter reflects the effect of total sum of family benefits on the probability that a 1st, 2nd or 3rd (or higher) child is born to a mother, all coming from separate regressions. Each row indicates different subgroups of

the population, for instance, the first row indicates that the effect of total family benefits on mothers belonging to the first decile (families within lowest 10% if incomes in a given year) is -0.002 (insignificant) for the first child, -0.007 (significant) for the second child and 0.001 (insignificant) for the third child.

As shown in the table, **the benefits have mostly negative or zero effect for the first birth**, ambiguous effect for the second birth **and positive effect for the third birth**. Accordingly, in middle-income deciles (deciles 5-8) the effect of cash benefits is significantly negative: this part of the population is most affected by the amount of GYED and CSED. The effect is concentrated in towns and cities. It is also clear that the effect is **pronounced in 20-29-year-old highly educated mothers**, who can increase the amount of CSED and GYED by delaying their childbearing. A few more years spent with working has a significant effect on their wages, which is directly translated into higher cash benefits. However, this effect is not present in the older age categories, who have a narrower time window left for such adjustments. This effect is present in economic boom and recession as well.

Apparently, the **cash benefits affect the birth probability of the third child positively**, at least in some subpopulations. This effect might be either an increase in third births (increase of completed fertility) or only the bringing forward of later third births (unchanged completed fertility). The benefits increase third births in the highest (8^{th} and 10^{th}) wage deciles, mainly in families living in villages. It is possible that in fact these are suburbs of Budapest and larger cities where upper medium and high class families are located. The effect is concentrated to **highly educated mothers at age 20-39**. The cash benefits increase the probability of third births only in recessions. This points to the insurance role of child benefits in case of unemployment, which is in line with the previous literature.

The effects are sharply divided between the Western and the Eastern part of Hungary. In the Western regions, including Central Hungary, the delay effect dominates, with a large negative effect on first children, whereas the effect is positive and significant for third births in most regions, but the point estimates are larger in the Eastern regions.

Table 6 Model 2: Break-downs (effects in 1st year, Specification 1)

	1st child	2nd child	3rd or higher order child
Decile: 1[(a)]	-0.002	-0.007*	0.001
(standard errors)	(0.002)	(0.003)	(0.005)
Decile: 2	-0.002	0.001	0.001
	(0.003)	(0.001)	(0.005)
Decile: 3	-0.001	0.001	-0.000
	(0.001)	(0.001)	(0.003)
Decile: 4	0.001	0.002**	0.002
	(0.002)	(0.001)	(0.002)
Decile: 5	-0.004**	0.000	0.001
	(0.001)	(0.001)	(0.001)
Decile: 6	-0.005**	0.001	0.002
	(0.002)	(0.001)	(0.002)
Decile: 7	-0.008***	0.000	-0.001
	(0.001)	(0.001)	(0.001)
Decile: 8	-0.007**	0.002*	0.003***
	(0.002)	(0.001)	(0.001)
Decile: 9	-0.001	0.000	0.002
	(0.002)	(0.001)	(0.001)
Decile: 10	-0.001	0.001	0.002*
	(0.002)	(0.001)	(0.001)
Non-employed[(b)]	0.000	-0.000	-0.002
	(0.000)	(0.001)	(0.001)
Employed	-0.000	0.003**	0.003**
	(0.001)	(0.001)	(0.001)
Region: Northern Hungary[(c)]	-0.003	0.003*	0.013*
	(0.002)	(0.001)	(0.005)
Region: Northern Great Plain	-0.004	0.003*	0.014**
	(0.002)	(0.001)	(0.005)
Region: Southern Great Plain	-0.003	0.004**	0.014***
	(0.002)	(0.001)	(0.003)
Region: Central Hungary	-0.006***	0.001	0.005***
	(0.001)	(0.001)	(0.001)
Region: Central Transdanubia	-0.004**	0.002*	0.007*
	(0.002)	(0.001)	(0.003)
Region: Western Transdanubia	-0.006***	0.002**	0.004**
	(0.002)	(0.001)	(0.002)
Region: Southern Transdanubia	-0.006***	0.003*	0.012***
	(0.001)	(0.001)	(0.003)
Budapest[(d)]	-0.005*	0.002	0.003***
	(0.002)	(0.001)	(0.001)

Town or city	-0.005***	0.002*	0.006***
	(0.001)	(0.001)	(0.002)
Village	-0.002*	0.001	0.010***
	(0.001)	(0.001)	(0.002)
Mother's age: 15-19[(e)]	0.016	-0.002	0.002
	(0.020)	(0.002)	(0.002)
Mother's age: 20-29	-0.004***	-0.001	0.006*
	(0.001)	(0.001)	(0.003)
Mother's age: 30-39	-0.001	-0.000	0.008***
	(0.001)	(0.001)	(0.002)
Mother's age: 40-49	-0.000*	0.000	0.000**
	(0.000)	(0.000)	(0.000)
Education level of mother: low[(f)]	-0.000	0.000	-0.000
	(0.001)	(0.000)	(0.001)
Education level of mother: high	-0.003*	0.001	0.001**
	(0.001)	(0.001)	(0.001)
Recession [(g)]	-0.005***	0.002*	0.017***
	(0.001)	(0.001)	(0.004)
Boom	-0.004***	0.002*	0.006***
	(0.001)	(0.001)	(0.001)

[(a)] Family wage decile: 1 – lowest 10%; 10 – highest 10% in given year [(b)] Female employment status [(c)] Geographical regions: place of living of the mother [(d)] Municipality type: Capital – town or city – village [(e)] Maternal age [(f)] Education level of mother: low – without maturity exam; high – with maturity exam [(g)] Economic prosperity: Boom (2000-2006 and 2013-15) vs Recession (2007-12)

4.6. Cost-benefit analysis of the family policies in Hungary

4.6.1. Fertility effect of the family policies

In this subsection, we analyse the effect of the cash benefits separately. If possible, we use the coefficients of the model with year fixed effects as reported in Panel B of Table 7. In other cases, we use the results from the model without year fixed effects in Panel A of Table 7, for the reasons we give a deeper explanation later in this section. As reported in Panel B of Table 7, nursery school coverage seems to exert a high positive effect on the probability of births. The first-year effect is complemented by an insignificant second-year and a significant third-year positive effect. Adding up the significant effects, a 1 %point increase in nursery school coverage would increase birth probability by 0.00046, which would be a 1.18% increase in birth probability in the next year (compared to the 3.87% average birth probability per annum), which is approximately 973 births per year on average. For comparison, nursery coverage increased from 7.8% to 13.1% (by 5.3 percentage points) between 2000 and 2014. A similar size intervention would be the recently announced large-scale nursery school expansion program (Family Protection Action Plan, 2019.02.10.) of increasing the number of the available slots from 49 thousand to about 70 thousand, which would be equal to a 5.6 percentage point increase in coverage.

Family tax credit affects birth probability on the longer-run. In the first two years it has no effect whatsoever, but in the third it raises birth probability. Increasing available family tax credit by 10% (by about HUF 30 billion), would raise birth probability by 0.00103 (2.5%, approximately 2375 births). This effect is very similar to the result of Gábos and co-authors[27] who report that "a 1% increase in child-related benefits would increase total fertility by 0.2 per cent, where child-related benefits include family allowance, tax relief, maternity allowance and childcare fee, childcare allowance, maternity grant and child-raising support.

