

**THE DYNAMICS OF FEMALE LABOUR FORCE  
PARTICIPATION: HOW FAMILY POLICY INFLUENCES  
WOMEN'S WORK BEHAVIOUR**

**By**

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## **Abstract**

Female labour force participation (FLFP) in the UK has stagnated in recent decades in spite of policies that have tried to increase the number of women in the labour force. This thesis uses system dynamics to investigate how various aspects of UK family policy operate and how inefficient policies keep the level of female labour participation from rising to the desired level. The system dynamics model developed to understand the dynamic behaviour of the system operationally indicates that there is a relationship between the labour supply of mothers and grandmothers due to the high costs of childcare in the UK. The outcome of the model suggests that the rising cost of childcare has too quickly outgrown the subsidies meant to stabilize the system in the past. This affects families with varying income levels and number of children differently. This thesis provides insight into family policy dynamics in the UK with a systems perspective that is lacking in the literature. In addition it also adds to system dynamics literature by providing an example of how system dynamics can be used to investigate issues related to gender and equality which is a research area where system dynamics has rarely been applied.

*Key words: System dynamics, social policy, family policy, female labour force participation, childcare, gender.*

## Table of Contents

|   |     |
|---|-----|
| Acknowledgments .....   | i   |
| Abstract .....  | ii  |
| Table of Contents .....   | iii |
| List of figures .....   | v   |
| List of tables .....  | vi  |
| 1. Introduction .....   | 1   |
| 1.1 Background .....  | 1   |
| 1.2 The Problem .....   | 2   |
| 1.3 Motivation .....  | 4   |
| 1.4 Research goals and questions .....                            | 5   |
| 2. Theoretical foundation and historical development .....        | 7   |
| 2.1 A note on gender .....  | 8   |
| 2.2 The problem of the ageing population .....                    | 10  |
| 2.3 The expectations of state and families .....                  | 11  |
| 2.4 Breadwinner theory .....                                      | 11  |
| 2.5 The double burden .....                                       | 12  |
| 2.6 History of female labour force participation in the UK .....  | 13  |
| 2.6.1 The post war years .....                                    | 13  |
| 2.6.2 Development from 1990 and onwards .....                     | 13  |
| 2.7 Social investment strategy .....                              | 14  |
| 2.8 The Nordic Model of Social Investment and Family Policy ..... | 15  |
| 2.8.1 Parental Leave .....  | 16  |
| 2.8.2 Childcare Arrangements .....                                | 19  |
| 3. Problem context .....  | 21  |
| 3.1 The current childcare situation in the UK .....               | 23  |
| 3.1.1 Formal childcare .....                                      | 24  |
| 3.1.2 Informal childcare .....                                    | 24  |
| 3.2 Governmental policies and its impact .....                    | 25  |
| 3.2.1 The impact on female labour force participation .....       | 28  |
| 3.2.2 The impact on women's pensions and female poverty .....     | 29  |
| 3.3 Literature gap .....  | 30  |
| 4. Methodology .....  | 31  |

|   |    |
|---|----|
| 4.1 The system dynamics approach .....                              | 31 |
| 5. The system dynamics model .....                                  | 33 |
| 5.1 Boundaries .....  | 33 |
| 5.2 The main feedback loops .....                                   | 35 |
| 5.3 The model structure .....                                       | 37 |
| 5.3.1 The array subscripts .....                                    | 38 |
| 5.3.2 The model split into parts.....                               | 39 |
| 5.3 Validation and model testing .....                              | 44 |
| <i>Dimensional consistency</i> .....                                | 44 |
| <i>Parameter assessment</i> .....                                   | 44 |
| <i>Structure assessment</i> .....                                   | 44 |
| <i>Extreme conditions</i> .....                                     | 44 |
| <i>Boundary adequacy</i> .....                                      | 45 |
| <i>Integration error</i> .....                                      | 45 |
| 6. Results .....  | 46 |
| 6.1 General model behaviour .....                                   | 46 |
| 6.1.1 The case of low income families.....                          | 47 |
| 6.1.2 Medium and high income families .....                         | 51 |
| 6.2 The impact of subsidies.....                                    | 56 |
| 6.3 A note on policy and future scenarios.....                      | 57 |
| 6.4 Limitations .....   | 60 |
| 7. Discussion .....   | 62 |
| 7.1 The effect of policy on female labour force participation ..... | 62 |
| Supply and demand in the childcare market .....                     | 63 |
| Revisiting the research questions and hypothesis .....              | 64 |
| How families are affected differently by policy .....               | 65 |
| 7.2 The mismatch in policy and desired outcomes .....               | 65 |
| 8. Conclusions and recommendations for further research .....       | 68 |
| Reflections and recommendations .....                               | 69 |
| Bibliography.....   | 70 |
| Appendix A - Stock and flow diagram of the full model.....          | 75 |
| Appendix B – Sources for model data and estimates.....              | 76 |
| Appendix C – Model Equations .....                                  | 77 |

