From Policy to Population:

Unravelling the Effects of Parental Leave Laws on Luxembourg's Fertility Across Nationals and Immigrants

Bachelor Thesis [International Bachelor Economics and Business Economics]

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Abstract

This thesis explores the effect of the 2016 parental leave law policy amendment in Luxembourg on fertility rates. To comprehensively address this issue, this study draws on data spanning from 2011 to 2020 levied by the World Development Indicators pertaining to the macro-level Difference-in-Differences analysis, and the Luxembourg Income Study database pertaining to the micro-level analysis using Pooled OLS and Fixed Effects models, where the study incorporates country of birth fixed effects to account for potential variations in individual characteristics. The primary emphasis of this research centers on elucidating the uncovered outcomes through detailed micro-level analyses. While the macro-analysis revealed statistically insignificant negative results, the inquiry delves into the intricate web of individual characteristics, enabling a deeper understanding of the nuanced dynamics at play. All models – though with varying levels of significance – suggested slight negative correlations between the policy implementation and birth counts. Immigration status seemed to correlate positively with family benefit uptake when interacting with the policy variable.

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1. Introduction

Luxembourg is home to one of Europe's most unique demographic structures, with an immigration population reaching almost 50% of the total number of inhabitants. Through this idiosyncratic makeup, the traditional understanding of a minority-majority dichotomy has unravelled, and made space for a more balanced equilibrium of the country's ethnic diversity and social cohesion. The number of immigrants gradually approaching that of native residents allowed the country to form a melting pot of cultural backgrounds and traditions. Such vast diversity influences perceptions, attitudes, and behaviours on various social matters, for example those regarding fertility and family dynamics. Studying the impact of the 2016 implementation of Luxembourg's parental leave law on fertility rates in such a diverse setting allows for a more comprehensive understanding of how different cultural contexts interact with family policies and influence fertility decisions.

The aim of the reform, which was first announced in 2014, was to enhance Luxembourg's work-life balance and motivate parents – especially fathers – to make greater use of parental leave. This law enables a more flexible system, in which both parents are eligible to take leave (Legilux, 2016). Immigrants often bring their own set of social norms, values, and expectations regarding family life and child-rearing practices and Luxembourg's distinctive demographic setting creates a unique opportunity to explore how this emphasis on more equal parental leave interacts with the different social norms and values of family formation and parenthood associated with diverging cultures.

In recent decades there has been a deterioration of Europe's demographic situation. The 2100 population pyramid projected by Eurostat shows a shrinking and ageing society (Eurostat, 2023). The share of those aged above 80 is estimated to more than double, from 6% in 2022 to 15% in 2100, whereas the share of the working population, as well as those aged below 20 is predicted to shrink. Those aged 65 and over are set to account for 32% of the EU's population, compared to a mere 21% in 2022. Such an ageing population intensifies fiscal sustainability challenges; the total cost of ageing has namely been projected to rise by 1.9 percentage points of GDP by the year 2070, compared to 2019 (European Commission, 2021). There will not only be an increased need for health and long-term care services, but also additional infrastructure investments, and the challenge of sustaining old-age pensions will have to be faced. The latter has particular relevance to the female population, whose pensions in 2021 were on average 26.9% lower than that of the male population, whereas – due to their longer life expectancy – they are often the ones in need of more long-term care (European Commission, 2023). Imbalances between intergenerational transfers in the economy may also arise due to the shortfall in replacement of middle-aged workers, potentially posing constraints on economic growth at both national and regional levels. EU regions that are predominantly rural and less developed are witnessing a rapid reduction in their working-age population, which is causing them to fall behind in terms of development and attraction of the skilled workforce needed for their development (European Commission, 2023).

The policy department of the European Parliament has stressed that demographic policies established to combat such deteriorations need to go hand in hand with other policy interventions – like for example family and employment policies –, as recent improvements made in terms of gender equality may otherwise be jeopardised (Davaki & Department of Social Policy, 2016).

Hence, understanding the dynamics of fertility rates is of great importance, as it allows us to obtain a better understanding of how the demographics of a population will change over time and how we can influence it. Too large population sizes and growth rates have further major economic effects, like natural resource congestion, and dependency changes. Previous studies have found that gender inequity in the workplace is one of the main factors contributing to low fertility and in present times parental leave has become a key pro-natal policy to combat these undesired effects (Thomas et al., 2022). Understanding how Luxembourg's diverse perspectives shape fertility choices can provide policymakers with valuable insights and contribute to a more inclusive and effective design of family policies. Advances in technology and interconnected economies continuously drive global mobility and globalisation. It is therefore fruitful to start understanding the evolving intricacies of policy effects in a country with such a unique melting pot status as Luxembourg. Further analysing these effects will enable us to better understand what the main drivers influencing fertility are and thus what can and should be done to combat undesirable fertility rates.

Gender-egalitarian norms have been found to be highly predictive of fertility levels, as the conflict between advancing career aspirations and traditional gendered household responsibilities has come between the woman's ability to balance work and family life (Baizan et al., 2016). Improving on *parental* leave allows for this unequal division between a fathers' and mothers' work-life balance to be levelled out, by promoting fathers to take on more household tasks related to childcare (Baum & Ruhm, 2016).

However, the question on whether leave actually increases fertility, remains a much-debated topic up for discussion. Some empirical literature has concluded evidence to be mixed, and ambiguous results have been found. Though leave has been found to encourage progressions towards a second child, it was also seen to be associated with significant delays in women's entering of the workforce (Matysiak and Szalma, 2014). Though there are countries, such as Slovenia, where after ample benefits and policies related to leave policies, fertility has stayed low (Stropnik & Sirceli, 2008), evidence has also been found that similar policies lead to large increases in fertility, as in the case of Germany (Trzcinski, 2014). Many of the previously conducted empirical studies have however failed to come up with clear causal effects, due to the various lacking research methods that were implemented. Analysing additional cases with a focus on different characteristics – as in this case, immigration status – would create a clearer view of the actual effects.

In order to do so, the two hypotheses to be analysed in this research paper are:

"The Art. L. 234-43 amendment, enabling more employees – with no distinction between father and mother – to take parental leave, had a positive causal effect on fertility rates in Luxembourg."

"This difference in outcome was more pronounced for Luxembourg-nationals than immigrants"

The exploration of these hypotheses will be structured in in the following way. Chapter 2 will provide a review of existing literature pertaining to the determinants of fertility and delve into the challenges encountered in identifying true effects, concluding with an elucidation of the policy under examination. The reader will subsequently be furnished with a detailed explanation of the dataset and variables in Chapter 3, offering a solid foundation for grasping the subject matter. The methodology and results sections, respectively Chapters 4 and 5 of this paper will serve as the heart of this analysis. Here, various analytical methodologies will be contrasted and employed. This includes a macro-level Difference-in-Differences approach focusing on total fertility rates, as well as the application of Pooled OLS and Fixed Effects models analysing individual characteristics in relation to both birth counts and family benefits uptake. These association regressions are aimed at shedding micro-level light on any discernible results. Chapters 6 and 7 will concludingly provide a culmination of the findings, offering an extensive discussion of the results and an overview of the limitations regarding the analytical methods employed.

2. Theoretical Framework

2.1. Literature Review: The Importance of Policy Effects on Fertility in Context

Longer lives and fertility far below the replacement level of 2.1 births per woman is resulting in a rapid ageing of the population, and this demographic shift has sparked concerns amongst experts regarding its potential negative repercussions on public finances and living standards (Lee et al., 2014). The importance of mitigating the emergence of an ageing society is underscored by several critical factors, including, but not limited to; economic sustainability, social welfare, pension systems, innovation and productivity, social cohesion, healthcare, and dependency ratios. Ageing populations typically entail a diminished workforce relative to the number of retirees, which places a considerable burden on the working-age population as they bear the responsibility of supporting the elderly. Additionally, such demographic shifts tend to elevate the demand for healthcare and social welfare services, resulting in an increased strain on healthcare systems and heightened societal expenditures. Younger workforces also often exhibit greater levels of innovation and productivity, which are fundamental drivers of steady economic growth. Moreover, higher dependency ratios, characterized by an increased proportion of non-working individuals—namely the young and the elderly—in relation to the working-age population, can exert significant pressure on a country's resources and social support systems.

Efforts to counter the challenges posed by ageing societies do not involve discouraging people from living longer but typically revolve around strategies such as promoting higher birth rates and implementing policies that facilitate healthy aging and workforce participation. Analysis has revealed that maintaining fertility rates well above the replacement rate should generally have the largest positive impact on government budgets. On the other hand however, keeping fertility close to the replacement level has also proven to be beneficial in maintaining a better standard of living (Lee et al., 2014). It is thus of uttermost importance to gain a comprehensive understanding of specific measures and their respective impacts on fertility rates, as well as the extent to which these effects last. Therefore, policies regarding the promotion of higher birth rates are precisely the areas of focus I will be exploring in this research paper.

As briefly introduced in Chapter 1, various studies have found differing results when it comes to the effect of more egalitarian parental leave laws on fertility. Much research has been conducted on the matter whether gender equity actually leads to higher fertility. Though some argue the answer to be seemingly ambiguous, an overwhelming amount of research has found egalitarian attitudes to be associated with higher intentions of fertility (Puur et al., 2008) and that overall gender equity boosts fertility (McDonald, 2000). In the case of parental leave, this gender equality goes hand in hand with the balance between work and lifestyle. A lack of such a balance has been associated with lower quality of life, affecting the relationship between couples, parents and children, which plays a crucial role in childbearing decisions (Fernandez et al., 2016). The importance of focusing on leave policies specifically, rather than other family policies, stems from the combined notions that the provision of more inclusive leave promotes gender equity in domestic responsibilities, and that gender inequity in domestic roles has been identified as a major contributor to low fertility rates (Goldscheider et al., 2015; Tamm, 2019).

OECD's data on gender equality shows that women remain underrepresented in the labour market. Only 67.7% of women in the EU were in employment in 2021, compared to 78.5% percent of men (European Commission, 2023). The Europe2020 target of a 75% labour market participation has thus been reached for the male part of the population, but not the female part. Though over the last years there has been an increase in female labour market participation, this development has been extremely slight. The European Parliamentary Research Service shows that in 2015 the female participation rate was 64.3%, showing a relatively modest increase of only 3.4% over a period of 6 years. While this is a positive shift, its meagreness also asks for a closer examination of the factors influencing gender disparities. The primary factor contributing to this gap between male and female labour participation has been marked as the unequal distributions of family responsibilities between the sexes; the load of familial obligations substantially falls on women. This is unsurprising, as traditionally, and still in many cultures today, women have shouldered a disproportionate burden of familial obligations – ranging from childcare to household management. Evidence to this disproportional effect can be found in that in the EU a mere 2.7% of men took up parental leave in 2010, while the figure for women was significantly higher at 40% (Werner, 2015). In countries where adequate child-care facilities are lacking, the gender disparity in labour market participation is the most pronounced. The relationship between fertility, gender equality, and labour market participation seems like a circular one. A positive influence in one has on many occasions been found to positively influence the others and vice versa. Amongst others, the Parliamentary briefing namely raised its concerns about that an important angle concerning the gender inequality issue in the labour market is how it relates to the EU's ageing population. Findings show that policies entailing better wage compensation could have a positive impact on this matter (Eurostat, 2022).

The significance of encouraging specifically male leave uptake has been demonstrated through various positive outcomes. Promoting increased father involvement could positively lower the mother's opportunity costs and thus lead to an upward influence of her fertility preferences (Goldscheider et al., 2015). When governments promote parental leave policies, a primary objective is often to bolster a more equitable division of responsibilities between the genders in domestic activities, such as household chores and childcare. This would not only facilitate mothers' reintegration's into the labour market, but simultaneously levels the playing field for both men and women in terms of the circumstances in which they are able to enter the labour market and participate in the workforce (European Parliament, 2014). By encouraging fathers to take on a more active role in caring for their children, mothers are more effectively able to balance their work and family lives, and thus expedite their future return to work after having taken maternity leave.

Through such changes, men and women are also presented with more similar opportunities. However, studies have put it up for debate which factor is the one actually pushing a rise in fertility. Findings have shown that the factors are more intertwined. The sole increases of women's participation in the labour market have not strictly resulted in rises in men's domestic duties, and it seems to be so that an unequal division of household labour only significantly impacts women's fertility intentions when they are already carrying a substantial workload in terms of working hours or number of children in the household (Mills et al., 2008).

It is difficult to unequivocally attribute one specific reason to the fluctuations in fertility levels. Research acknowledges that policy effects are influenced by the broader context and overall policy landscape in which specific policies are implemented (Thomson et al., 2014). Effects could be shaped by economic inequality or the expansive policy environment; such that a wider range of social and economic factors need to be considered when performing such analyses. For instance, the impact an additional year of leave has is highly contingent upon the specific alternatives to childcare available. And by the same token, the overall societal framework plays a pivotal role in shaping which types of policies are implemented in the first place. Similarly, variations in outcome effects will be found where policy development lags behind other more imposing social changes and situations compared to where such changes are leading societal development (Neyer & Andersson, 2008).