The combined measure for baby-care allowance and childcare benefit has a significant negative effect in the first year and a nearly same size significant positive effect in the third year, which indicates a mere delay effect of the benefit. Home loan interest subsidy has a slightly significant but altogether negligible effect on birth probability. The rest of the family benefits are omitted from the model as the average sum varies only with year, thus these are fully correlated with year fixed effects.

Panel A indicates a significant positive effect of home ownership support in the third year. The parameter estimate indicates that a 1%point increase in home ownership support would lead to a 0.00047 (1.2% compared to baseline birth probability 3.87%, which is equivalent with 1099 additional births per year) increase in birth probability.

Table 7 Model 3: The effect of cash benefits (Specification 2)

	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: Year FE not included			Panel B: Year FE included		
	Birth probability (1st year)	Birth probability (2nd year)	Birth probability (3rd year)	Birth probability (1st year)	Birth probability (2nd year)	Birth probability (3rd year)
Family allowance (CSP)	-0.0005	-0.0133	0.0138	0.0000	0.0000	0.0000
	(0.0065)	(0.0212)	(0.0092)	(.)	(.)	(.)
Family tax credit	0.0006	-0.0048	0.0086**	-0.0004	-0.0010	0.0103***
	(0.0021)	(0.0063)	(0.0027)	(0.0022)	(0.0057)	(0.0029)
Home ownership support (szocpol/LÉT)	-0.0133	0.0016	0.0470***	0.0000	0.0000	0.0000
	(0.0094)	(0.0237)	(0.0098)	(.)	(.)	(.)
Home loan interest subsidy	0.0006*	0.0006	0.0003	0.0006*	0.0006	0.0003
	(0.0002)	(0.0005)	(0.0003)	(0.0002)	(0.0005)	(0.0002)
Child care allowance	0.0262	-0.0532	-0.0423	0.0000	0.0000	0.0000

(GYES)						
	(0.0167)	(0.0353)	(0.0168)	(.)	(.)	(.)
Birth grant	0.0004	0.0095	-0.0239	0.0000	0.0000	0.0000
	(0.0050)	(0.0150)	(0.0060)	(.)	(.)	(.)
Baby-care allowance and Child care benefit (CSED + GYED)	-0.0392***	-0.0315	0.0388***	-0.0401***	-0.0287	0.0391***
	(0.0111)	(0.0183)	(0.0064)	(0.0111)	(0.0186)	(0.0064)
Payroll tax credit (START card)	0.0084	-0.0067	0.0048	0.0000	0.0000	0.0000
	(0.0107)	(0.0261)	(0.0126)	(.)	(.)	(.)
Marriage support	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)	(.)	(.)
Nursery coverage	0.0267***	0.0540	0.0190*	0.0269***	0.0537	0.0192*
	(0.0075)	(0.0510)	(0.0096)	(0.0075)	(0.0508)	(0.0096)
Instability of family benefit rules in past 3 years	0.0006	0.0010	0.0004	0.0048**	-0.0035	0.0025*
	(0.0009)	(0.0024)	(0.0011)	(0.0015)	(0.0033)	(0.0011)
Part-time work allowed (age of child)	-0.0014	0.0075	-0.0004	0.0000	0.0270*	0.0209***
	(0.0014)	(0.0041)	(0.0018)	(.)	(0.0114)	(0.0041)
Year effects				✓	✓	✓
County effects	✓	✓	✓	✓	✓	✓
Observations	2213	2005	2012	2213	2005	2012
Adjusted R^2	0.603	0.595	0.740	0.604	0.596	0.740
AIC	-13010.0072	-8187.9809	-11423.8710	-13009.0687	-8189.3159	-11424.0167

Standard errors in parentheses. Indication of significance: * p < 0.05, ** p < 0.01, *** p < 0.001

In Panel B of Table 7, regression results with the original specification are reported. In these regressions, year fixed effects are included, thus, all non-wage-dependent subsidies are omitted due to collinearity: the amount of benefit received is exactly determined by the year dummies. In order to uncover the effect of these policies, we present regression results in Panel A coming from the exact same specification except for year fixed effects. Comparing relevant columns of Panel A and B (full tables are reported in Annex 7) it can be seen that the inclusion of year fixed effects is important (see for instance the coefficient of family tax credit), but the estimated coefficients from the two

specifications point to the same direction. As a result, we use parameter estimates of wage dependent benefits reported in Panel B (all those not omitted from our preferred model) and the rest from Panel A.

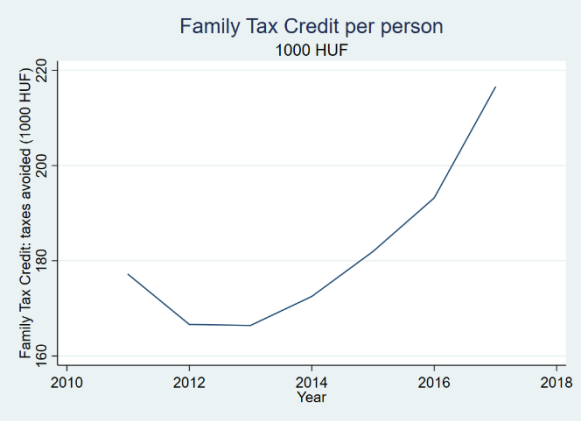
4.6.2. Government spending on family policies

In this subsection, we evaluate government spending figures on various family policy measures. The data received from the ministries refer to various years (available years was restricted by data availability) and divided to various subgroups. Thus, we present government spending only for years where data is available, and not for the entire period of availability of certain types of transfers.

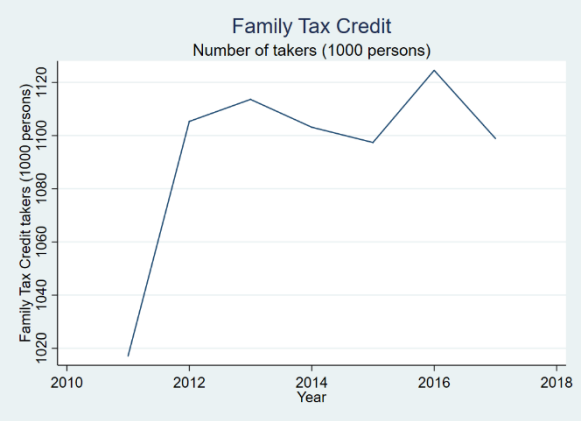
Figure 5 depicts the total sum of spending, the number of takers and the average sum of family tax credit for the years 2011 to 2017.