## List of figures

|  |    |
|--|----|
| <i>Figure 1 - Female labour force participation rate UK, adapted from World Bank (2017a)</i> .....   | 2  |
| <i>Figure 2 – Simplified causal loop diagram</i> .....   | 36 |
| <i>Figure 3 – Stock and flow diagram of mothers work participation loop</i> .....  | 39 |
| <i>Figure 4 – Stock and flow diagram of grandmothers’ work participation loop</i> .....  | 41 |
| <i>Figure 5 – Stock and flow diagram of the connection between the mothers and grandmothers work participation loops through the effect of percentage of family income spent on childcare on grandmother’s childcare hours decisions</i> ..... | 43 |
| <i>Figure 6 – Average work participation mothers of low income families by age group and number of children</i> .....  | 47 |
| <i>Figure 7 – Percentage of family income spent on childcare in low income families</i> .....  | 48 |
| <i>Figure 8 – Weekly childcare costs in low income families</i> .....  | 49 |
| <i>Figure 9 – Actual childcare hours covered by grandmothers to children in low income families</i> .....  | 50 |
| <i>Figure 10 – Average work participation grandmothers to children in low income families</i> .....  | 50 |
| <i>Figure 11 – Percentage of family income spent on childcare in medium income families</i> .....  | 51 |
| <i>Figure 12 – Percentage of family income spent on childcare in high income families</i> .....  | 52 |
| <i>Figure 13– Average work participation mothers of medium income families by age group and number of children</i> .....   | 53 |
| <i>Figure 14 – Average work participation mothers of high income families by age group and number of children</i> .....  | 54 |
| <i>Figure 15 – Actual childcare hours covered by grandmothers to children in medium income families by age group and number of children</i> .....  | 55 |
| <i>Figure 16 – Average work participation grandmothers of medium income families by age group and number of children</i> .....   | 55 |
| <i>Figure 17– Average work participation grandmothers of high income families by age group and number of children</i> .....  | 56 |
| <i>Figure 18 – Average work participation mothers aged 26 to 35, families with largest response to policy</i> .....  | 57 |
| <i>Figure 19 – Development of average work participation mothers aged 26 to 35, families with largest response to policy, under scenario 1 conditions</i> .....  | 58 |
| <i>Figure 20 – Development of average work participation mothers aged 26 to 35, families with largest response to policy, under scenario 2 conditions</i> .....  | 59 |
| <i>Figure 21 – Development of average work participation mothers aged 26 to 35, families with largest response to policy, under scenario 3 conditions</i> .....  | 60 |

## List of tables

|  |    |
|--|----|
| <i>Table 1 - Leave length with income-related compensation in 2010 (weeks), adapted from Lammi-Taskula et al. (2012)</i> ..... | 17 |
| <i>Table 2 - Leave length with income-related compensation in 2010 (weeks), adapted from Lammi-Taskula et al. (2012)</i> ..... | 17 |
| <i>Table 3 - Percentage of income spent on childcare, Adapted from Lammi-Taskula et al. (2012)</i> .....                       | 19 |
| <i>Table 4 - Current childcare policy and initiatives active in the UK, adapted from Rutter (2016)</i> .....                   | 27 |

# **1. Introduction**

*“Investing in women is not only the right thing to do. It is the smart thing to do. I am deeply convinced that, in women, the world has at its disposal, the most significant and yet largely untapped potential for development and peace”*. Ban Ki Moon, UN Secretary General

## **1.1 Background**

Female labour force participation (FLFP) is a topic that is on the agenda on many levels both for nation states as well as organisations, for a variety of reasons. Some nations are obliged to create policy influencing the matter due to commitments to organisations such as the EU, the UN and the World Bank etc., and aim only at meeting these obligations; others have realised the potential for building capacity and harnessing the skills and talents of the population half that historically have been kept away from paid work. With this in mind countries design and implement policies to try and influence FLFP towards the desired level. However, both the range and extent of the chosen policies determines the effect it has on FLFP. The matter is also influenced by a variety of political, economical, social and cultural values that governments may consider to a large or small extent before deciding on policy. When taking a closer look at the policies chosen by different countries in Europe, it is noticeable that the policies of countries which aim only to fulfil EU requirements are by far less successful than those of countries which have taken the impact on gender and equality into consideration when designing their policies. Countries which aim for policy options that promote gender equality can be seen to acknowledge that each individual, man or woman, has a right to work (Lewis and Giullari, 2005). These countries recognise that in order to gain equality for their citizens, both men and women need to have the same right and opportunity to access paid work, and thus sees FLFP not only as a means for increasing the country’s labour force, but also as a right of the female population, regardless of women’s biological ability to birth children.

The United Kingdom has gradually, throughout the last century, made a shift from a male earner, female carer model of family, towards a dual earner/carer model. This shift has lead to increased political pressure for policy on work/family reconciliation that supports the current model of families. In the United Kingdom, FLFP have thus been a key concern on the political agenda for quite some time. As a long term member of the EU (before the vote to leave in 2016), the country has been obliged to comply with EU guidelines and suggestions for social policy that influences FLFP. Every government since new labour came into power



in 1997 have had work/family balance on the agenda, and a variety of policies and actions has been made with the aim of reconciling work and family in a way that makes paid work more accessible for women, especially in the area of childcare. Still, considering the statistics, very little progress has been made.

Thévenon (2013) identifies formal childcare for children under the age of three as the main driver for FLFP, which imply that childcare can be seen as the number one factor which singly has the potential to make great impact on a country's FLFP. Yet, many states who invest in childcare as a means to promote FLFP do not see the expected results.

**1.2 The Problem**

Female labour force participation has been on the agenda in UK politics for several decades, and many initiatives and policies has been implemented in order to create growth in the number of women who partake in paid work. As women without children have high participation rates and average hours worked (which are close to those of men) (Office for National Statistics, 2015) these policies and initiatives mainly target families and in particularly mothers (Emmerson et al., 2014). The low participation rate of women in their child rearing years brings down the total FLFP rate which has stagnated around 53-55 percent since 1990 (see Figure 1 below). Considering this stagnation in light of the variety of policies that has been implemented since 2000 it is striking that there is not more change in the numbers.