Furthermore, one's socio-economic circumstances like income and education levels have been studied as determinants of fertility quantum (Balbo et al., 2012). Jones et al. (2008) discussed that two main aspects, namely quality-quantity tradeoff (Becker and Lewis, 1973; Willis, 1973), and the opportunity cost of having children (Kravdal, 1992), fuel a negative relationship between income and fertility. The quality-quantity trade-off argument states that parents who have higher incomes place higher values on their children's quality of life. So although their incomes rise, so do their desired living standards – ultimately raising the costs of having children. Mason (2009) reaffirmed this notion, by demonstrating that as income increases, a decrease in fertility is linked to higher expenditures in the human capital of their children. The opportunity cost argument is based on the matter that the time investment needed for providing for one's children becomes more costly for higher-income parents (Kravdal, 1922).

Findings by Wilson (2019) further indicate that depending on the origin group, foreign-born women have more children than native-born women. Specifically migrants from high-fertility countries tend to exhibit heterogeneity in fertility rates, and averagely exceed the total fertility rates of their destination countries (Desiderio, 2020) Comparably, Rijken and Liefbroer (2008) found that the ideas about certain values and behaviours that are transmitted intergenerationally are also major determinants of fertility. The idea behind this is that parents transmit family values, preferences and attitudes which they have learned from their parents and experiences. Since certain values and traditions are rooted in cultures, studying effects while taking into account people's immigration characteristics, should provide alluring insights on this notion.

Moving forward, Becker's (1991) primary assumption is that the number of children a couple decides to have is influenced by their purchasing power, the resources they anticipate will be required for raising children, and their inclination to allocate these resources to their children instead of using them for alternative purposes. Meaning that changes or increases in family income would lower the direct costs relating to having children, and thus translate into higher fertility rates (Becker & Lewis, 1973). These findings emphasize in this context both the importance of higher compensation in parental leave policies, as well as more equality in the labour market – as these bring with them higher household incomes. Contrarily, changes in policies aimed at strengthening parents' attachments to the workforce and providing them with higher wages have also been found to result in higher opportunity costs associated with taking time off from work in order to care for their children (Bergsvik et al., 2021). Such policies could thus ultimately have varying effects. But when policies are aimed at helping families balance two jobs and provide care for their children, this reduction of opportunity cost has been widely found to contribute to high fertility (Goldscheider et al., 2015). Evidence thus seems to lean toward the notion that, when a parental leave scheme is properly constructed, one could steer fertility towards one's desired direction. Examples of such well-designed policies include emphases on compensation of forgone earnings or imposing improved options for child-care facilities.

2.2. The Challenge of Defining Clear Impacts on Fertility

While consensuses seem to have been reached on certain aspects, depending on the employed research methods, there continues to be a certain degree of debate regarding how fertility precisely gets affected. As elucidated by Thomas et al. (2022), the challenge in comparing studies lies in that the variability of their conclusions is largely contingent on whether only the current-child effect, future-child effect or total child effect has been taken into account. The current-child effect pertains to the influence on subsequent fertility arising from a parent being able to take more leave for the child which has already been born, whereas the future-child effect refers to the effect on fertility stemming from the anticipation of a greater amount of leave being available in the future. Such discrepancies in the research focus introduce complexity and nuances in assessing the legitimate impact of parental leave policies on fertility decisions.

Studies which identified a more complete effect, found positive and significant results (Thomas et al., 2022). Besides looking at completing the effect by taking into account the actual child composition in the family, it is also important to examine the effects on different societal groups. To study these differing effects is of vast importance as any reform can have consequences to a regime's political stability (OECD, 2013). Though one part of the population may be affected in a positive way, the effect on all relevant social groups needs to be taken into account. An additional contribution this thesis will thus aim to provide is a more clear and accurate view of policy effects on varying groups in society.

In addition to which particular research methods are adopted in an analysis, another critical determinant influencing the results is the nature of the data that is being employed for analyses. Unanimity is growing in that a reliable evaluation of family policies requires research designs rooted in long-term microdata rather than macro-data (Bergsvik et al., 2021; Neyer & Andersson, 2008). During the 1970s and 1980s, a large number of macro-level analyses were conducted, primarily indicating that family policies had the capacity to influence fertility. However, it is imperative to acknowledge that during this period, the range of such policies was considerably restricted. Consequently, in subsequent years, when family policies encompassed a broader spectrum, the observed outcomes were notably less robust. In the 1990s, the majority of macro-level studies yielded results that were either inconclusive and contradictory or demonstrated a tenuous correlation (Sleebos, 2003; Neyer, 2003; Gauthier, 2007). Consequently, arriving at definitive conclusions regarding the true effects of these policies remains challenging, as most findings remain uncertain or of marginal effect (Demeny, 2007).

Neyer and Andersson (2008) argue that the effects of family policies can only be properly assessed if the impact on individual behaviour is studied, as fertility choices happen at a microlevel. Looking at microdata allows one to zoom in on this relationship between the policy and resulting behaviours, and thus better understand the social processes linking them. Various micro-level analyses have reaffirmed, with a stronger basis for conclusions, the potential influence of policies on fertility decisions. Responses to such polices might however vary, depending on the individual's specific circumstances. For instance, Mencarini et al. (2006) discovered that women who have only one child in their family, represent a group for whom family policies yield more substantial results, and therefore urge policy makers to carefully consider such insights and allocate their resources in a more efficient and effective manner.

In their analysis, Neyer and Andersson (2008) conclude that while policies may indeed have a positive impact on fertility, an increase in policy intensity does not necessarily equate to improved outcomes. More is not necessarily better. It is essential to delve into the normative and symbolic connotations, and look at their correspondence to the societal development. To determine which types of family policies are capable of achieving the desired effects, it is imperative to scrutinize the objectives that these policies seek to address, the messages they convey regarding family behaviour, the family structures they promote, and how each of these aspects corresponds with the social context of the population under examination. Ultimately, according to their findings, to comprehensively explore the impact of family policies on fertility and childbearing behaviours, it is crucial to situate the policies within a broader context that encompasses social, economic, and political dimensions. It is essential to investigate family policies within a framework which interconnects the population, market, society, and family compositions, and examine these all in relation to one another.

It is due to these reasons that I believe it imperative to utilise micro-data to perform the analysis of this paper's hypotheses. It is crucial to recognise that the effects of family policies are unlikely to be universally applicable, given their considerable dependence on the specific contextual factors of each situation. Whether a policy has an effect and in which way it will influence fertility will differ across dissimilar societies. Ergo, any discerned outcomes cannot not be decontextualised, and a micro-level analysis will specifically allow for controls that take into account the diverging factors of each individual. In light of this, Luxembourg's unique composition – as being a cultural melting pot –, might allow the formulation of slightly more global conclusions.

2.3. Summary of Parental Leave Amendments Art. L. 234-43

In order to provide the reader with a better understanding of the research question's precise scope, I will delineate the specific law alterations that occurred subsequent to the implementation Art. L. 234-43.

The reform was designed with the aim of enhancing the appeal of parental leave for both mothers and fathers, while incorporating additional European regulations. In doing so, its primary goal was to encourage a higher percentage of fathers to avail themselves of parental leave, thereby advancing equal opportunities. Moreover, the reform focused on better addressing the needs of parents, fostering improved work-life balance, and increasing overall participation in parental leave by making the leave divisible and providing adequate replacement income, thus making it more tailor-made to individual circumstances. In pursuit of the realisation of these goals, among other policy changes, the following were implemented (Chambre des Salariés, 2019).

1. Three different forms of parental leave were introduced

   Where previously parental leave had to be taken in its entirety at once, the new law implements a tripartite system leaving more flexibility for those eligible to receive parental leave. The available leave thus consists of three options; (1) Full-time parental leave of 4 to 6 months, during which the employee ceases to work entirely; (2) Part-time parental leave of 8 to 12 months, reducing work hours by 50% instead of the previous 20 hour per week reduction; or (3) Split leave, where an employee who works 40 hours per week has the possibility to reduce work hours either by 20% per week or – within a 20 month time-frame – reduce their work hours over a period of 4 distinct months.

2. Parents are provided with a higher and more tailor-made parental leave compensation

   Where at the 814.40 inflation index there had previously been a lump-sum allowance of €1,778.31 per month for full-time leave and €889.15 per month for part-time leave, the new law has enforced a real replacement income, paid continuously and proportionally to the remuneration lost by the parent. The reference for these calculations is the contributory pension insurance income of the 12 months leading up to the start of parental leave. In accordance with the minimum social wage this is implemented with a lower limit of €2,071.10 gross per month, and an upper limit of €3,451.83 gross per month.

3. Both parents are now able to take parental leave at the same time, regardless of whether they are working full-time or part-time.
4. The age limit relating to when the second parental leave is allowed to be taken has increased from previously the child standardly having to be maximum five years of age, to now six when it is a case of birth and twelve in case of adoption.
5. It is also no longer a requirement for the child to be living in te household of the person who has qualified for the allowance.

Over the course of the last two decades various parental leave laws in Luxembourg have naturally seen some amendments, but the changes implemented in 2016 have been by far the biggest. The policy change not only was the broadest Luxembourg had seen – never before had this many changes taken place at once –, but the implemented modifications also fostered the anticipation of the most substantial changes. The change in subsidies (point 2) for example, which allows for a more tailored compensation scheme to each parent involved, is a major contributor to the goal of advancing the harmonisation between the individual’s professional and family lives. Besides these strong abovementioned changes, there have been many other tweaks to the policy, from adding child bonuses, to back to school allowances. Ultimately, the goal of all these reforms is to promote equal opportunities, by both increasing the amount of fathers taking up parental leave, and also increasing the number of parents who take advantage of it in general.

The policy adopted by Luxembourg is formulated in a very neutral manner, as EU-law regulates that all policies must be non-discriminatory. In countries with different regulations on the other hand, such distinctions are sometimes accentuated. Policies in Norway for example, have precisely been geared toward specifically supporting women's employment and men's involvement in childcare (Rønsen & Sundström, 1999). Concerning EU member states, research has revealed that in some instances, even within the scope of these neutral laws, certain indirect barriers still hinder fathers' utilisations of parental leave benefits. Such a gender-neutral configuration of family policies might not prove effective in reshaping gender dynamics (Neyer, 2005). These obstacles, for instance, arise from too low benefit levels or impractical rules regarding the ability to claim leave as a father (Haas, 2003). Though Luxembourg is one of the few EU countries that does not distinguish between maternal and paternal leave whatsoever (Infographic, 2022), a pressing question is whether such a neutral law will translate itself into neutral usage as well, or that leave will rather mainly stay being taken up by women due to cultural norms.

3. Data

3.1. Datasets

In order to assess the formulated hypotheses in this research, I will utilise the Luxembourg Income Study Database (LIS). This comprehensive data archive comprises the most extensive income database containing harmonised microdata from 50 countries collected worldwide over a span of five decades. Each year a new Survey of Income and Living Conditions (SILC) is sent out in Luxembourg by the National Institute for Statistics and Economic Studies (STATEC), in order to study its household's living conditions in relation to their income. The structure of this source is a panel household survey data with a four year rotating panel design. After the data is collected by the providers of each respective country, LIS standardises the microdata into a unified template to enhance the comparability of datasets across different countries and over time.

For the purpose of conducting this analysis I will use the household and personal datasets of Luxembourg between the years 2011 and 2019. The SILC sample is drawn from Luxembourg's National Population Register, and covers only people living in private households in Luxembourg territory. Any persons living in collective households or institutions have been excluded from the target population.

The collection of the Surveys always takes place in the next calendar year; meaning that e.g. in 2017, questions are asked about living conditions in 2016. Throughout these collected years, the household non-response rate for Luxembourg held an average of 48%. In order to combat the misrepresentations due to the extensiveness of the non-response rate, weights have been added to the dataset, which allow us to inflate all observations to their true population size.

The remaining data for the macro-analysis has been sourced from the World Development Indicators (WDI) database. This is an open data site comprising worldwide statistics, which have been standardised. Due to data availability and reliability, comparability between all countries cannot always be assured. However this issue lies mainly when looking at the comparison of poorer countries, where statistical systems are limited, and a comparison between the similar and well-developed Luxembourg and Belgium is unlikely to pose considerable interpretation issues.

3.2. Data clean-up and Variables

As beforementioned, LIS has acquired and compiled datasets from a multitude of different data providers. This has of consequence that direct downloading of the aggregated microdata is not possible, primarily due to the restrictions imposed by several data providers who do not permit direct access to their acquired datasets. While this absence of direct access complicates the visualisation and direct examination of the numerical data, it is worth emphasizing that all essential data analyses and coding procedures were successfully carried out through the utilisation of LIS's online remote command processing system LISSY. Notably, these limitations on direct access – though at times an obstacle –, also positively contributed to the capacity to acquire more detailed, personalised data, which would otherwise possibly remain inaccessible due to stringent privacy policies.