Figure 5 Family Tax Credit

a Family Tax Credit per person (in HUF 1000)



b Family Tax Credit: number of takers (in 1000 person)



c Family Tax Credit total spending (Billion HUF)

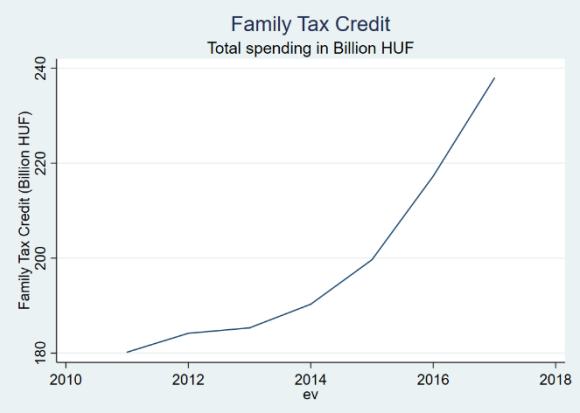
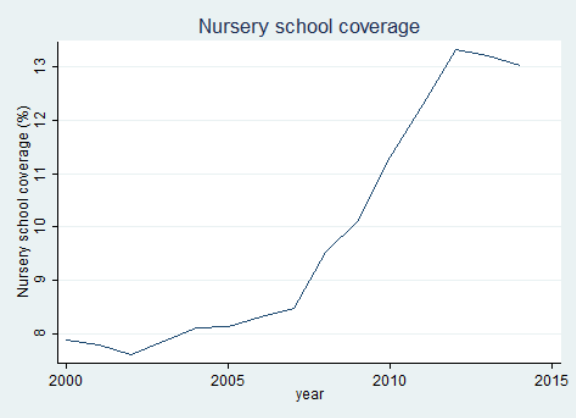


Figure 6 shows the increase of nursery school coverage from below 8% to above 13%.

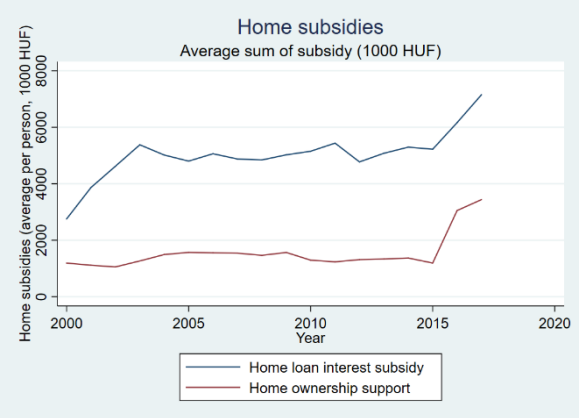
Figure 6 Nursery school coverage



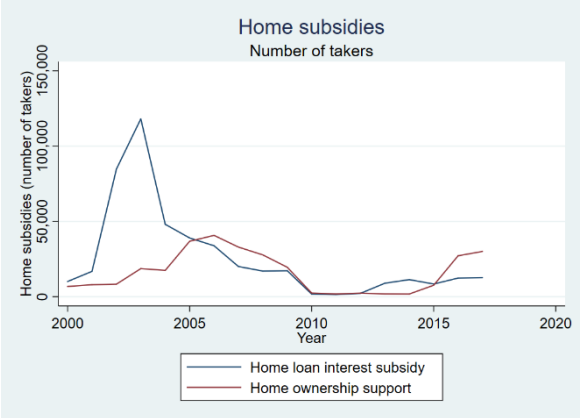
The total sum, number of takers and average amount of home ownership support and home interest subsidy are seen on Figure 7.

Figure 7 Home subsidies

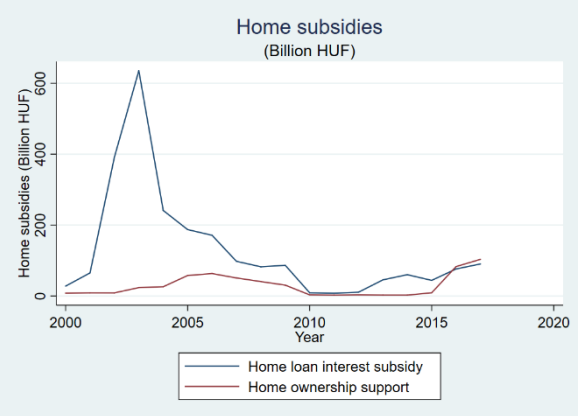
a Home subsidies per person (in HUF 1000)



b Home subsidies: number of takers (in 1000 person)



c Home subsidies: total spending (Billion HUF)



The summary figures of the rest of the family policies are presented in Annex 4.

4.6.3. Effectiveness of the family policies

In this subsection we focus on the family policies which have a significant effect on fertility and omitting those from the analysis which have insignificant effect. According to the presented results in Table 7, we calculate the cost effectiveness of government spending on **family tax credit, nursery school system expansion and home ownership support**. As shown in Figure 5, family tax credit increased dynamically in the reported period of 2011 through 2017. In these years, total spending on family tax credit increased by 5.3% on average, which meant an additional HUF 9.6 billion average spending increase. According to the model's predictions, this increased birth probability by 0.00055 (appr. 1.4%). This is 1274 more children born on average each year, which results an **estimated cost of HUF 7.55 million for an additional child**.

Nursery school coverage increased from 8.5% to 13.2% (by 4.73%points) in the period 2007 through 2013. According to the ex post evaluation of **nursery schools** and kindergarten development projects[39] regarding years 2007 to 2013 the average cost of building an additional nursery school slot was HUF 4.36 million. During these years 6533 new available slots were created at a total cost of about HUF 24.5 billion. Thus, a 1%point increase of nursery coverage cost HUF 5,178 million, which in turn increased fertility by 0.00046 (1.19%). This is equal to 1076 births per year, which indicates an **estimated cost of HUF 5.6 million for one more birth**.

Increasing home ownership support by 1% would increase birth probability by 0.00047. Noting that the average sum spent on this type of benefit was 72,897 million HUF, increasing it by 1% would cost the government HUF 728 million. The 1.21% fertility increase induced by this additional spending equals 1087 additional births. Thus, the **cost of one more child is HUF 1.19 million using home ownership support**.

These figures are similar to the results reported by Ang[28] who found that the Canadian government should spend 223 thousand Canadian dollars (HUF 46.5 million) on cash transfers or CAD 15 thousand (HUF 3.1 million) on parental leave to increase the number of births by one.

The rest of the policies do not seem to significantly effect fertility decisions, nevertheless some of them have other important goals than stimulating number of births. For instance, family allowance and childcare allowance play a crucial role in decreasing child poverty.

5. Macroeconomic model

In the macroeconomic model we utilize harmonized data and include as many countries as possible depending on data availability. In most of our models we include 19 countries and years 2001 through 2014, however, we also have a model specification including years 1997-2014. Among the countries in the database, Hungary is well comparable, and its figures lie within the 90% confidence band of the sample mean in mostly all dimensions, including the dependent variables (total fertility rate, woman's age at childbirth) and the most important explanatory variables (e.g. female unemployment rate or family benefits).

We measure a standard first-differenced model and include year and country fixed effects to eliminate any year or country specific effects unexplained by the included explanatory variables. The results are in line with those estimated in the microeconomic model. The estimation results show that economic and employment circumstances and old-age dependency affect most total fertility rate. Decreasing female unemployment rate by 1%point would increase TFR by 0.6%, and the same for old-age dependency ratio is 1.6%. Cash benefits have no significant effect on fertility and the point estimates are negative which is in line with the results of the micro model. This is intuitive, because TFR is comprised in a large part by first births.

The effect of cash benefits is significant and negative only in the youngest age group. It is possibly the result of delayed pregnancies to gain eligibility for high-amount cash benefits. The point estimates of in-kind benefits are mostly positive and for the 25-29-year-old group they are significant.

In this part of the analysis, we build a macroeconomic model to study the effects of macro level factors on total fertility rate (TFR). The model helps to **complement the Hungarian results with international context**. The analysis is hampered by the **relatively short available time series for Hungary** at least those harmonized with other European country-level data. In this part, we study the various factors affecting the fertility rates of European countries in the past 20 years, with a special focus on cash benefits. Macroeconomic factors suggested by previous literature are included if sufficiently long historical data is available in harmonized data sources. With these in hand, we can compensate for the relatively short time period by including relatively large number of explanatory variables and countries in the regressions.