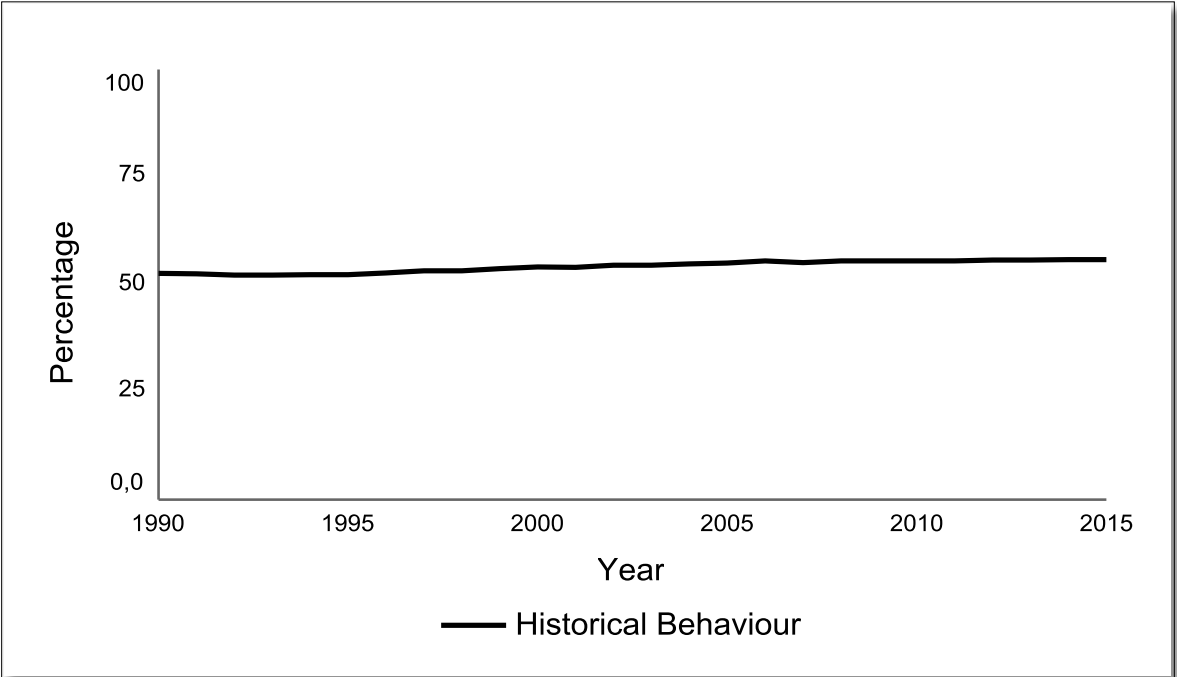


Figure 1 - Female labour force participation rate UK, adapted from World Bank (2017a)

Figure 1 will act as what is, in system dynamics, referred to as the reference mode. Although there is no dynamic behaviour present in figure 1, it is the lack of dynamic behaviour in the FLFP rate that is examined in this thesis; as the stagnating behaviour observed is a symptom of a failure in the dynamic social system that is under investigation. As it is widely recognised that a key factor for women's right and ability to access paid work is access to affordable, quality childcare; the UK has followed EU advice and focused strongly on childcare initiatives to support mother's access to paid work. Yet, in light of the lack of change in FLFP, it is reasonable to suggest that the effect of the implemented policies must be limited. Why is that? When examining data for participation rates originating from different sources, it is apparent that progress depends on how you measure it.

Some sources for government data, like the UK Office for National Statistics (ONS), report FLFP based on purely if women are *participating* or not, regardless of if the percentage worked is 2, 20 or 100 (European Commission, 2015). This measure gives similar participation rates for women and men and therefore implies that the goal of raising women's participation rates has been reached. However, reporting FLFP without adjusting for fulltime equivalent is a poor indicator of the actual differences in participation between the genders, as women are way more likely to work part time than men. This can mislead policy makers to believe that there is little difference between men and women's participation and thus no problem to address. When benchmarking FLFP data from the ONS against the male participation rate, the impression is given that there are nearly no difference in labour market participation between the genders in the UK; yet, when taking into account that 40 percent of women work part-time whilst only 2 percent of men work part-time (Office for National Statistics, 2015), it is clear that there are indeed differences between men and women's participation in the labour force that needs to be addressed by policy.

In light of the above, the obvious difference that can be extracted from the data is the number of hours men and women spend in paid work. This issue is at the core of this thesis. Women are spending fewer hours in paid work than men when they apparently are willing to participate at the same rate. Similar numbers of men and women are willing to participate in paid work; still women are not able to work similar hours to men, even after the excessive policy pieces implemented to address the issue in the last 15-20 years. The childcare policies are not working as intended, how are they insufficient?