To commence the data analysis process, I integrated the different datasets essential for my computations. This involved the merging and appending of individual-level data files with their respective household-level data files, ensuring the alignment and coherence of information for an in-depth and comprehensive analysis. Given the extensive questions covered and the fact that the collected datasets rely on surveys, it is inevitable that the data contains certain inaccuracies. Due to this, I have removed any unrealistic or missing values from the calculations. As can be seen in Figure 3.2.1, the family benefits variable (pi411) contains observations that need to be removed. Such benefits firstly cannot be below zero. Moreover, up until 2015, the cap for family benefits was set at €21,339.72 per year. With the new policy regulations starting in 2016, this became €41,421.96. Any observations outside this scope are thus atypical and will be removed. However, we see a clear jump in 2015, which includes many more variables surpassing the original cap. As the data for 2015 has been collected through survey's answered in 2016, I have made the decision to still keep the observations from 2015 containing values up until €41,421.96. Pi411 will namely not be used as a continuous variable, making the specific values of lesser importance. The observation points surpassing €21,339.72 cannot without a doubt be considered unrealistic, as this inaccuracy in value is most likely due to errors made by people filling in the survey. Especially those filling it in at the end of 2016 are likely to have included the numbers regarding 2016 rather than 2015. To provide the reader with a better understanding of the composition of the SILC questions, an excerpt has been added to the Appendix (Figure A.1).

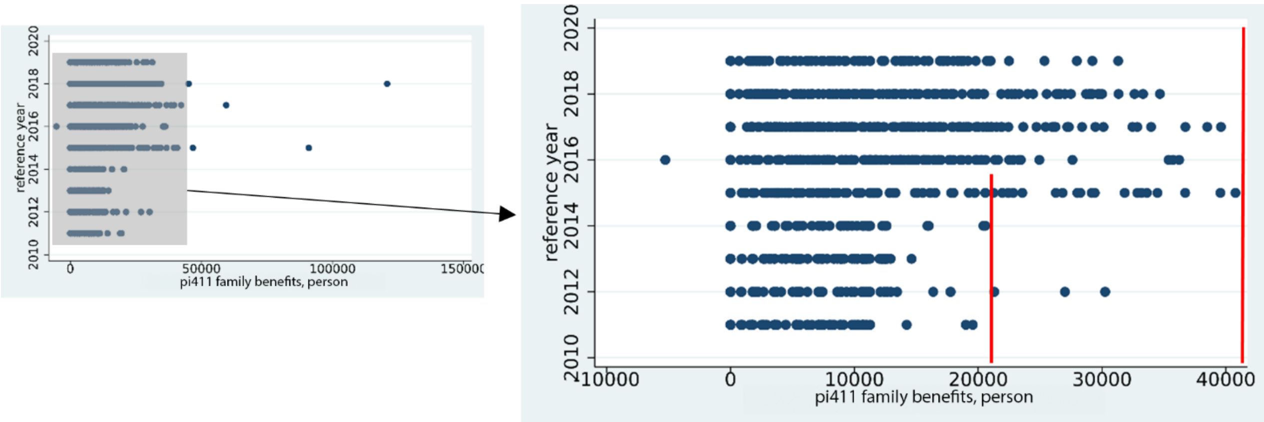

Figure 3.2.1 Yearly Family Benefits Levels per Individual (Pi411), in euros

Table 3.2.1 gives an overview of the remaining micro-level variables used in this paper after having removed missing datapoints, and the 9 unrealistic datapoints relating to pi411. These remaining observations do not highlight any anomalies. The means, standard deviations, minimums, and maximums all appear in line with what one might reasonably expect as their magnitudes. The Appendix (Table A.1), presents an additional descriptive statistics table relating to the utilised macro-data.

Table 3.2.1 Descriptive Statistics and Variable Explanations Micro-data

Variable		Obs	Mean	Std. Dev.	Min	Max
Hid	Household Identifier	75,378	2,080.355	1,294.894	1	6,031
Pid	Personal Identifier; counting person per household	75,378	1.803	0.960	1	11
Ppopwgt	Weight variable; inflating individual's values to total population	75,378	53.621	49.381	0.024	842.035
Pi411	Continuous variable for family benefits (maternity and parental leave), in euros	75,378	148.802	1,516.993	0	40,774
Benefits*	Dummy variable indicating when pi411>0	75,378	0.014	0.117	0	1
Employed	Dummy variable indicating employment status	75,378	0.536	0.499	0	1
Education	Categorical variable for low (1), medium (2), or high (3) level of education	75,378	1.895	0.787	1	3
Immigrant	Dummy variable indicating immigration status	75,378	0.499	0.500	0	1
Age	Continuous variable indicating age	75,378	45.625	17.527	16	98

Age(>35)*	Dummy variable indicating when age > 35	75,378	0.695	0.460	0	1
AgeGroup*	Categorical variable: age 16-25 (1), 26-35 (2), 36-49 (3)	75,378	1.243	1.241	0	3
Male	Dummy variable indicating female (0) or male (1)	75,378	0.493	0.500	0	1
Partner	Dummy variable indicating partnership status	75,378	0.645	0.479	0	1
Nchildren	Continuous variable indicating number of own children in household	75,378	0. 813	1.064	0	9
BigFamily*	Dummy variable indicating when nchildren > 3	75,378	0.016	0.126	0	1
Ageyoch	Continuous variable for age of youngest child (exclusive to non-childless individuals)	34,172	13.784	11.024	0	76
BirthCount*	Dummy variable indicating whether individual has a newborn (ageyoch = 0)	75,378	0.025	0.156	0	1
GFR*	Continuous variable for General Fertility Rate	75,378	0.042	0.006	0.031	0.054
CtryBirth	Categorical variable indicating country of birth	75,378	1635.215	710.494	1000	2913
Policy*	Dummy variable for Art. L. 234-43 (year >= 2016)	75,378	0.418	0.493	0	1

Notes: Variables with (*) are not directly taken from LIS but have been created through combining or adapting other existing variables. The computation of GFR *will be discussed in the following section.*

Micro-fertility (GFR) Computation

A multitude of measures have been used to look at fertility rates, including, but not limited to crude birth rate; general fertility rate; total fertility rate; and gross reproduction rate. The micro-fertility variable *GFR* is measured based on the General Fertility Rate. This is the best fitting measure of fertility rates in regards to my data, and defined as the number of births per year per woman of childbearing age. This approach serves to counteract potential discrepancies that might arise when dividing by a different population, ensuring the accuracy of the analysis. In formulaic terms, the general fertility rate can be expressed as $GFR = \frac{number\ of\ births}{number\ of\ women_{16-49}}$. Since the variables necessary for this measurement were not readily available in the dataset, I made some proxies through which I could recreate the most accurate fertility rate based on this sample.

I created a proxy variable for number of births exclusively based on data from women within the childbearing age range (16 to 49) by identifying instances where *Ageyoch* equalled zero. Only including women in this variable prevents double-counting a child as both the youngest child of their father and their mother. I then adjusted for personal level weights. Specifically, setting *Ageyoch* to zero allowed for the representation of the number of children born in a given year, as the proxy variable's value incremented with each new addition to the family of a newly-born child. Similarly, a proxy variable was created for females between ages 16 and 49 and multiplied by *Ppopwgt*, representing the number of women of childbearing age. This allows us to calculate *GFR* corresponding to the abovementioned formula in the following way: $GFR = sum(fertility\_rep)/sum(women\_rep)$.

It is crucial to highlight that the fertility representative variable (and so also the BirthCount variable) does not account for scenarios in which multiple children may be born in a single year, such as instances involving twins. However, it is also worth noting that this limitation is unlikely to significantly imped the study's objectives as the research focuses on assessing the effect of fertility intentions rather than delving into one's biological changes in fertility.

4. Methodology

4.1. Difference-in-Differences

In an attempt to find the causal effects between the policy implementation and fertility, I will be performing a difference-in-differences (DiD) analysis. The DiD approach is a robust and widely employed econometric method for estimating the causal impact of a policy change on demographic outcomes. Omidakhsh et al. (2020) used this same methodology to analyse the effect of differently designed parental leave policies on gender norms, while a difference-in-differences design was also employed to estimate the impact on Quebec's fertility rates after a reform significantly increased the generosity of parental leave benefits (Ang, 2014). DiD is frequently employed in order to do policy evaluations, as it allows one to assess the net impact of the initiatives over time. In the context of this study a DiD analysis seems promising as it should effectively account for pre-existing differences and time-variant changes between the two countries in question, allowing for a more accurate conclusion to be drawn. Belgium and Luxembourg are two countries sharing numerous commonalities in terms of demographics, culture, politics, and economics, and through these shared characteristics they are often similarly impacted by various external shocks. The control group I will use will thus be Belgium.

Understanding the causal link between a parental leave policy and fertility requires careful consideration of unobservable factors which might influence both policy implementation and fertility rates. A DiD analysis should effectively control for such unobserved confounders. As well as accounting for time-invariant unobserved factors which can differ between the treatment and the control group, it also accounts for time-varying unobserved factors if they are the same between the two groups. In order to make sure there are no time-varying factors that differ between the treatment and control group, certain assumptions must be met.

The Difference-in-Differences methodology relies on two fundamental assumptions: namely the existence of parallel trends, and the occurrence of a common shock (Angrist & Pischke, 2009; Dimick & Ryan, 2014). The principle of the parallel trends assumption dictates that, in the absence of the treatment, the trajectories of the outcome variable for both the treatment and control groups should exhibit equivalence, or at minimum, strong similarity. The concept of common shocks implies that any external events or factors that arise during or after the intervention should impact both groups similarly. While there isn't a definitive analytical method to prove the validity of the common shock assumption, when the parallel trends assumption is satisfied, it suggests that other relevant external shocks would have affected both groups similarly had the treatment not been introduced. This alignment in trends before the treatment helps reinforce the notion that the observed effects are more likely attributable to the treatment itself.

Regrettably, the LIS database has yet to update the Belgian datasets to include data beyond the year 2017. Given that the policy was implemented in 2016, this short time-frame will consequently not show us very complete results. Changes in fertility patterns may namely require more than a single year to manifest. The fertility rates based on micro-data calculated from the Belgium dataset also do not seem to be entirely in line with publicly available macro-data. For Luxembourg, the computed fertility rates do seem to be fitting, as will later be shown in Figure 4.2.1. Due to these limitations, the DiD analysis will solely be conducted on macro-level data sourced from WDI up until the year 2020 (as in 2021 the control group Belgium implemented a major parental leave policy change itself).

Figure 4.1.1 shows the macro-level comparison in total fertility rates between Luxembourg and Belgium. To evaluate the satisfaction to the parallel trends assumption, one can employ either an empirical examination of the outcome variable graphs over time, or assess the significance of the interaction term between time and treatment in the pre-intervention period (Dimick & Ryan, 2014). While to the naked eye it might seem that the parallel trends assumption likely holds, I will conduct a leads test to determine whether this is really the case. In this context, it is imperative that there are no statistically significant differences in outcomes between the treated and control groups. So, if the interaction between the time of policy implementation and the dummy variable representing the treated group is not statistically significant before the event occurs, it indicates that the trajectories of both groups would likely have continued in a similar and parallel manner had the treatment never been introduced. While it is important to note that such a test may not provide absolute certainty, if the test assumption is upheld, this gives a strong indication that the estimation of causal effects is unbiased and allows one to make conclusions following the DiD regression.