5.1. Data collection

Harmonized data for EU countries is available at the webpages of the **Eurostat, the OECD, the ILO, and the IMF-IFS**. We also used the **EU-LFS** database to calculate some rates by age. A further potential micro data source would have been EU-SILC (European Union Statistics on Income and Living Conditions) but it is only available from 2004. The result of the data collection is a database for 19

countries and years 1997 through 2014, which is available for download in the Online Appendix[4]. A detailed description of the variables included in the database are provided in Annex 1, which includes the variable name, definition, source of the data with webpage link if available, years of availability and countries. **The selection of the variables was based on the previous literature and it was constrained by data availability.** In many cases time series available for other European countries were long, but shorter for Hungary, for instance, labour market related data for Hungary in the Eurostat database. Some type of data, like child-related in-kind benefits and cash benefits were only available for a shorter period of time.

5.2. Descriptive analysis

The **19 countries included in the analysis** (restricted by data availability) are Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom (see visualized on map in Figure 8). In this section, we present statistics and histograms on how the various indicators changed historically in the analysis period in different countries, with special attention to Hungary. Our baseline regression refers to the period 2001-2014. Thus, we present statistics regarding this period. In some cases, the models with restricted variable set could go back in time as far as 1997.

[4] https://www.dropbox.com/sh/jtviy0e92g63o99/AABkor0NztaokaEDpE5C47KCa?dl=0

Figure 8 Countries included in the analysis

Source: https://mapchart.net/europe.html

Table 8 and various panels of Figure 9 provide a broad picture on the comparability of Hungary with the other countries included in the sample based on some of the relevant variables.

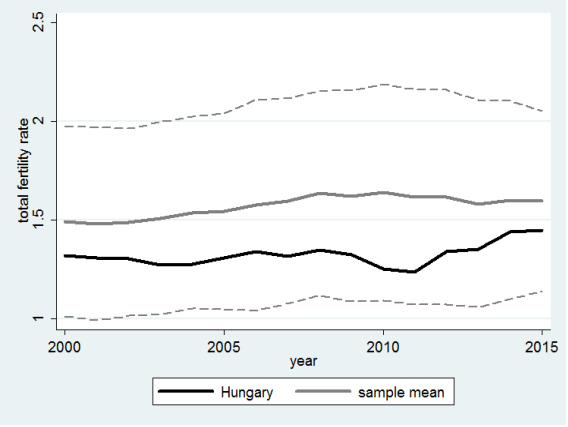
Table 8 Summary statistics of the database (2000-2015)

		Sample mean				Hungary	
		2001		2014		2001	2014
		Mean	sd.	mean	sd.	mean	mean
Total fertility rate	(number)	1,49	0,24	1,59	0,23	1,32	1,45
Mean age of woman at childbirth regardless of birth order	(years)	29,26	0,97	30,89	0,66	27,30	29,60
GDP per capita	(EUR)	26358,83	6250,38	29621,24	7316,85	7900,00	11100,00
Economic sentiment indicator	(standardized index value)	112,00	4,96	103,93	5,01	104,33	111,14
Real interest rate	(%)	3,10	1,25	1,39	1,85	-1,14	3,50
Female employment rate	(%)	54,18	9,30	61,19	8,66	49,70	57,80
Female unemployment rate	(%)	9,50	4,27	10,02	6,49	5,60	7,00

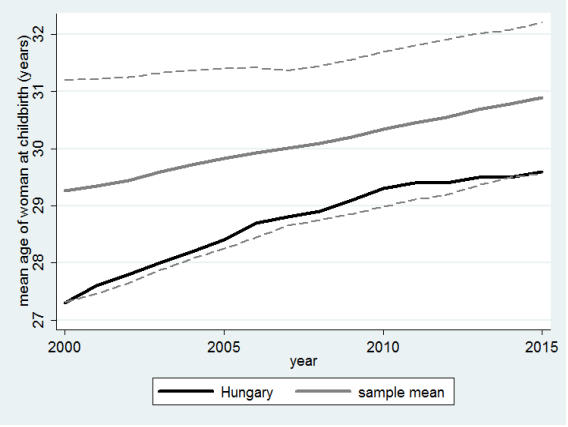
Part time employment rate (ratio of par time rel. to all employed)	(%)	29,93	14,43	34,99	13,80	5,05	7,69
Household spending per capita	(USD)	17573,41	2669,34	20769,53	2705,86	10843,2	11293,2
Share of births outside of marriage	(%)	27,45	12,67	43,32	10,96	29,00	47,90
Infant mortality rate	(‰)	4,87	1,02	3,32	0,53	9,20	4,20
Crude marriage rate	(%)	5,12	0,39	4,14	0,68	4,70	4,70
Duration of working life	(years)	28,79	4,08	33,10	3,69	24,70	30,00
Old-age dependency ratio	(%)	24,05	1,99	29,66	2,82	21,99	26,47
Child-bearing age females (% of population)	(%)	21,16	0,82	18,62	0,88	21,00	19,87
Life expectancy at age 65	(years)	18,11	1,00	20,14	1,05	15,10	16,60
Family cash benefits	(% of GDP)	1,19	0,51	1,36	0,51	1,88	1,73
Family in kind benefits	(% of GDP)	0,82	0,40	1,02	0,40	1,11	1,24
Family social expenditure	(% of GDP)	1,95	0,91	2,27	0,75	2,53	2,31
Family social expenditure per child	(% of GDP)	26,27	12,85	31,86	12,43	35,44	34,96
Old age pension expenditure	(% of GDP)	8,21	1,62	9,94	1,93	5,87	7,15
Share of female population with advanced degree	(%)	20,83	6,61	35,52	9,26	15,56	30,78
Share of female population with basic degree	(%)	35,49	14,44	20,06	8,57	27,42	14,97
Tax break for children	(%)	4,42	2,15	4,77	2,01	7,96	10,31

Figure 9 Descriptive figures

a Total fertility rate

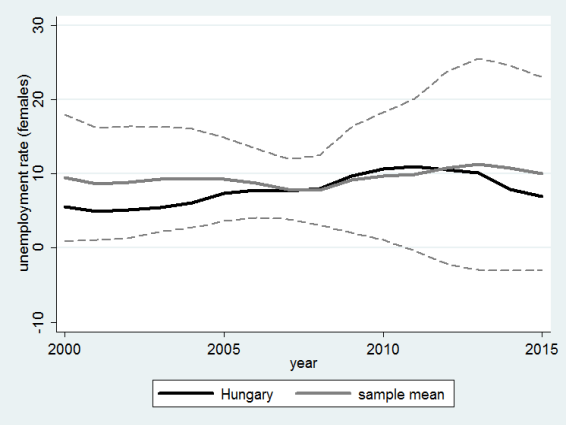


b Mean age of women at childbirth

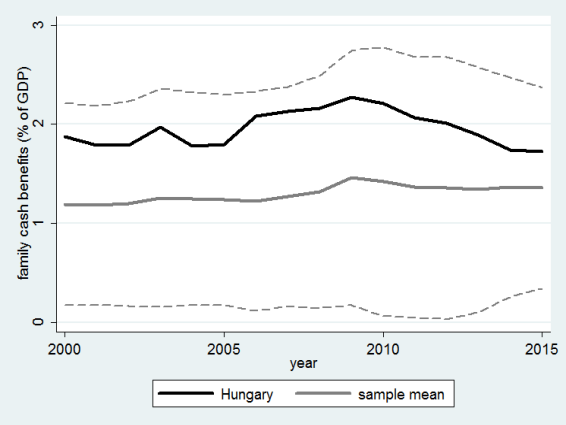


c Female unemployment rate (15-74-year-olds)