### 1.3 Motivation

My motivation for researching issues related to how government policy influences gender equality and female labour force participation in the UK, has derived from an interest in gender research and UK politics. Despite the UK being a western democracy, there are large differences in gender representation in politics. Although the general election of 2015 saw the highest number of women ever elected into parliament at 29 percent, a jump from 22 percent from the election in 2010, women had never been above 10 percent representation in parliament until 1997 (Apostolova and Cracknell, 2016). The historical underrepresentation of women in UK politics could be one of the contributing factors to why the UK has lagged behind other western countries in terms of adopting social policy packages for the promotion of gender equality. Policies in areas such as childcare, parental leave etc., was non-existent until 1999, when New Labour came into power. Since then there has been major developments in spending on early childhood education and care (ECEC), but still a large proportion of mothers report that access to affordable, quality, childcare is a major barrier to work (Emmerson et al., 2014).

Research relating to the case for government intervention in childcare in the UK has been inconclusive to date regarding whether or not subsidising childcare has an effect on the labour supply of mothers (Emmerson et al., 2014). Still, evidence from other western European countries, like the Nordics, has proven that there is a close relationship between access to high quality, affordable, childcare and high female labour force participation (Lammi-Taskula et al., 2012). An extensive report commissioned by the Institute for Fiscal Studies (Emmerson et al., 2014) concluded that although subsidised childcare has a proven effect on child welfare, there is not enough evidence supporting its effectiveness in accelerating maternal labour supply in the UK; as the varying government policies implemented so far has not led to extensive results. The report points to how state subsidised childcare does indeed increase the uptake of formal childcare, but that this may in turn reduce the uptake of informal childcare instead of actually freeing time for mothers to participate in paid work. This argument does indeed make sense when looking at the statistics for use of informal and formal childcare that was presented in an annual report for the Family and Childcare Trust (Rutter, 2016). However, what this report does not consider is *who* actually provides the informal childcare.

The research commissioned by the Family and Childcare Trust (2016) suggests that the majority of informal childcare in the UK is provided by healthy grandmothers below retirement age. In light of this finding, it is reasonable to believe that there is a relationship

between female labour supplies at different stages of women's lives. This relationship has not been the focus of much research and few pieces of literature to date can be said to address the relationship between parental (maternal) labour supply and informal childcare provided by grandparents (grandmothers). As the UK currently has active policies both for increasing the labour supply of mothers, and for increasing the labour supply of older women (Gray, 2005), it is a surprise that the relationship between the two seem to have remained unnoticed.

When considering the above in context with measures of child poverty and how women after retirement age are more than twice as likely to live below the poverty line than men (Price, 2006), it can be proposed that the time women are spending working part-time or not at all due to childbearing and rearing, are causing a spiralling, negative, effect throughout many areas of society. Considering all of the above from a system dynamics perspective, by identifying the feedback loops responsible for the unfavourable behaviour, one may thus potentially provide important insights about the underlying causal mechanism.

#### **1.4 Research goals and questions**

The research goals of this thesis is to identify the largest factors influencing UK women's labour market decisions and thus female labour force participation, and to find out whether those factors are related to governmental policy (or lack of it). It is also a goal to assess why current policy is not giving the expected result. Lastly, an analysis of whether 'best practice' of social policy, inspired by the Nordic countries, will be made in order to determine if the UK would benefit from adopting similar social policies.

As a result of the shift in family model, international policy pressure, and a necessity to increase the total labour force, the UK has since 1997 gone from spending no money on childcare and early childhood education (CCECE) towards spending 0.9 percent of GDP in 2014 (Organisation for Economic Co-Operation and Development, 2016a). One of the most explicit goals of such policies is to make it easier for women to combine work and family responsibilities. An increase in the total labour force has positive impact on GDP and helps safeguard against issues related to the continuing aging population. Yet, despite the total expenditure for policies supporting work/family balance increasing from 0 to 1.5 percent of GDP (Organisation for Economic Co-Operation and Development, 2016a), the FLFP rate seem to have stagnated with only a small increase from 53 to 55 percent in the last 25 years (see figure 1). This gives rise to the question of why the current policies are not working as planned and leads us to the main hypothesis of this thesis: *How does policy influence FLFP?*

*H<sub>1</sub>: “Inefficient social policies for work/family balance are responsible for the stagnation in development of female labour force participation in the UK.”*

An alternative hypothesis was suggested following the confirmation of *H<sub>1</sub>*:

*H<sub>2</sub>: “A social investment policy package inspired by the Nordic countries can bring female labour force participation towards desired level.”*

This thesis will use system dynamics modeling to examine how the social policies implemented in the UK have not given the desired results. The social policy in the area of childcare will be the main focus as research implies that access to affordable childcare is a main driver for FLFP. In this thesis I will firstly go through the theoretical foundation needed to understand female labour force participation, mainly in relation to gender theory and social policy. I will then continue by providing an account for the historical development of female labour force participation in the United Kingdom in order to explain how the problem came about. Furthermore, I will clarify and define what is meant by social investment strategy and how it is related to gender equality and families. I will then follow on with a detailed explanation of the family policies found in the Nordic countries and how they are successfully. Next, I will continue with a description of the problem context in terms of female labour force participation, the current childcare situation, and policy influencing the two matters. From there I will give account for the method used and how and why it is a useful methodology for analysing such issues, before describing the system dynamics model and findings extracted from it. Finally, I will discuss the results in relation to the theoretical foundation before giving conclusions and recommendations for further research.

## **2. Theoretical foundation and historical development**

*“The beginning of the twenty-first century is a symbolic moment to give shape to the new social contract on gender, in which de facto equality of men and women in the public and private domains will be socially accepted as a condition for democracy, a prerequisite for citizenship and a guarantee of individual autonomy and freedom, and will be reflected in all European policies... Both men and women, without discrimination on the grounds of sex, have a right to reconcile family and working life”.* Resolution of the Council and Ministers for Employment and Social Policy, 2000.