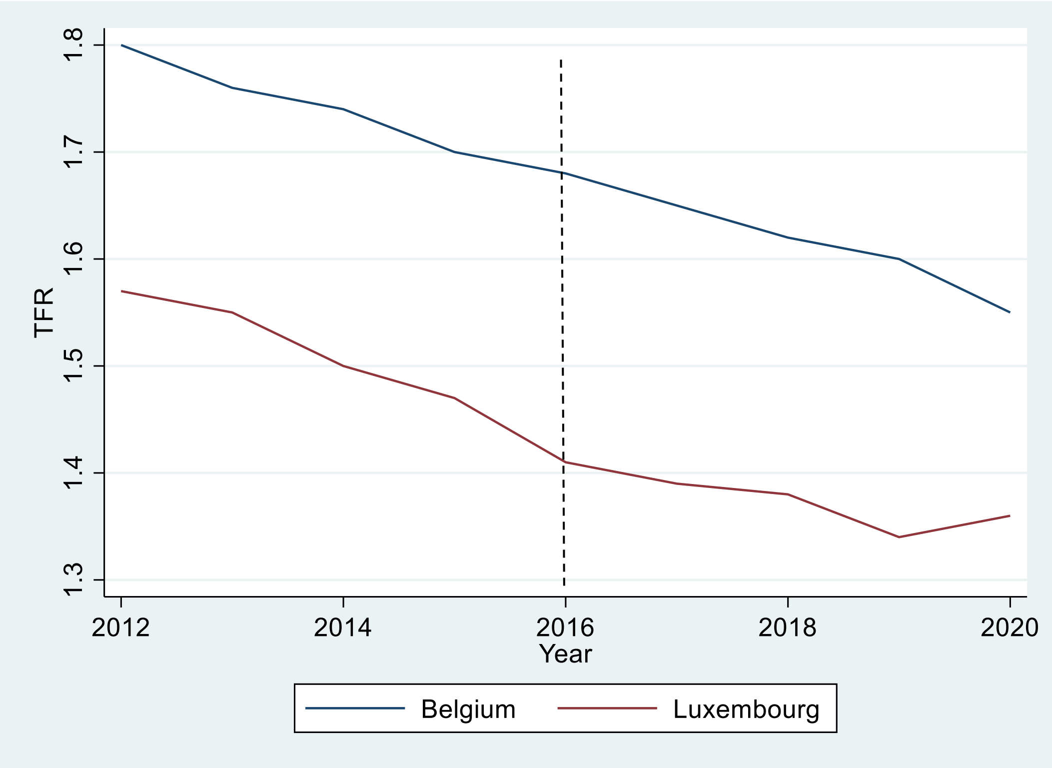

Figure 4.1.1 Total Fertility Rates In Luxembourg and Belgium based on Macro-data

In order to in this manner statistically check the parallel trends assumption I created the variable *Policy_lux*, indicating when the year is larger than or equal to 2016, and when the country associated is Luxembourg. Next, a regression was performed containing a pre-treatment lead to check whether the parallel trends assumption holds. The purpose of this control is to demonstrate that, after having accounted for the initial differences between the two groups, and having accounted for what happens over time, the lead variable will reveal whether, in the year prior to the intervention, there exist any additional differences that would make the DiD regression invalid. The leads test is implemented on the basis of the following regression, where i represents the country, and ε the error term (any non-included unobserved factors or noise which could affect the fertility rates):

$$Y_{it} = \alpha + \rho T_i + \gamma_t + \beta T_{it} + \beta_1 T_{i,t-1} + \varepsilon_{it}$$

Y_{it} represents the outcome variable Total Fertility Rates, and α the intercept, representing the outcome of the fertility variable in the control group prior to any treatment or intervention. T_i is the treatment indicator, taking on value 1 for Luxembourg and 0 for Belgium. This represents the policy effect for Luxembourg relative to Belgium, measuring the difference in outcomes between the treatment and control groups after the policy is implemented. ρ thus accounts for initial differences between Luxembourg and Belgium. The fixed time effects – any overall time-specific changes or trends in outcome – are captured by γ_t. The dummy t takes on value 1 in policy years (>=2016). T_{it} shows the interaction between the treatment indicator T_i and time indicator t (captured as “policy”). β ultimately captures the average treatment effect on the treated (ATT); namely the difference between the treated and counterfactual outcome. Finally, the term $\beta_1 T_{i,t-1}$ captures the lead – i.e. the lagged value of the treatment indicator –, and thus controls whether there are any pre-policy differences between Belgium and Luxembourg.

Table 4.1.1 Parallel Trends Assumption test Macro-data

	TFR
Luxembourg	-0.24***
	(0.013)
Year	
2012	0.2
	(0.029)
2013	-0.01
	(0.033)
2014	-0.045
	(0.009)
2015	-0.080**
	(0.029)
2016	-0.118***
	(0.033)
2017	-0.143***
	(0.031)
2018	-0.163***
	(0.030)
2019	-0.193***
	(0.031)
Policy_lux	-0.004**
	(0.007)
F1	-0.003
	0.009
Constant	1.798***
	(0.005)
Observations	16

Notes: Table 4.1.1 represents the macro parallel trends assumption results. F1 is the lead, where the interaction term policy_lux *is brought one year forward. Standard errors are presented in parentheses. Significance levels: *p-value<0.1, **p-value<0.05, ***p-value<0.01.*

As seen in Table 4.1.1 the P-value of the lead (F1) is highly insignificant. This allows us to conclude that the parallel trends assumption holds, as there were no significant differences in fertility rates between Belgium and Luxembourg preceding the policy change.

The next step will be to run the Difference-in-Differences regression. To help better understand the workings of the DiD model I will now provide the framework for such a regression:

$$Y_{it} = \alpha + \rho T_i + \gamma_t + \beta T_{it} + \varepsilon_{it}, t = -4, -3, -2, -1, 0, 1, 2, 3, 4$$

The variables in this regression are – just as in the previous regression - defined as the following. Variable α is a constant, corresponding to the outcome of the control group, and ε to the error term. ρ refers to the initial difference between treatment and control group – thus taking into account any initial selection bias. T is the treatment indicator. The small t corresponds to the time indicator (year), and it's interaction with γ captures everything that happens over time when the time trend is the same for both groups. Ultimately, the β coefficient in the interaction term gives the Difference-in-Differences outcome, estimating the ATT. The results as seen in Table 5.1.1 will be discussed in Chapter 5.

4.2. Association Analyses

As stated in Chapter 2.2, to properly be able to analyse policy effects on fertility, one should consider micro-data – as policy's will influence different groups of people in different ways. After having completed the DiD analysis and discussing subsequent results, I will thus conduct a series of regressions based on micro-data in an attempt to make these results more comprehensive; what could be underlying reasons that explain the impact of the policy? Figure 4.2.1 shows the general fertility rates in Luxembourg based on children born from women of childbearing age, divided by number of women of this age (as discussed in Chapter 3.2). Naturally the outcome of the micro-GFR will be different to what we have seen from the macro-TFR, as an entirely different calculation is being used, and the data has been extracted using distinctive methods. The micro-level fertility trend rate in Luxembourg looks like the following.

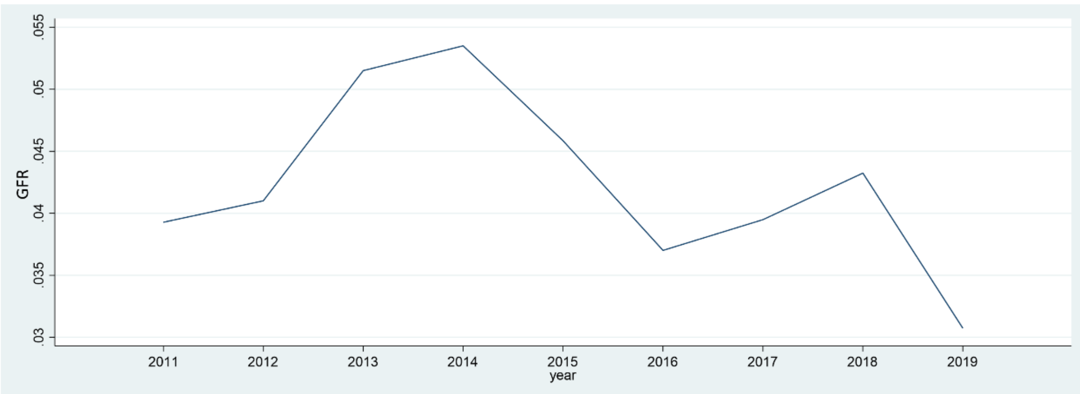

Figure 4.2.1 General Fertility Rates in Luxembourg based on Micro-data (2011-2019), weight adjusted

In order to perform individual level regressions to find the association of fertility rates and the policy implementation, I will use "BirthCount" as the dependent variable. This is so that I can specifically look at the individual level correlations rather than nationwide coefficients related to fertility rates.

The main multiple regressions performed – which will all be weight adjusted and performed under robust standard errors – will consist of Pooled Ordinary Least Squares (OLS) models. Pooled OLS allows for straightforward estimations and interpretations; however, it suffers from a significant drawback. Pooled regressions do not discriminate between various cross sectional units, potentially camouflaging the uniqueness existing within these unit. The regressions will ignore the data structure and simply run an OLS regression. This limitation could easily result in Omitted Variable Bias (OVB), and consequently yield biased results. A way to try and lessen this bias, would be to use Fixed Effects (FE) OLS models, I will thus perform an FE analysis to serve as a robustness check against the Pooled OLS model. Between Random and Fixed effects, in this case the preference goes toward FE, as one does not have to assume that the variance between the policy and FE is zero. FE takes up important variations to lessen the bias of the estimator. However, due to the composition of the LIS data set, it is not possible to account for individual-specific FE. Each year, part of the participants are dropped and an additional selection of participants is introduced. Controlling for individual FE on the one hand significantly dropped the number of observations, as we are left with but a small overlap between individuals over the years, and also posed issues in the computation due to the substantial amount of individuals across the years. Including birth country FE could potentially help control for some of the individual-specific factors. It is imperative to note that it will not fully capture individual-level effects, but as the ability to do this is restricted due to the nature of the dataset, it will be used as an approximation in the hopes that it can capture some of the shared characteristics of individuals from the same origin.

In order to perform the FE analysis, certain assumptions must be upheld; the error term (u_{it}) must possess a zero conditional mean, $E(u_{it} \mid X_{i1}, \ldots, X_{it}) = 0$; observations should be identically distributed (i.i.d.) draws; where the occurrence of large outliers is unlikely; and perfect collinearity should be absent. When individuals are selected through simple random sampling, the assumption of independent and i.i.d. draws is met. This guarantees that each individual has an equal chance of being in the sample, thereby ensuring population representativeness. In the case of the SILC, stratified simple random sampling from the National Population Register was used, upholding this assumption. Furthermore, there seems to be no perfect collinearity, as can be seen in Table A.2. All variables in the regression are categorical, ensuring the absence of significant outliers. As will be discussed in Chapter 7, the zero conditional mean is the one condition that is likely to not hold. Conclusions must thus be drawn with caution, and the FE model will mainly serve as a robustness check against the Pooled OLS models.

First I will check, without other control variables, both the correlation between the number of births and policy implementation, as well as immigration status, as these are the main areas of interest;

1. $BirthCount_{it} = \beta_0 + \beta_1 * Policy_{it} + \varepsilon_{it}$
2. $BirthCount_{it} = \beta_0 + \beta_1 * Immigrant_{it} + \varepsilon_{it}$

Here, and in all following equations, i represents the individual and t the year. I intentionally opted for a simplified model without control variables to maintain clarity and transparency in the analysis. The focus of this study is primarily on the relationship between the policy implementation and immigration status on fertility rates.

However in order to look at these correlations in a fuller view, the following regressions will contain a multitude of control variables. Due to the availability of micro-data, this multiple regression analysis should allow us to understand certain complex relationships in a better way. Including more variables could reduce omitted variable bias, and control for certain confounding variables.

The reasoning for specifically including the chosen control variables stems from varying existing literature. One's socio-economic circumstances like income and education levels have been studied as determinants of fertility quantum (Balbo et al., 2012). However, results linking fertility and education have been very mixed, and in some instances even been found insignificant (Skirbekk, 2008; McCrary & Royer, 2011). The argument leads that women with higher levels of education are more likely to pursue demanding careers and thus increase their earning power, postponing childrearing (Balbo et al., 2012). Per contra, Oppenheimer (1994) found that more highly educated women are also more likely to find more highly educated partners, which allows them to pool their economic resources, incentivising earlier childbearing behaviours. Moreover, family size frequently exhibits correlations with fertility intentions. On one hand, some families might intrinsically have a preference for larger family sizes and desire more children, while other handedly, family size can also impact their financial capacity, influencing their decisions regarding the additional number of children they aim to have. Having only one child in the family further seems to influence the specific effects of family policies, and thus indirectly also fertility (Mencarini et al., 2006). Moreover, partnership status, in line with intuition, has been found to be an important determinant of fertility intentions, as those in stable relationships are more likely to have children (Philipov et al., 2006). Controlling for age – regarding when fertility possibilities start declining in one's 30s – allows us to assess disparities between the different sides of the fertility spectrum. Finally, controlling for sex and employment status reduces further omitted variable bias, as gender-related factors could influence whether one has a child, and the policy also mainly goes hand in hand with people who are employed.

These supplementary regressions will thus include;

Additional control variables; sex, age, education level, employment status, partnership status, and whether the individual has a big family (more than 3 children);

3. $BirthCount_{it} = \beta_0 + \beta_1 * Policy_{it} + \beta_2 * Immigrant_{it} + \beta_3 * Male_{it} + \beta_4 * Age(>35)_{it} + \beta_5 * Education_{it} + \beta_6 * Employed_{it} + \beta_7 * Partner_{it} + \beta_8 * BigFamily_{it} + \varepsilon_{it}$

Additional interaction terms; namely *policy* and immigration status, and *policy* and *age*;

4. $BirthCount_{\ it} = \beta_0 + \beta_1 * Policy_{it} + \beta_2 * Immigrant_{it} + \beta_3 * Male_{it} + \ \beta_4 * Age(> 35)_{it} + \beta_5 * Education_{it} + \beta_6 * Employed_{it} + \beta_7 * Partner_{it} + \beta_8 * BigFamily_{it} + \beta_9 * Policy * Immigrant_{it} \ + \beta_{10} * Policy * Age(> 35)_{it} + \ \varepsilon_{it}$

And lastly, the additional Fixed Effects concerning birth country – as shown by the term α_{it}. To perform this regression, I combined the household and personal id's to create unique individual id numbers;

5. $BirthCount_{\ it} = \beta_0 + \beta_1 * Policy_{it} + \beta_2 * Immigrant_{it} + \beta_3 * Male_{it} + \ \beta_4 * Age(> 35)_{it} + \beta_5 * Education_{it} + \beta_6 * Employed_{it} + \beta_7 * Partner_{it} + \beta_8 * BigFamily_{it} + \beta_9 * Policy * Immigrant_{it} \ + \beta_{10} * Policy * Age(> 35)_{it} + \alpha_{it} + \ \varepsilon_{it}$

In an attempt to further explain the fertility results, I will do a similar set of regressions regarding family benefit uptakes of parental leave allowances. This will allow the analysis of whether the policy was correlated to any changes in benefit uptake, which could provide explanations to observed results.