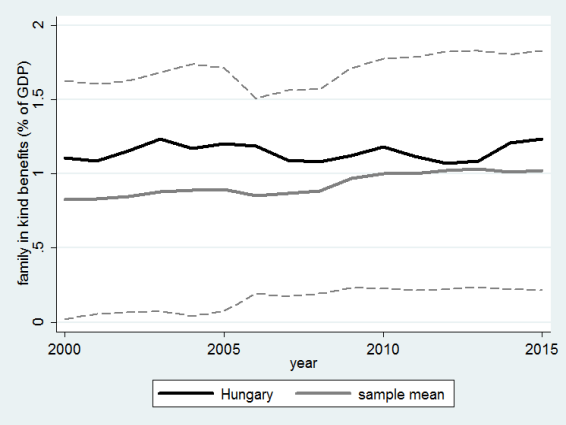
d Female unemployment rate and TFR (2015)



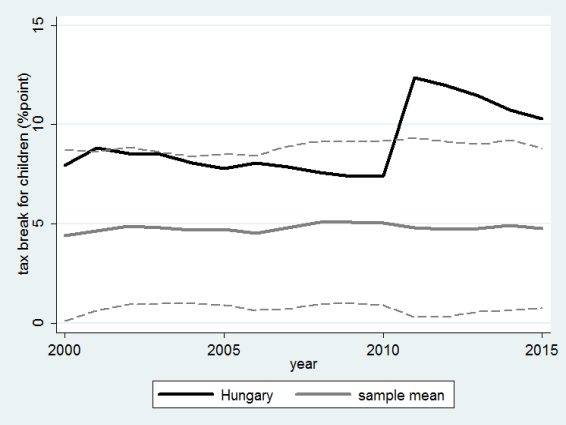
e Family cash benefits (% of GDP)



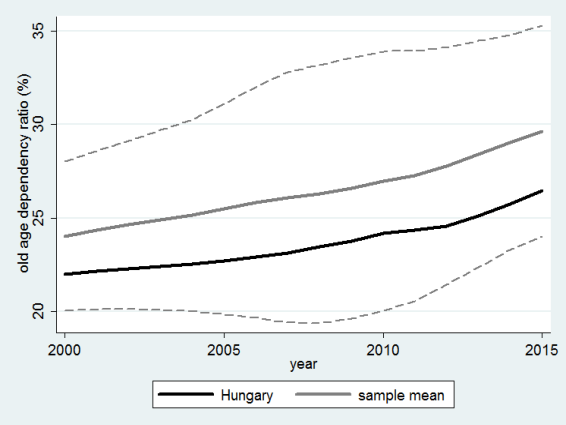
f Family benefits in-kind (% of GDP)



g Difference of childless and 2-child families' tax wedge



h Old-age dependency ratio



Data sources: World Bank, OECD, Eurostat,
Notes: Sample mean is population weighted mean of the sample. Dashed lines indicate the 90% confidence interval of the sample mean, where countries included in the sample: Austria, Belgium, Czech Republic, Denmark, Finland, France, Estonia, Germany, Greece, Hungary, Ireland, Italy, Netherlands, Portugal, Slovakia, Slovenia, Spain, Sweden and the United Kingdom
AUT = Austria; BEL = Belgium; CZE = Czech Republic; DNK = Denmark; FIN = Finland; FRA = France; DEU = Germany; GRC = Greece; HUN = Hungary; IRL = Ireland; ITA = Italy; NLD = the Netherlands; PRT = Portugal; SVK = Slovakia; ESP = Spain; SWE = Sweden; GBR = Great Britain

The evolution of total fertility rate through time is depicted in Figure 9.a, where the black line represents Hungary, the grey line stands for the rest of the estimation sample and the dashed lines indicate the 90% confidence interval. The figure shows that **TFR in Hungary is lower than the sample mean, but still comparable**. The sample TFR is fairly stable throughout the sample period, while in Hungary TFR reaches its minimum in 2011 (of 1.23) and then recovers. The absolute minimum of TFR in this period was recorded in the Czech Republic (1.15) in 2001 and the absolute maximum in Ireland (2.06) in 2008.

Another important dependent variable is the mean age of women at childbirth (in Figure 9.b). Hungarian values are lower than the sample mean, which means, that **Hungarian women tend to give birth at a younger age**. There is a positive trend in both the sample mean (from 29.25 years in 2000 to 30.88 years in 2015) and in the Hungarian values (from 27.3 years in 2000 to 29.6 years in 2015). The lowest values are in Slovakia (26.6 in 2000 and 28.8 in 2015) and the highest values are in Spain and Ireland (31.9 years) in 2015.

As pointed out in the literature review, the labour market position of females can be a major determinant of fertility decisions. Labour market is represented here by the female unemployment rate (Figure 9.c). Hungarian female unemployment rate was lower than the sample mean before the crisis, higher between 2008 and 2011, and lower again after 2011. An upward trend in female unemployment rate can be detected in Hungary until 2011. The lowest value of the sample mean is observed in 2008. The wide confidence interval in 2013 is caused by the high Greek unemployment rate of 31.4 %.

Figure 9.d depicts the cross-sectional correlation between TFR and female unemployment (Figure 9.d) in 2015 and reveals a strong negative relationship.

The focus of this research is whether social expenditures, namely cash or in-kind benefits affect fertility rate. The historical evolution of cash benefits (Figure 9.e), as the percentage of the current local GDP, include family allowance, maternity and parental leave, but tax breaks are omitted (see Annex 1 for details). Hungarian cash benefits are significantly higher than the sample mean during the whole period, taking up its highest value, 2.27% of the GDP in 2009. The sample mean displays a slight upward trend with a peak in 2009 when the GDP contracted in the recession, but the family benefits were not cut similarly. The lowest overall cash benefit ratio belongs to Spain (0.28%) in 2002. The highest relative cash benefit spending in the period is observed in Ireland (3.07%) in 2009.

Figure 9.f presents the yearly sum spent on in-kind benefits, like early childhood education and care (ECEC), home help or accommodation (relative to GDP). The Hungarian values fluctuate around 1.14% and are higher in the whole period than the sample mean, which displays a slight upward trend. The lowest overall value belongs to Greece (0.01%) in 2006. The highest ratio to GDP in the period was spent in Denmark (2.3%) in 2009.

Figure 9.g depicts the difference between the average tax wedge of a childless two-earner married couple, and the average tax wedge of two-earner married couple with 2 children at the median

wage. We use OECD tax wedge data for the calculations. This is a proxy on tax break for children. The Hungarian tax break was already high in 2000, but in 2010 it almost doubled, and it is the highest in the sample ever since (with a peak of 12.37%point in 2011), meanwhile the sample mean stagnated. The lowest tax break for children was in Greece in 2001, the -0.26%point means that couples without children paid less tax, than families bringing up two children.

As women are usually the caretakers of the families, so the number of people they must care for can affect their fertility decisions. In the literature cited above this phenomenon is called the extended family argument. A metric that can represent the changes in these circumstances is the old-age dependency ratio, which is the ratio of older dependents, those older than 64, to the working-age population (between 15-64) (see Figure 9.h).