Traditionally the problems related to work and family life has been firmly grounded and legitimized by the theoretical perspective of what has been called a ‘two spheres’ structure (Caracciolo Di Torella and Masselot, 2010). Implied in this structure is the division of public and private/domestic life into two separate spheres. Issues regarding employment belong in the public sphere, whilst issues such as care for the dependant and family organisation belong in the private sphere. Historically, men has dominated the public sphere and women the private. It is however, as argued by James (2003), a structure of division that has been socially and politically structured and thus can be altered accordingly.

The UK, as a classic liberal state, has been hesitant to intervene in the ‘private’ sphere. This comes as no surprise as what defines the social policy of a liberal regime is that state intervention is seen as subordinate to the market and the family (O’connor et al., 1999). Caracciolo Di Torella and Masselot (2010) argue that it is indeed the state’s responsibility to “reconcile and regulate the tensions that exist between the two spheres” because: “as the paid employment market (public sphere) depends intrinsically upon the contribution of women in the private sphere, it is important to understand the relationship between the two spheres and its impact on women, in particular women who become mothers”. The two sphere framework has been strongly challenged with the entry of masses of women into the labour market in the period after World War II, and as a consequence, women’s role is now both to participate as an earner as well as having the traditional responsibility of caring and the household. Correspondingly the concept of ‘reconciliation’ of work and family life (as adopted by the EU), was seen initially as a women’s issue. But as changes in employment, society and family (such as the ageing population, new family structures and loss of the ‘job for life’) has caused new challenges to arise, the issue of work/family reconciliation has gradually become an issue that matters to all people regardless of age, gender or position as carer, earner, or both

(Caracciolo Di Torella and Masselot, 2010). Indeed, the EU (European Commission, 2017) states that reconciliation is a basic condition for equality.

It is in light of the above that this thesis will adopt the definition of reconciliation offered by Caracciolo Di Torella and Masselot (2010) as a “dynamic set of policies and legal provisions which focus specifically on the tension inherent in juggling work commitments and family responsibilities”. The policies in focus in this thesis will be considered from a gender equality perspective. With an overall view that the case for such policies does not just relate to helping women balance their responsibilities (by facilitating part-time work etc.), but that they have a variety of wider repercussions throughout areas such as children’s development and reduction of child poverty, as well as limiting the gender wage and pension gaps.

## **2.1 A note on gender**

The UK has a strong history of gender inequality and discrimination. Women gained their vote in 1928 after marching for their rights for nearly a century, but by 1945 they still remained in general both poorer and without similar opportunities in all areas of life in comparison to men (Thane, 2010). This can be seen as a result of how women’s access to work, and the conditions of the work and its pay, were all strictly regulated (Davis, 2012). Women were forced to organise amongst themselves as the unions were strongly influenced by the patriarchal system and as such did not allow women to become members (Davis, 2012). Regardless of the post-war economy heavily relying upon female labour, the politics and policies implemented were firmly grounded in a male head of the household and woman as his dependant (Davis, 2012). Up until recent time, policy and legislation in the UK did not reflect an equal view of gender. For example, women were not individually taxed until 1990 and rape in marriage did not become illegal until 1994. Although women gradually gained similar rights as men throughout pieces of legislation in the latter half of the last century, women’s political representation in the UK remained well below 10 percent up until the late 1990s. The low level of women’s political representation contradicts with research supporting a correlation between democratic rights and high representation of women in politics (Welzel et al., 2002). As the next section will show, the low representation of women can be seen to threaten democracy and can lead to a vicious cycle of ineffective policies.

In the UK, as in most societies, more than half the population are women (51% (Office for National Statistics, 2017)) Considering this in light of a common definition of democracy as “a government elected by the people; *especially*: rule of majority” (Merriam-Webster, 2017)

one can discuss whether the current 29 percent female representation (a record high) equals full political rights. Gender equality is therefore, arguably, a predominant for true democracy; and thus gender inequality becomes an important issue to tackle to ensure the democratic rights of all UK citizens.

Internationally, the promotion of gender equality is recognized as a major factor for development and change in less developed countries. It is on the agenda of powerful organizations and institutions such as the UN, the OECD and the World Bank. In fact the UN in 2010 created UN Women, a separate entity for gender equality and the empowerment of women (United Nations Women, 2017). The OECD likewise has its own gender initiative which aims to examine existing barriers to gender equality, promote gender equality in member countries and provide good practices based on reliable data (Organisation for Economic Co-Operation and Development, 2016b). The World Bank also views gender equality as a key factor and states on its website that: “ The World Bank Group takes as its starting point that no country, community, or economy can achieve its potential or meet the challenges of the 21st century without the full and equal participation of women and men, girls and boys. Failure to fully unleash women’s productive potential represents a major missed opportunity with significant consequences for individuals, families, and economies” (World Bank, 2017b). Common to all these initiatives is that they aim to provide guidance and support to countries on developing policies that ensures gender equality and eliminating policies that are reinforcing direct or indirect gender inequality today. Indeed, the EU’s focus on gender equality in their member countries has led to a vast range of legislation on the topic throughout Europe.