I will again start with a regression of solely *policy* on benefit uptake;

6. $Benefits_{\ it} = \ \beta_0 + \beta_1 * Policy_{it} + \ \ \varepsilon_{it}$

Additionally I will include the control variables; immigrant status, sex, partnership, employment, and age group – looking at the correlations concerning young parents (ages 16-25), more common ages for parenthood (ages 26-35), and those above the average age of fertility (ages 36-49);

7. $Benefits_{\ it} = \beta_0 + \beta_1 * Policy_{it} + \beta_2 * Immigrant_{it} + \beta_3 * Male_{it} + \ \beta_4 * Partner_{it} + \beta_5 * Employed + \beta_6 * Education_{it} + \beta_7 * AgeGroup_{it} + \varepsilon_{it}$

Then, interaction effects between *policy* and sex, as well as *policy* and *immigrant* will be included;

8. $Benefits_{\ it} = \beta_0 + \beta_1 * Policy_{it} + \beta_2 * Immigrant_{it} + \beta_3 * Male_{it} + \ \beta_4 * Partner_{it} + \beta_5 * Employed + \beta_6 * Education_{it} + \beta_7 * AgeGroup_{it} + \beta_8 * Policy * Immigrant_{it} \ + \beta_9 * Policy * Male_{it} + \ \varepsilon_{it}$

The final regression will additionally include the birth country Fixed Effects;

9. $Benefits_{\ it} = \beta_0 + \beta_1 * Policy_{it} + \beta_2 * Immigrant_{it} + \beta_3 * Male_{it} + \ \beta_4 * Partner_{it} + \beta_5 * Employed + \beta_6 * Education_{it} + \beta_7 * AgeGroup_{it} + \beta_8 * Policy * Immigrant_{it} \ + \beta_9 * Policy * Male_{it} + \alpha_{it} + \ \varepsilon_{it}$

5. Results

5.1. Difference-in-Differences Results

Table 5.1.1 presents the DiD regression results based on macro-data from Luxembourg and Belgium. The observed negative coefficient (-0.004) of the interaction term *Policy_lux* suggests a minor decrease in fertility rates due to the 2016 policy change, but this effect is statistically insignificant at the 95% confidence interval. There is thus insufficient evidence to conclude that the policy significantly impacted fertility rates. The 0.196 standard error indicates a considerable amount of uncertainty in the estimated effect, with potential for variations of up to 0.196 units when using different samples or datasets.

Table 5.1.1. Difference-in-Differences Fertility rates based on Macro-data

	TFR
Luxembourg	-0.24***
	(0.013)
Year	
2012	0.2
	(0.029)
2013	-0.01
	(0.033)
2014	-0.045
	(0.009)
2015	-0.080**
	(0.029)
2016	-0.118***
	(0.033)
2017	-0.143***
	(0.031)
2018	-0.163***
	(0.030)
2019	-0.193***
	(0.031)
2020	-0.208***
	(0.042)
Policy_lux	-0.004
	(0.196)
Constant	1.785***
	(0.029)
Observations	20

Notes: Table 5.1.1 presents the macro-level Difference-in-Differences results. The policy_lux *variable (coefficient β) estimates the ATT. Standard errors are presented in parentheses. Significance levels: *p-value<0.1, **p-value<0.05, ***p-value<0.01.*

5.2. Multiple Regression Results

The different regressions in Table 5.2.1 all show – in varying magnitudes – a weak negative correlation between the policy and birth count. This seems in line with the DiD findings suggesting an (insignificant) negative causal relationship between the policy and fertility rates. The pooled model (4) suggests that post 2016, there is a 0.016 decrease in units of *BirthCount*. The -0.003 coefficient of the FE model (5) suggests this correlation is insignificant. Immigration status further seems to have a positive correlation with birth count (fluctuating around 0.012 units), while the additional effect of the interaction between the policy and immigration status seems to be – though very slight and insignificant – negative. It seems that individuals of the elder age group significantly show less probability of having a newborn, but the Pooled OLS regression (4) shows a positive additional association of 0.014 between age group and birth count when the policy takes place. All the other variables in the regressions – besides *Male*, which shows a slight significant negative correlation to *BirthCount* – seem, in line with earlier findings, to be significantly positively correlated to the birth count. Interestingly in both the Pooled and FE regressions – but with a much larger difference between the two in the FE regression – high education levels seem to be more positively correlated to birth count than medium levels. In past research there have been many different results concerning such effects, calling for further deliberation in Chapter 6.

Table 5.2.1 Pooled and Fixed Effects OLS Regressions on Birth Count; Micro-data 2011-2019

BirthCount	(1)Pooled	(2)Pooled	(3)Pooled	(4)Pooled	(5)FE
Policy	-0.005***		-0.006***	-0.016***	-0.003
	(0.002)		(0.001)	(0.004)	(0.003)
Immigrant		0.019***	0.012***	0.012***	0.010***
		(0.001)	(0.002)	(0.002)	(0.003)
Male			-0.004***	-0.004***	-0.006***
			(0.001)	(0.001)	(0.001)
Age(>=35)			-0.053***	-0.059***	-0.078***
			(0.002)	(0.003)	(0.002)
Education					
Medium			0.007***	0.007***	0.005***
			(0.002)	(0.002)	(0.002)
High			0.016***	0.016***	0.018***
			(0.002)	(0.002)	(0.002)
Employed			0.011***	0.011***	0.009***
			(0.001)	(0.001)	(0.001)
Partner			0.048***	0.048***	0.047***
			(0.002)	(0.002)	(0.002)
Big Family			0.028***	0.028***	0.029***
			(0.009)	(0.009)	(0.005)

Policy*Immigrant					
Immigrant				-0.000	-0.004
				(0.003)	(0.003)
Policy*Age(>=35)					
Age(>=35)				0.014***	0.001
				(0.004)	(0.003)
CtryBirth FE					Yes
Constant	0.027***	0.014***	0.017***	0.022***	0.036***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Observations	75,378	75,378	75,378	75,378	75,378

*Notes: Various model alterations of the BirthCount regression are depicted in the columns. Independent variables and their corresponding coefficients in the rows. All independent variables are binary variables, except for the categorical variable Education. Standard errors presented in parentheses. Significance levels: *p-value<0.1, **p-value<0.05, ***p-value<0.01.*

Table 5.2.2 concerns correlations of the variables regarding benefit uptake. The policy seems positively correlated with the uptake – though as the regressions grow more robust and include the interaction terms, this correlation becomes slightly smaller at 0.004 and 0.003, and less significant. In all regressions, *Immigrant* seems to have a small, negative association with *Benefits*. However, when *Policy* interacts with immigration status, there is a small significant increase in the probability of benefit uptake, of 0.007 in model 8, and 0.009 in model 9. The youngest and oldest age groups portray the least probability of taking up benefits, while the middle group shows the strongest positive and significant correlation to *BirthCount*, averaging in all models at 0.051. Males take up less benefits than their counterparts, and seem to also be – though only somewhat significantly – associated with slightly less additional probabilities of taking up benefits after the policy implementation. Partnership and employment status both exhibit significant positive correlations with benefit uptake.

Table 5.2.2 Pooled OLS Regressions on Benefits; Micro-data 2011-2019

Benefits	(6)Pooled OLS	(7)Pooled OLS	(8)Pooled OLS	(9)FE
Policy	0.006***	0.006***	0.004*	0.003*
	(0.001)	(0.001)	(0.002)	(0.002)
Immigrant		-0.003***	-0.005***	-0.006**
		(0.001)	(0.001)	(0.003)
Male		-0.014***	-0.014***	-0.015***
		(0.001)	(0.001)	(0.001)
Partner		0.023***	0.021***	0.023***
		(0.001)	(0.001)	(0.001)
Employed		0.008***	0.007***	0.007***
		(0.001)	(0.001)	(0.001)
AgeGroup				
Young(16-25)		0.019***	0.017***	0.031***
		(0.001)	(0.001)	(0.002)

Middle(26-35)		0.050***	0.045***	0.058***
		(0.003)	0.003	(0.002)
Older(36-49)		0.015***	0.013***	0.018***
		(0.001)	(0.001)	(0.001)
Policy#Immigrant				
Immigrant			0.007***	0.009***
			(0.002)	(0002)
Policy#Male				
Male			-0.005**	-0.003*
			(0.002)	(0.003)
CtryBirth FE				Yes
Constant	0.011***	-0.014***	-0.010***	-0.014***
	(0.001)	(0.001)	(0.001)	(0.002)
Observations	75,378	75,378	75,378	75,378

*Notes: Various model alterations of the Benefits regression are depicted in the columns. Independent variables and their corresponding coefficients in the rows. All independent variables are binary variables, except for the categorical variable AgeGroup. Standard errors presented in parentheses. Significance levels: *p-value<0.1, **p-value<0.05, ***p-value<0.01.*

6. Discussion

As discussed in Chapter 2, policy effects vary drastically based on specific societal circumstances. Therefore when implementing a new policy, governments attempt to make it as tailor-made as possible to the goal they want to achieve. Though parental leave policies have been used in an attempt to raise fertility intentions, the main goal of this policy was to raise parental, and more specifically, father-leave uptake. Consequently, it is not surprising that potential effects on fertility from this policy are quite marginal. Much of previously conducted research has found positive causal effects relating to policy improvements. However, the macro-level result of the DiD regression in Table 5.1.1 shows the policy had an insignificant negative effect on total fertility rates in Luxembourg. Again, these effects, relative to the scale reflected by TFR, are marginal, as the observed ATT is 0.004.

Several factors may have contributed to the observed statistical insignificance. Notably, the relatively short observation window combined with the potential of a delayed impact of the policy implementation could explain these results. It is worth pointing out that short-term statistically insignificant findings do not necessarily rule out the possibility of finding more substantial longer-term impacts. To obtain more exhaustive results, it is essential to consider the broader implications of the policy. Moreover, the complexity of policy implementations deserves attention. Potential anticipatory behaviour could have been triggered in expectation of the forthcoming changes due to the announcement effect from the policy change being disclosed in 2014. Such pre-policy reactions could jeopardise the parallel trends assumption between the treatment and control group. This will be explored further in Chapter 7. In spite of the statistically insignificant findings, there are still valuable insights for policymakers. The direction of the negative effect implies that the policy might have exerted some (limited) influence, albeit one that was not robust enough to reach conventional levels of statistical significance. This absence of the policy's significant effects opens the door for critical discussions regarding objectives, expected outcomes and whether the particular intended goals were achieved. These results are a starting point for the analysis of further multiple regressions, allowing for a more comprehensive evaluation of the policy's multifaceted effects.

In my estimation, this differently found result could be due to the fact that although the leave policy introduced changes, it might not have been tailored enough towards raising fertility rates. The main target was to boost the male leave uptake. Although such an uptake could have positive effects on fertility by lowering the mother's opportunity costs as the father gets more involved (Goldscheider et al., 2015), this may not have had a very significant effect in the explored setting. Numerous studies have demonstrated that parental leave, which is not tied specifically to paternal leave, is predominantly utilised by mothers (Moss & Deven, 2015). On the one hand, the lack of considerable effects could thus be explained by the notion that increasing fertility rates was not a goal of this policy. An indirect effect of increasing male leave uptake, however, has been found to correspond with increasing fertility rates. It could thus also be possible that the policy may simply not have led to the desired results, due to various overlooked factors. Given the intricate interconnections within the economy, intended results are seldom the sole produced consequence. Historical precedents highlight how policies can often miss their mark, or even lead to adverse outcomes as policies undergo changes that frequently spawn unintended, negative consequences (Kim, 2022). Potential factors contributing to policy ineffectiveness are endless. Examining such plausible explanations of the observed counterintuitive results are precisely why this paper further included multivariate regressions.

It seems that in all regressions, *Policy* is negatively correlated to *BirthCount*. In the robustness check done by including birth country FE (model 5), the resulting coefficient becomes very similar to the DiD coefficient, in that its magnitude declines and it loses its significance. While the weakening of the policy variable could mean that the initial relationship between *Policy* and *BirthCount* was confounded by certain unobserved birthplace-specific factors, these results should be interpreted with caution. The FE model is likely still subject to omitted variable bias and other unobserved individual-specific effects. The birth country fixed-effects namely do not adequately control for all time-invariant factors which may be correlated to the policy implementation (see Chapter 7). Due to *Policy*'s insignificance in both the DiD as well as the FE model, a conclusion is not able to be drawn about this negative direction. The significance shown by the Pooled OLS models suggests some negative correlation between the variables, but this could be because OVB predominantly present itself in Pooled regressions. The true effect thus, remains uncertain, and should be further researched. When adding an interaction term to the Pooled OLS model (4) however, the magnitude of the policy coefficient increases. This may reveal that the policy effect is more pronounced when the additional interaction conditions are met.