5.3. Estimation method

Some studies allow a one year lag for the policies to be effective[7,27], others allow for a longer time span, for example, Ehrlich and Kim[40] include a 5-year rolling average of the TFR. Assuming a longer reaction time reflects that fertility decisions are not made from one day to another (and it takes time to turn plans into reality), as well as the fact that it may take time for policies to reach high awareness in the population.

However, these econometric solutions imply two basic assumptions. First, each included policy influence fertility with the same timing. Second, the effects are equal in the first years and zero afterwards. These underlying assumptions simplify the models suitably, however, should be tested. We test the timing of the policies and conclude that a two-year lag seems most plausible. In this section, we present this model, but in Annex 6 we show the results for various time lag assumptions.

Based on the unit-root tests, we measure a **differenced model** which is similar to that of Gábos and coauthors[27]. Using country-level historical data, the following regression estimates the effect of the various macroeconomic factors on fertility:

$$\Delta_2 LogTFR_{j,t+2} = \eta_j + \theta_t + \delta' \cdot \Delta_1 X_{jt} + \varepsilon_{jt}$$

where Δ_1 indicates the change in a variable in one year, whereas Δ_2 indicates a two-year average change. $\Delta_2 LogTFR_{j,t+2}$ is the percentage change of total fertility rate from year t to year t+2 in country j (allowing for a two-year reaction time).

There are a large number of country-specific factors, like norms and values, views on optimal family size and the ideal timing of maternal return to labour market, intra-family work sharing practices, time fathers spend with the children and several types of national institutions which hinder or incentivize childbearing. Most of these country-specific differences are not available in a harmonized country-year panel, if at all, and most of these are not easily influenced by government policies. Thus, our aim is not to measure, just to filter out their effect. Country fixed effects (η_j) exactly

serve this purpose, filter out any unobserved country-specific (time invariant as well as time trending) factors which may affect fertility. On the other hand, we want to net out the effect of any year-specific changes in factors affecting fertility, like spreading of new birth control methods or changes in neonatal mortality due to technological progress in healthcare. Year fixed effects (θ_t) partial out these confounders, ensuring that year-specific changes do not introduce bias to the measurement.

$\Delta_1 X_{jt}$ is the vector of percentage (or percentage point) change in different macroeconomic factors from year t-1 to year t, the levels are transformed into logs where needed. ε_{jt} is the error term.

This regression accounts for initial cross-country differences in fertility rates as well as cross-country differences in trends of fertility rates. As a result, we can measure the effect of the policies and the possible omitted variables will not affect the estimates.

5.4. Estimation results

Some of the explanatory variables in Table 8 refer to the same influencing circumstances thus are highly correlated. These are variables describing the state of the economy including labour market (GDP, household spending, economic sentiment, real interest rate, employment and unemployment rate), measures of extended family (age dependency, ratio of child-bearing age females) and social expenditure variables (cash and in-kind benefits, social expenditures for families and children). To avoid multicollinearity, we included only one from each group in the estimation. This procedure resulted in a high number (24) of model variants reported in Annex 6. We have selected 5 estimation results from these to present, on the basis of goodness-of-fit measures as well as to present a wide range of model variations (see Table 9). But the main message is the same regardless of the model selected. According to the Akaike information criterion (AIC), Model 4 fits best to the data among shorter time-period models (Models 1 to 5). The five selected models are completed with Model 6, which includes a longer time span. This comes at a cost of omitting some important explanatory variables and a few countries due to data constraints. Still, AIC shows that Model 6 fits better to the data than the shorter ones.

In each model, **measures of the economic cycle are significant, especially female unemployment rate**, which takes up most of the effect of the economy's dynamics. The parameter estimate of Model 4 means that **if female unemployment rate decreases by 1 percentage point**, TFR will increase by 0.0092 which equals a **0.6% increase** compared to the 1.49 baseline rate (see Table 9). The effect of female unemployment rate is significant at the 0.1% in the model. These are in line with the results of the previous literature.

According to the estimation results, old-age dependency ratio has a negative effect on the total fertility rate. It is significant at the 1% level in Model 4, which indicates that **if old-age dependency ratio increases by 1 percentage point then TFR decreases by** more than 0.024, which equals a **1.6%** decrease to the 1.49 baseline rate. In Model 6 the age dependency ratio becomes less significant. The negative effect of old-age dependency ratio on fertility is in line with the findings of Gábos et al.[27], who

find that a one percent increase in pensions would decrease fertility by 0.2 percent. We aim to testing whether this result is in connection with the extended family argument (more elderly distract time and financial resources from additional children) or the pension system argument of Gábos et al[27] (a more extended pension system deteriorates incentives for childbearing as a type of old-age insurance). In Annex 6, we report the results of various specifications of old-age dependency. The above 75-year age dependency is insignificant, which may capture more the effect of life expectancy and not the number of elderly. Moreover, old-age pension expenditure is not significant either in these specifications, which suggests that the pension argument is less important in this setup. Instead, a positive effect of duration of working life becomes significant in these models, such that the increase of the duration would decrease the share of elderly to be cared for and this, in turn, increases fertility. These results point to the **importance of the number of inactive elderly people** and are in line with the findings of Harknett and coauthors[34].

The **cash benefits are insignificant** in all model specifications, and the **point estimates are negative**. This is in line with the findings regarding the probability of first birth in the micro model, which is intuitive, because TFR is comprised in a large part by first births (check Figure 2.a). In some specifications, family in-kind benefits have a significant positive effect, which is also in line with the significant positive effect of increasing the number of available nursery school slots.

Crude marriage rate (number of marriages per 1000 people) shows a **slightly significant effect** on TFR, however, its **magnitude is practically zero**. For instance, according to Model 6, if marriage rate increased by 0.01 (number of marriages increased by 10 per 1000 people), then fertility would increase by 0.00031, which is 0.02% compared to the 1.49 baseline rate. This would be a huge increase in marriages, taking into account that Hungary's crude marriage rate increased from about 3.5 to 4.7 during the first 3 years of new marriage tax benefit, reaching a much higher marriage rate than the sample average (see Appendix 2).

Overall, all models, including longer-term Model 6, indicate that **female involvement in the labour market** (decrease in unemployment rate) and the **economic environment** are the most important factors for fertility decisions.