The historical underrepresentation of women in UK politics has ensured that women have not had the full opportunity to shape policies that directly affects them. Putting this into context with Esping-Andersen’s typology of welfare regimes (Esping-Andersen, 1990), which characterizes the UK as liberal, and Lambert’s findings that “Having women in power is consistently associated with more generous child care and parental leave policies” (Lambert, 2008), which is the case in the social democratic countries; one can point to the UK’s political system and processes as a factor that hinders gender equality by limiting women’s political representation and therefore in turn fail to come up with policies that actually work for women. As noted by the Fawcett Society (2016): “At the current rate of progress it will take 50 years to close the gender pay gap and a child born today will not see equal representation in her lifetime”.



Despite the UK's involvement with organisations and institutions mentioned above, the development of women's political representation has been slow and as a result the UK has lagged behind culturally similar countries on policies that promote gender equality.

## **2.2 The problem of the ageing population**

One of the most prominent problems for European states today and in the near future is that of the ongoing population aging. Due to a strong decline in fertility rates in recent times in combination with how people are living longer due to modern health care and medicine, countries are faced with populations where the proportion of people of working age is declining in comparison to that of the elderly population. Thus, a smaller in relative terms, working age population, will have to support the increase in government spending on health, pensions and social care (United Kingdom Parliament, 2016). The UK is currently spending 55 percent of its welfare budget on pensioners in the form of health care and pensions. This amounted to £114bn in 2014/15 and is expected to increase with £2.8bn a year in the next five years (United Kingdom Parliament, 2016).

In practice, as the working age population decline relative to the numbers of elderly, the state tax income will go reduced and public expenditure will increase (United Kingdom Parliament, 2016). This means that in order to keep up the level of production and growth of the country's economy, the state must find ways to prevent this effect. As the threat of an ageing population has become more prominent in recent years, the UK government has many options for policies to mitigate the negative effects of the ageing population. Policies that reduce welfare payments, improve health, and increase the working population has been identified as the three areas where potential policy could impact the most. Nonetheless, it is unlikely that any political initiative to reduce welfare payments would receive any support as the older generations are a main part of the voters (Melo and Stockemer, 2014). Policies that improve the healthy life expectancy (i.e. keep people healthier for longer parts of their life) would impact positively on state healthcare spending by reducing costs. However, one area where policy could make the largest impact to prevent the effects of the ageing population, is in increasing the working age population to keep up productivity and tax income (Börsch-Supan, 2003).

This is in line with findings from several studies conducted on behalf of the UK government (see for instance Harper and Walport (2014)). For example, a report by the Women's Business Council (2013) found that there are more than 2.4 million women in the UK who are

not in work but who want to work. In addition, there are 1.3 million women who wish to increase the hours they spend in paid work. Furthermore, the report estimates a 0.5 increase growth in GDP per capita a year if the full-time equivalent labour force participation rates for men and women were equalized. Kabeer and Natali (2013) offer a thorough assessment of a variety of studies on women's contribution to growth in productivity. Their findings add to the wide range of literature that supports the positive relationship between FLFP and growth (Briar, 2006). Furthermore, Kabeer and Natali (2013) argues that women's employment must be taken seriously as goal for policy and that women's domestic work must be recognised accordingly in supportive policies such as parental leave and public provision of childcare.

The UK government has on many occasions shown that they wish to harness the skills and potential of women in order to boost growth, and has since 2000 invested heavily in a variety of policies to support women's employment in general. The main reason for doing this has, however, so far been related to the 1999 government pledge to eradicate child poverty (Ostner et al., 2008). Yet, the expectations of the state are not matched by the behaviour of FLFP.

### **2.3 The expectations of state and families**

In the wake of major changes to the UK labour market, new conditions for employment have become the norm. As the economic conditions changed in the last half of the previous century, women increasingly took up paid work to compensate for the increased risk in employment and the loss of the traditional male 'job for life'. Over the past few decades, further changes to the composition of families, and especially the increase in divorce leading to lone parent households, has led to new expectations and implications in the relationship between the state and families. A major issue being that the state has failed in reacting to women's changing role in the labour market in a sufficient way. Women rely on the state to enforce their increasing attachment to the labour market, which is of crucial importance to their equality in both social and economic terms. On the other hand, the state is relying on women's increased participation to safeguard against the negative effects of an ageing population. Yet, as evidence presented in this thesis will imply; none of the parts are able to meet the others expectations.

### **2.4 Breadwinner theory**

Breadwinner theory is related to the work-family arrangement that reached its peak in the mid twentieth century (Lyonette et al., 2007). During this time the two spheres structure was accepted as the model foundation for society. The 'ideal' and 'natural' family arrangement in

the eyes of society and sociologists alike were that of a breadwinner husband and a wife carer, where both women and children were seen as a responsibility and dependants of a man. The male breadwinner family gradually demerged in the second half of the twentieth century, and was replaced by the model of family that has been known as the dual earner household (Lewis and Campbell, 2007). However, as argued by O'Connor et al., the influence of the traditional male breadwinner model is still very much pervasive. This is particularly evident in the UK in that women conduct exceptionally high level of part-time work (in comparison to other countries), and most work very few hours (O'Connor et al., 1999).

Ciccia and Bleijenbergh (2014) examines 30 European countries in order to establish what direction work-family arrangement has taken as countries move away from the male breadwinner model. Their findings place UK in the category of what they name 'one-and-a-half breadwinner' model. Common for countries in this category is that although women's labour force participation is encouraged, the extent of social policies does not allow for women to work full-time; thus, women's paid work is seen as supplementary but not as a replacement for unpaid care work. In the case of the UK were women increasingly report that they wish to work more hours but that they cannot access affordable, quality, childcare to do so; progression in the delivery of sufficient childcare through policy is contradictory and notably slower than changes evident in the social reality (Daly, 2011).