Regression 2 further demonstrates that immigration status is significantly positively correlated with a 0.019 unit increase in the likelihood of having an newborn (*BirthCount*), however, this is partly explained by other variables, seen in regressions 3 through 5. The added variables likely explain some of the variance in *BirthCount* that was initially attributed to immigrant status, as they seem partly correlated to both the dependent an independent variables. With this addition, immigration status correlations is consistent across the different model specifications, even when the interaction terms are included. In the Pooled OLS model (4), there seems to be no additional change in the probability of *BirthCount* when immigration status interacts with *Policy*. We do see that when *Policy* interacts with *Immigrant* in the FE model (5), this additional association change, although still insignificant lowers to -0.004. Though these insignificant and modest results are somewhat disappointing – as one main focus area in this paper is how the policy affected immigrants differently compared to Luxembourg-natives, in the case of model (4) it is not entirely surprising. Solely looking at immigration status does not give us a full picture of the matter. More than half of the foreigners residing in Luxembourg come from, if not neighbouring, then other EU countries (STATEC, 2023). Indubitably, there are a vast amount of cultural differences between countries in the EU, and these diverge even more when looking at cultures further away from home. Findings about whether foreign-or native-born women have more children vary based on origin groups (Wilson, 2019). Similarly, the underlying factors between these differences could potentially influence their reactions towards policy changes. Certain attitudes, values and behaviours are transmitted intergenerationally, and this could potentially influence how different origin-groups react differently to such amendments.

Though the birthplace-FE has precisely controlled for time-invariant characteristics relating to the individual's origin groups – helping to account for related unobserved heterogeneity –, there are still a plethora of other characteristics that could vary between individuals from the same countries. An ideal analysis would take into account these different characteristics and thus include both individual, and country of birth FE, in the hopes that this approach could yield more valuable insights in contrast to the insignificant results found regarding the immigrant interaction term in model 5.

It seems that in all models, though ever so slightly, changes in *BirthCount* are further positively significantly explained by employment status (ranging between 0.009-0.011) and negatively significantly by *Male* (with values -0.004--0.006). The same is true for partnership status and having a big family, though these variables consistently show even larger correlations with changes in *BirthCount* (respectively ~0.048, and ~0.028). These findings align with rationality and prior research, and thus do not invoke extensive further discussion within the scope of this paper. Interestingly, education, which in prior studies has seen to have portrayed mixed and insignificant results, was significant in each of this paper's models. In line with Oppenheimer (1994), more highly educated persons seem to be correlated to having slightly higher birth counts. This may be connected to his proposed hypothesis that more highly educated individuals are likely to form partnerships with each other, enabling them to combine their economic resources, resulting in increased financial flexibility for childrearing.

Being older than 35 has the strongest significant correlation with *BirthCount*, showing in models (3), (4), and (5), coefficients of respectively -0.053, -0.059, and -0.078. In general, these negative coefficients align with the common pattern of declining intentions to have children as individuals age beyond their thirties. The vast jump between the Pooled models and the FE model could be explained by that individuals from different origins might typically show different fertility trends relating to age; certain groups could be inclined to have children later in life compared to others due to cultural differences. These changes are exactly what the FE model controls for. Accordingly, the interaction between *Policy* and this age range shows logical results. The less negative correlation between *Age>35* and *BirthCount* seen in model 4 compared to model 5, goes accompanied with a higher and significant correlation (0.014) regarding the interaction term of *Policy* and *Age>35*, compared to the insignificant lower correlation (0.001) seen in model 5. If one model indicates that the individuals studied tend to have fewer children as they surpass age 35, it is reasonable that the policy change would also affect this group to a lesser extent compared to the model which found a higher coefficient for the age variable.

All in all, both tables 5.1.1, as well as 5.2.1 exhibit signs that fertility in absolute terms might have lowered after the policy implementation. Claiming any causal effects is difficult due to the insignificance of the DiD regression. Having said that, it is not too surprising that major changes in fertility rates were not found, as the policy was not specifically aimed at increasing fertility rates. The found outputs are still able to provide us with some valuable insights. It seems that introducing a monetary incentive – one of the dominant amendments of the policy – did not, based on findings from these regressions, substantially influence fertility rates in a positive manner.

As proposed earlier on though, the target of raising paternal leave uptake could have indirectly influenced fertility rate levels. Looking at the *Benefits* regressions could help induce whether the insignificant effect on fertility rates stems from a failure of the policy to achieve its goal of higher paternal leave uptake, and whether it is even correlated with higher leave uptake in general. Though looking at parental leave uptake is not possible, the results regarding benefit uptake should provide a similar estimate, as the two seem to go hand in hand.

Looking at Table 5.2.2, the policy only seems slightly correlated with benefit uptake. Model 7 shows a high significance level for the 0.006 coefficient, but when including the interaction terms, the significance level and magnitude of this coefficient decreases. Both the Pooled model (8), and the FE model (9) show similar values and significance levels. Whether this slight uptake in benefits is causally related to the policy, cannot be answered with these regressions. Any number of outside factors could have introduced more of an incentive for individuals to take up parental benefits. However, even if it were possible to conclude that as a result of the policy implementation, the benefit uptake did not substantially increase, this does not inadvertently mean the amendment was bad and did not reach its intended goals. Part of the change included the longer possibility of taking up parental leave and extra accommodations. It does thus not mean that individuals will necessarily immediately make use of these accommodations. Potentially, the policy effects on benefit uptake would only properly be able to be assessed over a longer time frame. Another possible explanation of the low increases in uptake could be regarding other childcare options. If there are a lot of alternatives to childcare available in Luxembourg, a change in parental accommodation options might not provide much of a visible effect.

When the policy is not considered, each regression regarding benefit uptake shows a significantly negative correlation between men and *Benefits*. It appears men are less likely to avail of parental benefits compared to women. Interesting reasons to consider for this could be average household dynamics, whether there is a higher prevalence of women in caregiving roles, and that gender wage gaps might allow men to feel less of a financial need to take up benefits. It further seems the policy is correlated with less of an uptake for men compared to women; meaning the policy might not have increased male benefit uptake as much as it did so for females. So although the policy might have been correlated with a higher overall benefit uptake, results suggest that a bigger part of this increase can be explained by the female part of the population. Now, as we do not know exactly what the relationship between male and female uptake was before the policy, it is not possible to draw causal conclusions that the goal of increasing male benefit uptake was not achieved. Without knowledge of the baseline or pre-policy gender differences in benefit uptake, we cannot definitively conclude that the policy failed to increase male benefit uptake. The policy may have narrowed the gender gap, even if males still lag behind females in uptake.

The additional control variables partnership and employment status both seem standardly positively correlated to benefit uptake. This seems straightforward as those with a partner are more inclined to have children for whom they could take up benefits, and benefits are often associated with employment status. In similar vein, it is natural that the group aged 26 to 35 is most highly correlated with taking up benefits, as these are the most common fertility ages. Interestingly the correlation of the younger group becomes more prominent when looking at the FE model (9). Birth countries might thus by themselves have a significant influence on the dependent variable, as the younger age effect becomes more prominent when accounting for these country-specific differences.

Finally, immigration status seems to in itself be significant and negatively correlated with benefit uptake in all models, though increasingly negative, as the robustness intensifies. Immigrants are less likely to take up parental leave compared to Luxembourg natives. What I found extremely interesting from these results however is that the interaction term *Policy*Immigrant* seems in both the Pooled as well as the FE model, to be significantly positive. This would suggest that following 2016, immigrants started taking up more family benefits compared to nationals. Of course this could be attributed to something other than the policy, but the huge variety of immigrants in Luxembourg – of which many are from societally similar countries to Luxembourg – make it difficult to come up with a reasoning that could have affected them so differently to Luxembourg nationals.

7. Limitations

While this study offers certain valuable insights, it is important to acknowledge its inherent limitations, as is often the case with research of this nature.

While computing this variable using the available microdata, I encountered challenges in aligning the calculated rates with the official fertility rates provided for Luxembourg and Belgium. Belgium's fertility rates derived from the microdata consistently appeared substantially lower than those reported in all other empirical macro-data sources. As a result, I chose not to include them in this paper, as the unconventional results would not contribute any additional valuable insights due to data concerns regarding the Belgian micro-dataset. The Luxembourg fertility rates derived from micro-data exhibited better alignment with official statistics. As the macro-rates, sourced from the WDI were based on TFR calculations, whilst the micro-fertility calculations were based on GFR methodology, it is natural that the micro-levels appear as only a fraction of the macro-levels. However, the computed micro-fertility rates displayed notable fluctuations. Potential reasons for such disparities include that the variables used to calculate General Fertility Rates were derived from survey responses rather than concrete empirical data, introducing an inherent source of variation. These surveys exhibited an average non-response rate of approximately 48%. Consequently, the approximation of fertility rates is reliant on the subset of individuals who participated in the survey, responded to questions regarding the age of their youngest child, and did not make any human errors while doing so. These limitations hold not only for the calculation of the fertility variable, but for all other micro-variables used in this analysis. Though personal level weights were implemented to account for the large non-response rate, it is not possible to mitigate all the errors that may occur from incomplete or inaccurate survey responses.

It is further imperative to take into account the potential influence of the announcement effect, which could have skewed analysis outcomes. The policy change was first announced in 2014, meaning that certain people might have proactively started adapting their behaviour in anticipation of this impending change. Numerous studies have investigated the relationship between news announcements or expectations of future events, and individual responses – specifically regarding effects relating to labour market frictions, business cycles, and stock prices (Blundell et al, 2011, Beaudry & Portier, 2006; Jaimovich & Rebelo, 2009). The driver behind these effects is that people are often considered as forward looking agents. When they know – or expect – a change will be implemented, they may already start adapting their behaviour proactively, even if it might not always beneficial to do so. A more recent illustration of this phenomenon is found in a study by Andersson et al. (2021), which revealed that the anticipation effect of Covid-19 vaccines led to a reduced willingness to adhere to social distancing measures. While relatively fewer studies have explored such effects relating to policy announcements and fertility rates, the recurring nature of the announcement effect across various areas suggests its potential relevance in this context. It is thus plausible to consider the possibility that the announcement effect may have played a role in influencing the observed fertility rates past 2014.

Further, considering the temporal constraints of the analysis; the relatively short observation period after the reform has implications for both the tempo and quantum effects of the analysed relationship. In a short observation period, there is not enough time to accurately measure changes that occur over a more extended period. Certain processes, such as the progression from fertility intentions to conception and, ultimately, to live births, inherently unfold in a gradual manner. This temporal constraint becomes even more prominent if we consider that fertility rates might be influenced via potential resulting paternal leave uptake – as this would take even longer to manifest. Consequently, the constrained observation period may fail to adequately capture the true tempo or pace of these changes. The quantum effect comes into play, emphasizing the potential influence of statistical fluctuations on observations. The brevity of the observation period makes it challenging to distinguish between mere statistical fluctuations, or substantive, genuine effects.

Moreover, Neyer and Andersson (2008) discussed in their paper the limitation that certain effects might be different in situations where policy development lags behind broader social change compared to situations where policies are at the forefront of societal development. The timing and sequence of implementation of different elements of family policy can limit its generalisability or applicability of this study's findings across different historical contexts. There seems to be no universal effect of family policies. Even when fertility-elevating effects of such policies are found, it is not possible to de-contextualise these results, as they are bound by time and space, and are dependent on uptake. They argued that the effects can only be properly assessed when individual behaviour's are studied. Looking at microdata should allow one to zoom in on these relationships. It would therefore have been very interesting to – besides benefit uptake – additionally look at the effects on parental leave uptake, especially since this is what the policy was aimed towards. However, the vast amount of missing observations for this variable led to the exclusion of this analysis.

While the Difference-in-Differences analysis is a widely-adopted method, it does not come without its vulnerabilities. The parallel trends test seeks to substantiate the requisite assumptions, but in practice, an array of variables must be considered, and the assumptions need not necessarily hold. Although attempts were made to control for other major changes occurring during the years under examination, the potential for unforeseen external influences on fertility rates cannot be entirely discounted, and these may have pushed fertility rates more toward a specific direction. DiD would further be more convincing if the treatment and control groups had more similar levels to begin with, and did not predominantly only display similarities in trends. Though the regression attempts to account for inherent differences, a fundamental question arises regarding the initial divergence in fertility rate levels between Luxembourg and Belgium. It is essential to consider the possibility that historical events, to which these two nations responded differently, may have contributed to this variety in levels. Critical is to reflect on whether such a mechanism might have enduring implications for fertility rate trends at future time points, and could thus cloud the actual effects.

Not being able to distinguish effects stemming from external influences further diminishes the understanding and thus also generalisability of the findings. A potential way to make the parallel trends assumption test more plausible could be to include more years leading up to the policy, which would allow for additional leads to be implemented as the statistical power to detect whether the assumption is satisfied would not drop as drastically.