Table 9 Estimation results

	(1)	(2)	(3)	(4)	(5)	(6)
GDP per capita (log)	0.413***					
	(0.111)					
Real household spending (log)		0.274**				
		(0.089)				
Economic sentiment indicator (log)				0.061		
				(0.045)		
Real interest rate					-0.002	
					(0.002)	
Female employment rate			1.109***		0.912**	
			(0.317)		(0.305)	

Female unemployment rate				-0.924***		-1.129***
				(0.230)		(0.259)
Duration of working life	0.009	0.008	-0.002	0.013*	-0.005	
	(0.005)	(0.005)	(0.007)	(0.005)	(0.008)	
Crude marriage rate	0.019*	0.023*	0.020*	0.018	0.022*	0.031**
	(0.010)	(0.010)	(0.010)	(0.010)	(0.011)	(0.012)
Old age dependency ratio	-2.787**	-2.424**	-2.881**	-2.407**	-3.835***	-2.200*
	(0.851)	(0.854)	(0.885)	(0.878)	(0.772)	(0.968)
Tax break for children	0.006	0.006	0.006	0.006	0.007	
	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	
Family cash benefits (% of GDP)		-2.991		-1.421	-4.604	
		(2.451)		(2.736)	(2.989)	
Family in kind benefits (% of GDP)		4.894		5.386*	4.163	
		(2.687)		(2.690)	(3.261)	
Social protection expenditure per children (% of GDP)	-0.074		-0.114			
	(0.166)		(0.163)			
Constant	0.016	0.015	0.022*	0.019	0.021*	-0.016
	(0.011)	(0.011)	(0.010)	(0.011)	(0.010)	(0.013)
Observations	266	266	266	266	238	252
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Years	2001-2014	2001-2014	2001-2014	2001-2014	2001-2014	1997-2014
Countries	19	19	19	19	17	14
Adjusted R^2	0.429	0.428	0.436	0.451	0.423	0.365
AIC	-1011.997	-1010.886	-1014.620	-1020.625	-920.702	-977.201

*The country and year fixed effects are not reported. Robust standard errors are in parentheses. Indication of significance: * p < 0.05, ** p < 0.01, *** p < 0.001*

The panel estimation method raises the question, how well the estimation results fit to a particular country. Figure 10 depicts mean residual as a proportion of the total fertility rate and its confidence interval.

Figure 10 Mean relative residual

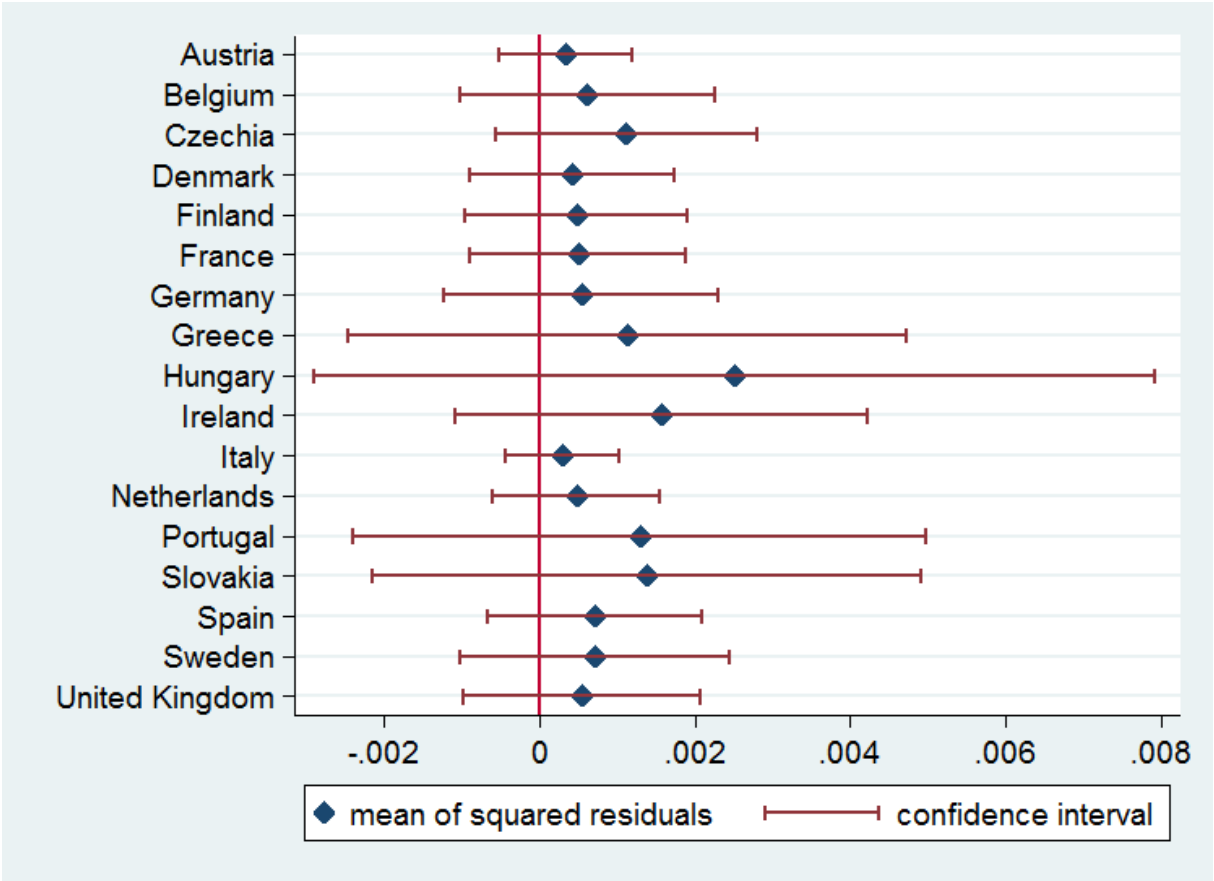
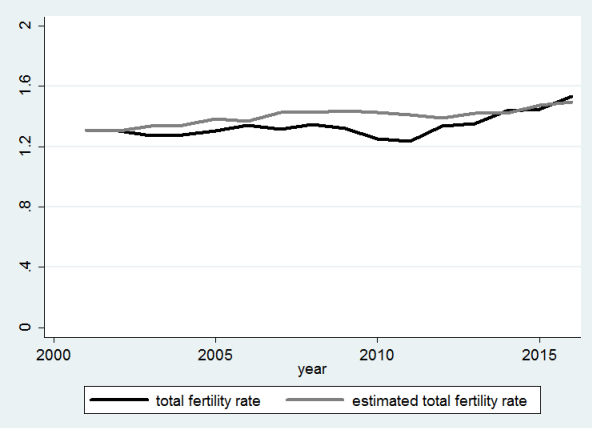
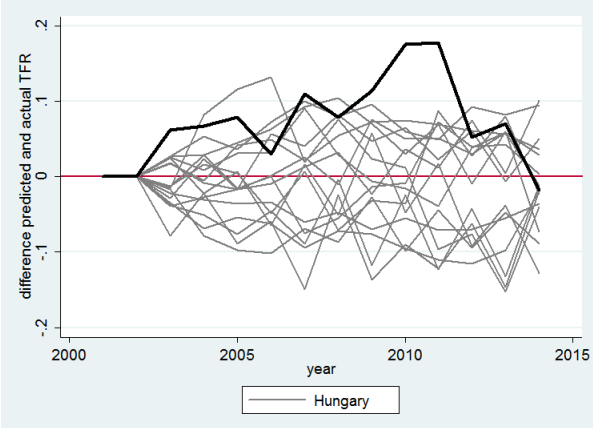


Figure 11a presents actual and predicted TFR values for Hungary (based on Model 4), whereas Figure 11b shows yearly prediction errors. In 2011 the difference between the actual and the estimated values reach 14% of the actual TFR. Even with this outlier value, the prediction seems acceptable for Hungary.

Figure 11 a Actual and predicted TFR - Hungary



b Yearly prediction errors – Hungary vs. other countries in sample



Estimated TFR in Model 4 *Prediction errors in Model 4*

Total fertility rate, the dependent variable in the previous estimations, is a good measure for the quantity of children born, but yet another interesting question is the timing of childbearing. To gain a better understanding of the timing of the decision we estimated Model 4 from Table 9 for different age categories and for the mean time of childbirth. The results are shown in Table 10.