## **2.5 The double burden**

In gender theory and research the double burden is a well known phenomenon. It refers to how women have over time and in response to societal changes and expectations from the state etc., entered the domain of working for pay but at the same time keeping the same or similar amount of responsibilities in terms of looking after children and the household. In practice this creates a double burden on women where their total hours of work, both unpaid and paid is a great deal larger than those of men. The double burden has been widely acknowledged as an important societal issue and as a result there is a growing body of research in the area. Hochschild and Machung (1990) terms this phenomenon 'the second shift' and their findings were similar to that of other research of the time; namely that despite their entry into the paid labour force, women continue to conduct the majority of household and family chores and responsibilities.

The double burden remains a very relevant problem today as studies have found that even though women have been increasing the hours they participate in paid work in recent years, they still conduct the majority of unpaid work at home (Lewis and Campbell, 2007).

## **2.6 History of female labour force participation in the UK**

### **2.6.1 The post war years**

After the war there was a production drive to increase exports and the UK faced a labour shortage, as a response appeals were made to encourage women to stay in the workforce and to take up paid work. Although the labour shortage was expected to be temporary, it lasted well into the 1960's and decision makers began to point to married women as a labour reserve that would give fewer problems than the employment of overseas workers (Beechey and Perkins, 1987). Thus, the pattern of increasing employment for women became a trend. Still, most women worked part-time jobs and the work continued to be unskilled for the decades after the war. Despite women now being seen as a resource in the eyes of policy makers, by law it was still possible to discriminate against women. Women were routinely sacked upon marriage or pregnancy, and were barred from certain occupations. Women received less pay even when they did the same job as men. Mothers of young children were discouraged from working.

Women continued to campaign for equal pay throughout the 50's and 60's, by 1970 the Equal Pay Act was passed and applied to public and private sectors where men and women did similar work. Yet, women in jobs that were gender segregated, such as secretaries and typists, were still paid low wages in comparison with men.

### **2.6.2 Development from 1990 and onwards**

The areas of FLFP and gender equality saw arguably little development in the UK in the 1990s. The conservative government who was in power for most of the '90s had little to no focus on social policy (Turner, 2013) as it was mostly concerned with political division regarding membership in the European Union. Despite little development in terms of women's political representation, social policy and gender equality, the '90s was a decade where the views, attitudes and beliefs of the UK population developed tremendously (Turner, 2013). These changes led to a new culture of higher acceptance, where cultural and social equality became of major importance. Thus, when Labour came into power in 1997, there was a political shift from economic to social liberalism. Turner (2013) argues that the changes seen in the UK in the '90s was not brought about by the politics and policies of the time, but

that it was instead a result of this gradual shift from economic to social liberalism; resulting in a “demand for equality, initially in terms of culture, with the possibility that it might extend into the political sphere” (2013) .

In the mid ‘90s, the UK opted out of what was known as ‘the social chapter’ of the Maastricht treaty due to the conservative’s view that the UK was an EU leader in the marketplace and therefore would lose its competitive advantage if partaking in a binding EU agreement on social legislation (Her Majesty's Government, 2014). As a result, the social chapter applied to all EU member states but the UK until 1997, when the new Labour government agreed to be bound by the agreement. For the UK this meant that any social policy legislation that had been negotiated in the period of the opt-out, would apply to the UK without any option for negotiating to make legislation fit with UK employment practices. This spurred a wave of changes to social policy and rights for UK citizens.

## **2.7 Social investment strategy**

After the UK joined the social chapter of the Maastricht Treaty, new terms came into the UK political discussion. One of these terms is what is known as social investment. The European Commission (2017) offers the following definition for social investment: “Social investment is about investing in people. It means policies designed to strengthen people’s skills and capacities and support them to participate fully in employment and social life. Key policy areas include education, quality childcare, healthcare, training, job-search assistance and rehabilitation”. Although the UK has extensive policies in areas like health care and education, the idea of investing in people through supporting them to fully participate in both employment and social life through for instance childcare policy, was a totally new perspective of UK policy making. Underlying the European Commission’s definition are some important connections, mainly that key policy areas are linked. For instance, even if a country provides free high quality education on a universal level, failure in providing quality childcare that is accessible universally will lead to the education policy becoming less effective; as half the population’s skills will not be available during their childbearing and rearing years. Thus, the notion of social investment is highly relevant to gender equality as it implies policy that helps *all* people, regardless of gender, to participate fully in employment and social life. However, in order to succeed with social investment strategies in a liberal state, the boundaries of division of responsibility for care for the dependant (children, sick and elderly) between state, market and family, must be renegotiated.

Bound by EU commitment, the UK developed what can be recognised as a social investment strategy throughout the first decade of the 2000s. This strategy involved the implementation of a variety of so called ‘family friendly’ policies like parental leave, subsidised childcare etc. These policies were expected to have a positive effect on women’s labour market behaviour. However, despite extensive expenditure on such policies, the results are still lacking. In a 2008 comparative review of family policy within the European context, Ostner et al. (2008) concludes that despite the UK Governments ambitious goals, the welfare state is still strongly reflecting that it is built upon the male breadwinner family. Furthermore, Ostner et al. (2008) argues that the move towards an individualistic state in the UK has been strangled because social policies are still based on the principles of the male breadwinner model of family arrangement. In practice, this means that women are forced to take on work that fit with their care obligations, and therefore do not have the opportunity to fully access paid work.