Moreover, it is important to acknowledge that the counterfactual selection (Belgium) was influenced by data availability, and not entirely randomized. A randomly chosen counterfactual group enhances the likelihood that observed differences in outcomes between the treatment and control groups are directly linked to the treatment rather than to systematic biases, thus fortifying the causal inference that the treatment is responsible for the observed effects.

In order to enhance the analytical depth and robustness, an improved study would ideally encompass a broader spectrum of countries, facilitating meaningful cross-country comparisons. This approach would enable researchers to disentangle the intricate web of influences, dissecting the convoluted relationships between various factors and their corresponding effects. A synthetic control method, rather than a DiD analysis could have potentially led to more powerful results. Furthermore, to attain a more comprehensive understanding of the intricate interplay between policies and their repercussions, the analysis should ideally encompass a more diverse array of policies, each with its distinct elements. This multifaceted approach allows for a nuanced evaluation of the different impacts of various policy components, enabling a more accurate determination of causal relationships and their respective effects. Broadening the scope of the study in this way, would allow researchers to better elucidate the intricate dynamics which underlie fertility rates.

Finally, I must discuss the limitations regarding the association analyses performed in section 4.2. A main limitation of the Fixed Effects model is that results drawn cannot without question be considered causal, as many factors could influence the results and lead to endogeneity issues. Due to this reason, I included it mainly as an explanatory factor for associations and as a check against the other regressions performed in the paper, rather than a causal analysis in itself. As previously stated, the zero conditional mean assumption likely does not hold, and Fixed Effects regression drawbacks become more pronounced when the foundational assumptions are not satisfied. The error term having a conditional mean of zero could be accounted for if all time varying omitted variables were controlled for, but despite a multitude of control variables being included in the regression, the possibility of other omitted variables like social attitudes, or other policy implementations are not included in the model.

Furthermore, the nature of the dataset did not provide the possibility to control for individual Fixed Effects, which would have been ideal in analysing the distinct personal ramifications of the policy. These particular individual effects are precisely why using micro-data is such an interesting measure of policy effectiveness on fertility rates. Including birth country Fixed Effects provided the possibility to slightly control for factors in that direction, but is by far not an impeccable substitute. Origin FE namely controls for specific characteristics relating to where individuals were born, but does not account for which precise individual we are looking at. Even individuals from the same areas might display some inherent differences. Birth Country FE would group certain individuals together which could serve as an approximation to keep account of individuals over the years, however there is not a complete consistency of individuals across all time periods, making this assumption highly flawed. Though some sources of unobserved heterogeneity will be controlled for, individual-specific effects will not be fully captured. It is therefore very likely that the results still contain a substantial amount of omitted variables, and an individual Fixed Effects regression would provide a better estimate of the true effect.

In contrast to the Fixed Effects models, the Pooled OLS regressions relax the standard errors, which introduces a vulnerability to bias. In this analysis though, the Fixed Effects results cannot provide completely robust outcomes due to the inability to control for individuals. The Pooled OLS regressions lack some accuracies and also do not allow for any causal conclusions to be drawn. In pooling the observations, the potential individual-specific or time-specific effects get ignored, which could lead to Omitted Variable Bias and a violation of the assumption of independence between the error terms for different observations. OVB occurs when important explanatory variables – which are correlated with the independent variables – are left out of the regression model. Ignoring individual- and time-specific effects means that any such effects omitted from the model can potentially bias the estimated coefficients and lead to incorrect inferences, resulting in potentially inaccurate and inconstant results. Any conclusions drawn from this analysis must be approached with caution and cross-validated with other methodologies to ensure robust and dependable result. Adding on to this, to enhance the reliability of the *Benefits* regressions, it would have been beneficial to incorporate controls for individuals who had children. It is namely evident that individuals without children typically would not avail themselves of family benefits. Including this variable could have helped account for some of the variance in the data.

8. Conclusion and Recommendations

This paper aimed to investigate how intricate individual characteristics can shape the impact of policies on fertility rates. Evaluating data from the WDI between 2011 and 2020, comparing Luxembourg and Belgium, as well as data from the LIS between 2011 and 2019, the analysis revealed weak and statistically insignificant results concerning the uptake of fertility rates in response to the 2016 parental leave law amendment aimed at increasing male participation in leave-taking in Luxembourg. The performed Difference-in-Differences analysis based on macro-data did not yield any statistically significant results, making it difficult to draw any conclusive causal effects associated with this policy. Pooled OLS and Fixed Effects analyses both suggested negative correlations between the policy implementation and birth counts, though these findings were modest, and the Fixed Effects results even statistically insignificant. Furthermore, immigration status appeared to have limited explanatory power in the models examining *BirthCount*. An additional analysis focusing on family benefit uptake indicated a potential but very marginal correlation between policy implementation and benefit uptake, which was again relatively statistically insignificant. While immigration status did not seem to portray any significant association with birth counts regarding the policy, it did display an interesting sign change in the *Benefits* regression. Where initially immigration status seemed significantly negatively correlated with family benefit uptake, the interaction effect between the policy and immigration status revealed a significant positive correlation with benefit uptake. Whether the policy reached its intended goal of increasing male leave uptake, was not able to be determined, though it seems that male uptake remains slightly, yet significantly lower than female uptake.

In conclusion, while the analysis yielded statistically insignificant results, it is essential to recognise the complex interplay of factors surrounding policy implementation and the potential for long-term impacts should not be overlooked. These insights contribute a deeper understanding of the nuanced dynamics at play, offering valuable knowledge for both academics and policymakers alike. As we move forward, there remain abundant opportunities for future researchers to explore the intricate individual-level characteristics within the broader societal context of the regions under investigation. This paper, aligned with its comprehensive literature review, hopefully serves as a foundational framework for future research endeavours. In a rapidly evolving world, it is imperative to grasp how individuals from diverse backgrounds respond to varying incentives. Analysing countries like Luxembourg, known for their rich cultural intricacies, can serve as a pivotal starting point for such investigations. Ultimately, this study not only underscores the importance of rigorous analysis in the realm of fertility policy, but also highlights the need for continued exploration in this field, helping to inform more effective policies and strategies in the ever-evolving landscape of demographic dynamics.

B Bibliography

Angrist, J. D., & Pischke, J. (2009). Mostly harmless Econometrics: an empiricist's companion. *Economics Books*. https://ideas.repec.org/b/pup/pbooks/8769.html

Andersson, O., Campos-Mercade, P., Meier, A. N., & Wengström, E. (2021). Anticipation of COVID-19 vaccines reduces willingness to socially distance. *Journal of Health Economics*, *80*, 102530. https://doi.org/10.1016/j.jhealeco.2021.102530

Ang, X. L. (2014). The Effects of Cash Transfer Fertility Incentives and Parental Leave Benefits on Fertility and Labor Supply: Evidence from Two Natural Experiments. *Journal of Family and Economic Issues*, *36*(2), 263–288. https://doi.org/10.1007/s10834-014-9394-3

Baizán, P., Arpino, B., & Delclòs, C. R. (2016). The Effect of Gender Policies on Fertility: The Moderating Role of Education and Normative Context. *European journal of population*, *32*(1), 1–30. https://doi.org/10.1007/s10680-015-9356-y

Balbo, N., Billari, F. C., & Mills, M. (2012). Fertility in Advanced Societies: A Review of research. *European Journal of Population*, *29*(1), 1–38. https://doi.org/10.1007/s10680-012-9277-y

Baum, C. L., & Ruhm, C. J. (2016). The Effects of Paid Family Leave in California on Labor Market Outcomes. *Journal of Policy Analysis and Management*, *35*(2), 333–356. https://doi.org/10.1002/pam.21894

Beaudry, P., & Portier, F. (2006). Stock prices, news, and economic fluctuations. *The American Economic Review*, *96*(4), 1293–1307. https://doi.org/10.1257/aer.96.4.1293

Becker, G. S., & Lewis, H. G. (1973). On the interaction between the quantity and quality of children. *Journal of Political Economy*, *81*(2, Part 2), S279–S288. https://doi.org/10.1086/260166

Becker, G. S. (1991). A treatise on the family. *Harvard University Press eBooks*. https://doi.org/10.4159/9780674020665

Bergsvik, J., Fauske, A., & Hart, R. K. (2021). Can policies stall the fertility fall? A Systematic Review of the (Quasi-) Experimental Literature. *Population and Development Review*, *47*(4), 913–964. https://doi.org/10.1111/padr.12431

Bloom, T., Mosher, W. D., Alhusen, J. L., Lantos, H., & Hughes, R. B. (2017). Fertility Desires and Intentions Among U.S. Women by Disability Status: Findings from the 2011–2013 National Survey of Family Growth. *Maternal and Child Health Journal*, *21*(8), 1606–1615. https://doi.org/10.1007/s10995-016-2250-3

Blundell, R., Francesconi, M., & Van Der Klaauw, W. (2011). Anatomy of Welfare Reform Evaluation: Announcement and Implementation Effects. *Social Science Research Network*. https://doi.org/10.2139/ssrn.1951341

Cerna, L. (2013). The Nature of Policy Change and Implementation: A Review of Different Theoretical Approaches. *Organisation for Economic Co-operation and Development (OECD)*. https://www.oecd.org/education/ceri/The%20Nature%20of%20Policy%20Change%20and%20Implementation.pdf

Chambre des Salariés, & Reding, J., Tremuth, N., Hoffman, S. (2019). *Parental Leave: Labour Law*. Chambre Des Salariés - CSL. https://www.csl.lu/app/uploads/2020/02/le-conge-parental-anglais.pdf

Davaki, K., & Department of Social Policy. (2016). Demography and Familiy Policies from a Gender Perspective: Study for the Femm Committee. *Directorate General for Internal Policies, Policy Department C: Citizen's Rights and Constitutional Affairs.* https://www.europarl.europa.eu/RegData/etudes/STUD/2016/571394/IPOL_STU(2016)571394_EN.pdf

Demeny, P. (2007). A clouded view of Europe's demographic future. *Vienna Yearbook of Population Research*, *2007*, 27–35. https://doi.org/10.1553/populationyearbook2007s27

Desiderio, R. (2020). The Impact of International Migration on Fertility: An Empirical Study. *Global Knowledge Partnership on Migration and Development*, *36*. https://www.knomad.org/sites/default/files/2020-01/Migration%20Fertility%20Paper%20%282019%20Update_World%20Bank%29_final_-converted.pdf

Dimick, J. B., & Ryan, A. M. (2014). Methods for evaluating changes in health care policy. *JAMA*, *312*(22), 2401. https://doi.org/10.1001/jama.2014.16153

Oshio, T. (2019). Is a positive association between female employment and fertility still spurious in developed countries? *Demographic Research*, *41*, 1277–1288. https://doi.org/10.4054/demres.2019.41.45

European Commission. (2021). The 2021 Ageing Report: Economic & Budgetary Projections for the EU Member States (2019-2070). *European Economy Institutional Paper 148.* https://economy-finance.ec.europa.eu/system/files/2021-10/ip148_en.pdf

European Commission. (2023). The Impact of Demographic Change in a changing environment. *Secretariat-General*. https://commission.europa.eu/system/files/2023-01/Demography_report_2022_0.pdf

European Commission. (2023). *Women's situation in the labour market*. European Commission. https://commission.europa.eu/strategy-and-policy/policies/justice-and-fundamental-rights/gender-equality/women-labour-market-work-life-balance/womens-situation-labour-market_en

European Parliamentary Research Service. (2022). *Maternity and paternity leave in the EU*. At a Glance - Infographic. https://www.europarl.europa.eu/RegData/etudes/ATAG/2022/698892/EPRS_ATA(2022)698892_EN.pdf

Eurostat. (2023). EU's population projected to drop by 6% by 2100. *Eurostat*. https://ec.europa.eu/eurostat/web/products-eurostat-news/w/DDN-20230330-1

Fernandez-Crehuet, J. M., Gimenez-Nadal, J. I., & Recio, L. E. R. (2016). The National Work–Life Balance Index©: The European Case. *Social Indicators Research*, *128*(1), 341–359. https://doi.org/10.1007/s11205-015-1034-2

Gauthier, A. H. (2007). The Impact of family policies on fertility in Industrialized Countries: A Review of the literature. *Population Research and Policy Review*, *26*(3), 323–346. https://doi.org/10.1007/s11113-007-9033-x

Goldscheider, F. K., Bernhardt, E., & Lappegård, T. (2015). The Gender Revolution: A Framework for Understanding Changing Family and Demographic Behavior. *Population and Development Review*, *41*(2), 207–239. https://doi.org/10.1111/j.1728-4457.2015.00045.x

Haas, L. (2003). Parental Leave and Gender Equality: Lessons from the European Union. *Review of Policy Research*, *20*(1), 89–114. https://doi.org/10.1111/1541-1338.d01-6

Jaimovich, N., & Rebelo, S. (2009). Can News about the Future Drive the Business Cycle? *The American Economic Review*, *99*(4), 1097–1118. https://doi.org/10.1257/aer.99.4.1097