All the coefficients of the unemployment rates, calculated for the given age group, are negative, but are only significant for age groups 20-24 and 25-29. The explanation can be that high unemployment can reduce the fertility of twenty-year-old females as they still have time to postpone childbearing, but the thirty-year-old females don't have this option, so the effect of unemployment is smaller. We see the same effect in case of mean age of women at childbirth (column 7), a significant positive coefficient was found, which means that 1%point increase in female unemployment would postpone mean childbirth by 0.035 year (about 13 days). As before, age dependency decreases the total fertility rates most significantly in the youngest age groups.

The **effect of cash benefits is significant and negative only in the youngest age group. It is possibly the result of delayed pregnancies in order to gain eligibility for high-amount cash benefits**. At the same time, the point estimates of in-kind benefits are mostly positive and for the 25-29-year-old group they are significant. This result may point to the **importance of childcare expenditures**, nevertheless, this variable in the model includes many other types of expenditures as well. These results are in line with the findings of the microeconomic model presented in the previous subsection.

Table 10 Estimation results for age specific total fertility rate and mean age at childbirth

	(1) Fertility age15-19	(2) Fertility age20-24	(3) Fertility age25-29	(4) Fertility age30-34	(5) Fertility age35-39	(6) Fertility age40-44	(7) Mean age at childbirth
Female unemployment rate at relevant age	-0.188	-0.800***	-0.378**	-0.204	-0.391	-0.485	
	(0.118)	(0.141)	(0.132)	(0.183)	(0.212)	(0.333)	
Female unemployment rate							3.503***
							(0.792)
Old age dependency ratio	-6.189**	-4.280**	-2.436*	-1.847	-0.851	-0.059	6.234
	(2.248)	(1.595)	(1.076)	(1.128)	(1.053)	(1.316)	(3.419)
Family cash benefits (% of GDP)	-11.360*	-3.339	-2.938	-0.388	-1.252	2.438	-0.823
	(5.365)	(3.964)	(3.595)	(3.524)	(3.129)	(4.185)	(9.430)
Family in kind benefits (% of GDP)	-9.588	2.864	7.268*	4.298	3.372	5.536	0.735
	(8.973)	(4.652)	(3.328)	(3.574)	(3.074)	(4.655)	(10.900)
Observations	266	266	266	266	266	266	266
Time FE	✓	✓	✓	✓	✓	✓	✓
Country FE	✓	✓	✓	✓	✓	✓	✓
Years	2001-2014	2001-2014	2001-2014	2001-2014	2001-2014	2001-2014	2001-2014
Countries	19	19	19	19	19	19	19
Adjusted R^2	0.372	0.330	0.332	0.552	0.573	0.356	0.336
AIC	-582.522	-757.381	-942.361	-902.645	-884.944	-746.987	-359.950

Country and year fixed effects are not reported here.
*Robust standard errors are in parentheses. Indication of significance: * p < 0.05, ** p < 0.01, *** p < 0.001*

The factors affecting the timing decision are even more visible if we use the mean age of women giving birth to their first child. This variable is available for fewer countries, so the sample size is smaller, but our previous findings still hold in these models. Unemployment affects fertility negatively and makes women postpone pregnancy (the coefficient is slightly higher). The effect of unemployment is even higher if women expect their first child.

Table 11 Estimation results for total fertility rate, mean age at childbirth and mean age at 1 child birth

	(1) TFR	(2) mean age at childbirth	(3) mean age at 1st birth
Female unemployment rate	-1.010***	4.739***	4.899***
	(0.248)	(0.887)	(1.199)
Old age dependency ratio	-1.216	4.734	3.200
	(1.216)	(4.302)	(5.077)
Family cash benefits (% of GDP)	-2.688	-0.730	-9.983
	(3.852)	(12.952)	(17.104)
Family in kind benefits (% of GDP)	3.930	1.742	5.508
	(3.743)	(12.965)	(20.268)

Observations	182	182	182
Time FE	yes	yes	yes
Country FE	yes	yes	yes
Years	2001-2014	2001-2014	2001-2014
Countries	13	13	13
Adjusted R^2	0.468	0.382	0.342
AIC	-668.618	-217.226	-104.754

The country and year fixed effects are not reported here.
*Robust standard errors are in parentheses. Indication of significance: * p < 0.05, ** p < 0.01, *** p < 0.001*

We have done standard **robustness checks** of the presented model, which **indicate that the model is correctly specified** (see Annex 6). We have also tested for variations of the baseline model, which differ in the effects timing assumption: how long will it take for a change in policies to affect TFR. These results reveal that the indications of **our models are invariant to the choice of effect time assumptions** (see Annex 6 for details).

6. Conclusions

In this study, we aim to measure the effect of Hungarian family policies on fertility rates. For this purpose, we built a micro and a macro model and found very similar patterns regarding the effects of the various factors.

In the micro model we measure the combined and the separate effect of family policies, separately to 1st, 2nd and higher order births and an overall effect for birth of any order. Also, we allow for 1, 2 and 3 years for fertility to react to policy changes. This variety of regressions ensure that we get a broad understanding of the effects. The regression results show that **first and second-order births are positively influenced by employment possibilities**, availability of **flexible work opportunities** and **nursery school coverage**. The **third births are affected negatively by maternal employment**. Higher family cash benefits seem to delay first births and increase third births slightly.

In the separate analysis of the family policies, we find a significant positive effect in the first to third year in case of three types of family policies. The results indicate that **1 additional birth costs HUF 7.6 million in case of family tax credit, HUF 5.6 million in nursery school development and HUF 1.2 million in home ownership support.**

In general, previous literature suggests that **fertility decisions are affected primarily by employment, subsistence and housing prospects**. Our results clearly show that **those elements of the family benefit system which target these areas have the most significant fertility effect.** We find that factors related to reemployment probability after childbearing, i.e. **current female employment**, **nursery school availability** and **part-time work possibilities** significantly increase birth probabilities. Also, the increase of **disposable income due to family tax credit**, as well as the **better availability of housing due to home ownership support** have a positive impact on fertility.

There are two important implications of this finding which may help policy makers increase the efficiency of the system of national pro-fertility policies. First, **economic policies aiming to increase employment rates and wages are likely to belong to the most efficient pro-fertility policies**. Second, the results point to **affordable housing as a key factor of childbearing decisions**. Rindfuss and Brauner-Otto[1] claim that this goal may be achieved by easily obtainable and low-cost mortgage (which is supported by the current system) and the availability of affordable house rental, which highlights that **the development of the house rental market and state-provided houses for rent could be a vital part of a pro-fertility strategy**.

In the macro model we estimate a standard first-differenced model and include year and country fixed effects to eliminate any year or country specific effects unexplained by the included explanatory variables. The results are in line with those estimated in the microeconomic model. The estimation results show that **economic and employment circumstances** and **old-age dependency** affect most total fertility rate. Decreasing female unemployment rate by 1%point would increase TFR by 0.6%, and the same for old-age dependency ratio is 1.6%. Cash benefits have no significant effect on fertility and the point estimates are negative which is in line with the results of the micro model. This is intuitive, because TFR is comprised in a large part by first births.

The effect of cash benefits is significant and negative only in the youngest age group. It is possibly the result of delayed pregnancies in order to gain eligibility for high-amount cash benefits. The point estimates of in-kind benefits are mostly positive and for the 25-29-year-old group they are significant. This result may point to the importance of childcare expenditures.

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