Jones, L. E., Schoonbroodt, A., & Tertilt, M. (2008). *Fertility Theories: Can they explain the negative Fertility-Income relationship?* https://doi.org/10.3386/w14266

Kim, M. (2022, September 6). *Public policy and its unintended effects*. Lindau Nobel Laureate Meetings. https://www.lindau-nobel.org/blog-public-policy-and-its-unintended-effects/

Kravdal, Ø. (1992). The Emergence of a Positive Relation Between Education and Third Birth Rates in Norway with Supportive Evidence from the United States. *Population Studies-a Journal of Demography*, *46*(3), 459–475. https://doi.org/10.1080/0032472031000146456

Lee, R. D., & Mason, A. (2009). Fertility, Human Capital, and Economic Growth over the Demographic Transition. *European Journal of Population*, *26*(2), 159–182. https://doi.org/10.1007/s10680-009-9186-x

Lee, R., Mason, A., Amporfu, E., An, C., Bixby, L., Bravo, J., Bucheli, M., Chen, Q., Comelatto, P., Coy, D., d'Albis, H., Donehower, G., Dramani, L., Fürnkranz-Prskawetz, A., Gál, R., Holz, M., Hương, N., Kluge, F., Ladusingh, L., … Zhang, Q. (2014). Is Low Fertility Really a Problem? Population Aging, Dependency, and Consumption. *Science*, *346*(6206), 229-234. https://doi.org/10.1126/science.1250542

Legilux. (2016, 3 november). https://legilux.public.lu/eli/etat/leg/loi/2016/11/03/n1/jo

LIS Cross-National Data Center in Luxembourg. (n.d.). https://www.lisdatacenter.org/our-data/lis-database/

Matysiak, A., & Szalma, I. (2014). Effects of Parental Leave Policies on Second Birth Risks and Women's Employment Entry. *In Population*, *69*(4), 599–636. https://www.cairn-int.info/article-E_POPU_1404_0659--.htm

McCrary, J., & Royer, H. (2011). The Effect of Female Education on Fertility and Infant Health: Evidence from School Entry Policies Using Exact Date of Birth. *The American Economic Review*, *101*(1), 158–195. https://doi.org/10.1257/aer.101.1.158

McDonald, P. (2000). Gender Equity in Theories of Fertility Transition. *Population and Development Review*, *26*(3), 427–439. https://doi.org/10.1111/j.1728-4457.2000.00427.x

Mclean, S. (2014). We are family? governance and the prospects for instability in Europe. *European Journal of Futures Research*. https://doi.org/10.1007/s40309-014-0059-0

Mencarini, L. & Tanturri, M. (2006). High Fertility or Childlessness: Micro-Level Determinants of Reproductive Behaviour in Italy. *Population*, 61, 389-415. https://doi.org/10.3917/popu.604.0463

Mills, M., Mencarini, L., Tanturri, M. L., & Begall, K. (2008). Gender equity and fertility intentions in Italy and the Netherlands. *Demographic Research*, *18*, 1–26. https://doi.org/10.4054/demres.2008.18.1

Milner, A., Kavanagh, A., Scovelle, A. J., O'Neil, A., Kalb, G., Hewitt, B., & King, T. (2021). Gender Equality and Health in High-Income Countries: A Systematic Review of Within-Country Indicators of Gender Equality in Relation to Health Outcomes. *Women's health reports*, *2*(1), 113–123. https://doi.org/10.1089/whr.2020.0114

Moss, P., & Deven, F. (2015). Leave policies in challenging times: reviewing the decade 2004–2014. *Community, Work & Family*, *18*(2), 137–144. https://doi.org/10.1080/13668803.2015.1021094

Namatovu, F., Lundevaller, E. H., & Vikström, L. (2021). The relationship between disability and parental status: a register study of the 1968 to 1970 birth cohorts. *BMC Public Health*, *21*(1). https://doi.org/10.1186/s12889-021-10371-1

Neyer, G. (2003). Family Policies and Low Fertility in Western Europe. *Max Planck Institute for Demographic Research*, WP-2003-021. https://www.demogr.mpg.de/papers/working/wp-2003-021.pdf#search=%22family%20policies%20low%20fertility%20western%20europe%22

Neyer, G. (2005). Family policies in Western Europe. Fertility policies at the intersection of gender, employment and care policies. *Austrian Journal of Political Science*, *34*(1), 91–102. https://doi.org/10.15203/ozp.943.vol34iss1

Neyer, G., & Andersson, G. (2008). Consequences of family policies on childbearing behavior: effects or artifacts? *Population and Development Review*, *34*(4), 699–724. https://doi.org/10.1111/j.1728-4457.2008.00246.x

Omidakhsh, N., Sprague, A., & Heymann, J. (2020). Dismantling restrictive gender norms: Can better designed paternal leave policies help? *Analyses of Social Issues and Public Policy*, *20*(1), 382–396. https://doi.org/10.1111/asap.12205

Oppenheimer, V. K. (1994). Women's rising employment and the future of the family in industrial societies. *Population and Development Review*, *20*(2), 293. https://doi.org/10.2307/2137521

Patient Education Committee. (2012). Age and Fertility: A Guide for Patients. *The American Society for Reproductive Medicine*. https://www.reproductivefacts.org/globalassets/rf/news-and-publications/bookletsfact-sheets/english-fact-sheets-and-info-booklets/Age_and_Fertility.pdf

Philipov, D., Spéder, Z., & Billari, F. C. (2006). Soon, later, or ever? The impact of anomie and social capital on fertility intentions in Bulgaria (2002) and Hungary (2001). *Population Studies-a Journal of Demography*, *60*(3), 289–308. https://doi.org/10.1080/00324720600896080

Puur, A., Oláh, L. S., Tazi-Preve, M. I., & Dorbritz, J. (2008). Men's childbearing desires and views of the male role in Europe at the dawn of the 21st century. *Demographic Research*, *19*, 1883–1912. https://doi.org/10.4054/demres.2008.19.56

Rijken, A. J., & Liefbroer, A. C. (2008). The influence of partner relationship quality on fertility. *European Journal of Population*, *25*(1), 27–44. https://doi.org/10.1007/s10680-008-9156-8

Rønsen, M., & Sundström, M. (1999). Public policies and the employment dynamics among new mothers : a comparison of Finland, Norway and Sweden. *RePEc: Research Papers in Economics*. https://brage.bibsys.no/xmlui/handle/11250/180857

Skirbekk, V. (2008). Fertility trends by social status. *Demographic Research*, *18*, 145–180. https://doi.org/10.4054/demres.2008.18.5

Sleebos, J. (2003). Low fertility rates in OECD countries. *OECD labour market and social policy occasional papers*. https://doi.org/10.1787/568477207883

STATEC. (2023). *Nationalities*. Statistics Portal - Luxembourg. https://statistiques.public.lu/en/recensement/nationalites.html

Stropnik, N. (2008, 1 juli). *Slovenia: Generous family policy without evidence of any fertility impact*. Demographic Research. https://www.demographic-research.org/volumes/vol19/26/

Tamm, M. (2019). Fathers' parental leave-taking, childcare involvement and labor market participation. *Labour Economics*, *59*, 184–197. https://doi.org/10.1016/j.labeco.2019.04.007

Thomas, J., Rowe, F., Williamson, P., & Lin, E. K. (2022). The effect of leave policies on increasing fertility: a systematic review. *Humanities & social sciences communications*, *9*(1). https://doi.org/10.1057/s41599-022-01270-w

Thomson, E., Lappegård, T., Carlson, M. J., Evans, A., & Gray, E. (2014). Childbearing across partnerships in Australia, the United States, Norway, and Sweden. *Demography*, *51*(2), 485–508. https://doi.org/10.1007/s13524-013-0273-6

Trzcinski, E., & Camp, J. K. (2014). Family Policy in Germany. *Springer eBooks* (pp. 137–153). Springer Nature. https://doi.org/10.1007/978-1-4614-6771-7_10

Werner, H. & European Parliamentary Research Service. (2015). Gender Equality in Employment and Occupation: Directive 2006/54/EC. *European Implementation Assessment*. https://www.europarl.europa.eu/RegData/etudes/STUD/2015/547546/EPRS_STU(2015)547546_EN.pdf

Willis, R. J. (1973). A new approach to the economic theory of fertility behavior. *Journal of Political Economy*, *81*(2, Part 2), S14–S64. https://doi.org/10.1086/260152

Wilson, B. (2019). Understanding How Immigrant Fertility Differentials Vary over the Reproductive Life Course. *European Journal of Population*, *36*(3), 465–498. https://doi.org/10.1007/s10680-019-09536-x

World Development Index. (n.d.). World Bank Open Data. https://data.worldbank.org/

A Appendix

Figure A.1 Excerpt from 2016 SILC Questionnaire, section regarding parental leave benefits

1 - Net 2 – Gross

Q194 For how many months did you receive a benefit for an inability to work or benefit for illness ("prestation pour incapacité de travail ou maladie") in 2015? QPY120G03

|__|__|

-1 – Does not wish to answer

Q199 In 2015, did you receive a parental leave benefit? QHY050G18

1 – Yes

2 – No **=> Go to Q203**

-1 – Does not wish to answer **=> Go to Q203**

Q200 What was the last monthly amount in Euros of this parental leave benefit that you received in 2015? QHY050G19

|__|__|__|__|__|__|,|__|__| **=> Go to Q202**

-1 – Does not wish to answer

-4 – Does not know

Q201 In which of the intervals shown on this card does the last monthly amount in Euros of this parental leave benefit received in 2015 fall? Please answer by indicating the letter corresponding to the interval. QPIMPU_42

Note à l'enquêteur: Montrer la carte des intervalles de revenu.

|__| [A – X]

-1 – Does not wish to answer

Is this a gross or a net amount? QHY050G15

1 - Net 2 – Gross

Q202 For how many months did you receive a parental leave benefit in 2015? QHY050G20

|__|__|

-1 – Does not wish to answer

Q203 In 2015, did you receive a maternity allowance? QHY050G21

1 – Yes

2 – No **=> Go to Q207**

-1 – Does not wish to answer **=> Go to Q207**

Q204 What was the last monthly amount in Euros of this maternity allowance that you received in 2015? QHY050G22

|__|__|__|__|__|__|,|__|__| **=> Go to Q206**

-1 – Does not wish to answer

-4 – Does not know

Q205 In which of the intervals shown on this card does the last monthly amount in Euros of this maternity allowance received in 2015 fall? Please answer by indicating the letter corresponding to the interval. QPIMPU_43

Note à l'enquêteur: Montrer la carte des intervalles de revenu.

|__| [A – X]

-1 – Does not wish to answer

Q206 For how many months did you receive a maternity allowance in 2015? QHY050G23

|__|__|

-1 – Does not wish to answer

Q207 In 2015, did you receive an unemployment benefit? QPY090G01

1 – Yes

2 – No **=> Go to Q211**

-1 – Does not wish to answer **=> Go to Q211**

Q208 What was the last monthly amount in Euros of this unemployment benefit that you received in 2015? QPY090G02

|__|__|__|__|__|__|,|__|__| **=> Go to Q210**

-1 – Does not wish to answer

-4 – Does not know

Table A.1 Descriptive Statistics and Variable Explanations Macro-data

Variable		Obs	Mean	Std. Dev.	Min	Max
Year	Continuous variable indicating year	20	2015.5	2.947	2011	2020
TFR	Continuous variable for Total Fertility Rates	20	1.570	0.149	1.340	1.810
Country	Dummy variable indicating Belgium (0) or Luxembourg (1)	20	0.500	0.513	0	1
Policy_lux	Dummy variable for Art. L. 234-43 (year >= 2016 & Country == Lux)	20	0.25	0.444	0	1

Notes: Variables in Table A.1 have been sourced from the World Development Indicators Database.

Table A.2 Correlation Table Micro-variables

	Benefits	Male	Policy	AgeG~p	Age(35)	Partner	Empl~d	BigFa~y	Birthc~t	Immig~t	Educ~n	CtryB~h
Benefits	1.000											
Male	0.059	1.000										
Policy	0.030	0.006	1.000									
AgeGroup	0.103	0.014	-0.0257	1.000								
Age(>35)	-0.062	0.018	0.002	-0.118	1.000							
Partner	0.077	-0.022	0.021	0.070	0.438	1.000						
Employed	0.089	-0.078	0.011	0.467	0.008	0.174	1.000					
BigFamily	0.009	0.007	0.001	0.090	0.056	0.075	0.040	1.000				
Birthcou~t	0.213	0.003	-0.006	0.127	-0.100	0.107	0.085	0.030	1.000			
Immigra~t	0.016	0.013	0.010	0.180	0.060	0.130	0.143	0.063	0.057	1.000		
Education	0.075	-0.040	0.085	0.173	-0.008	0.096	0.243	-0.012	0.067	0.007	1.000	
CtryBirth	0.071	0.016	0.046	0.154	0.133	0.191	0.147	0.062	0.053	0.896	0.025	1.000