The political commitment towards a social investment strategy is likely to be affected by the result of the 2016 referendum which ended in the UK pulling out of the EU. Although historically it was being bound by EU legislation that forced the UK to make efforts in the area of social policy, there still remains a strong business case for continuing the efforts regardless of the lack of results so far. Social investment is of crucial importance to all citizens but in particular to women. O’connor et al. (1999) stresses the importance of the state to afford women a minimum income, or at least the right to earn one, in order for women to have the option of escaping personal economic dependence. Social investment is therefore also of major importance to families as especially women’s full access to employment alters the nature of family organisation and responsibilities. To illustrate the impact of a universal social investment strategy the next section will take a closer look at the case of the Nordic countries.

## **2.8 The Nordic Model of Social Investment and Family Policy**

The idea of social investment stems back to Sweden in the 1930s where social democrats argued that social policy was not a cost but instead an investment (Tilton, 1990). Although social investment today reflects ‘new’ ideas in international context, the idea spread throughout the Nordic countries in the last century resulting in the common welfare model found in these countries today.

The Nordic countries are well known for their welfare strategies and their models for family policy. Although none of the countries have the exact similar system as the others, the Nordic

model of family welfare policy is a term used collectively about the combination of policies that are particular for these social democratic, Nordic countries. Each country has its own unique model but they are all different versions of the same political view; a view that investment in families and children creates productive and happy citizens. In political context, the success of the Nordic countries has over the past few decades been repeatedly brought into light by politicians and organizations worldwide as an example to follow.

In general, what characterizes the family policies of these countries, are that they are all universal, generous in terms of paid parental leave, provision of high quality childcare, and that the policies are designed to reduce gender inequality both in the work place and in the home (Lammi-Taskula et al., 2012). In terms of gender equality, Nordic policy stands out in that policies are designed to limit inequality for both men and women, and as a result ‘father’s rights’ has become a key element for policy making in several of these countries (Kamerman and Moss, 2009). These policy features in combination has proved to be unique to the social democratic countries, and has lead to high FLFP and gender equality as well as low measures of child poverty (Jaumotte, 2004).

### **2.8.1 Parental Leave**

Parental leave refers to both maternity leave (can only be used by the mother) and paternity leave (can only be used by the father) as well as to parental leave which can be shared between both parents. As mentioned earlier, the level of parental leave is high in all the Nordic countries. The policies for parental leave has been reformed and extended many times in all the countries since the first parental leave policies were introduced, and today appears roughly as illustrated in the tables on the next page.

|                              | <b>Denmark</b>     | <b>Finland</b>  | <b>Iceland</b>   | <b>Norway</b>      | <b>Sweden</b>     |
|------------------------------|--------------------|-----------------|------------------|--------------------|-------------------|
| <b>Maternity leave</b>       | 18                 | 17.5            | (2) <sup>1</sup> | -                  | (2) <sup>2</sup>  |
| <b>Paternity leave</b>       | 2 <sup>3</sup>     | 3               | -                | 2 <sup>4</sup>     | 2 <sup>5</sup>    |
| <b>Shared parental leave</b> | 32/40 <sup>6</sup> | 26.5            | 12               | 27/37 <sup>7</sup> | 51.5 <sup>8</sup> |
| <b>Father's quota</b>        | (3) <sup>9</sup>   | 5 <sup>10</sup> | 12               | 10                 | 8.5               |
| <b>Mother's quota</b>        | -                  | -               | 12               | 9 <sup>11</sup>    | 8.5               |

*Table 1 - Leave length with income-related compensation in 2010 (weeks), adapted from Lammi-Taskula et al. (2012)*

<sup>1</sup> Obligatory leave after birth.

<sup>2</sup> Obligatory leave before or after birth, with or without compensation.

<sup>3</sup> Six weeks in the public sector. <sup>4</sup> As of July 2011, the father's quota in Norway has been extended to 12 weeks.

<sup>5</sup> Five days of father's quota = a week.

<sup>6</sup> With full compensation/reduced reimbursement.

<sup>7</sup> With 100% or 80% reimbursement.

<sup>8</sup> 390 days (seven days = a week). To this, in certain municipalities, can be added the opportunity to receive a childcare allowance until the child turns three. Municipalities can themselves decide whether they wish to provide childcare allowances, and generally, conservative-led municipalities have done so.

<sup>9</sup> In the industrial sector.

<sup>10</sup> The father receives five bonus weeks if he uses two weeks of the shared portion of parental leave.

<sup>11</sup> One might as well call at least six of these weeks "maternity leave", because the mother is not allowed to work.

|                              | <b>Denmark</b>     | <b>Finland</b>  | <b>Iceland</b>   | <b>Norway</b>      | <b>Sweden</b>     |
|------------------------------|--------------------|-----------------|------------------|--------------------|-------------------|
| <b>Maternity leave</b>       | 18                 | 17.5            | (2) <sup>1</sup> | -                  | (2) <sup>2</sup>  |
| <b>Paternity leave</b>       | 2 <sup>3</sup>     | 3               | -                | 2 <sup>4</sup>     | 2 <sup>5</sup>    |
| <b>Shared parental leave</b> | 32/40 <sup>6</sup> | 26.5            | 12               | 27/37 <sup>7</sup> | 51.5 <sup>8</sup> |
| <b>Father's quota</b>        | (3) <sup>9</sup>   | 5 <sup>10</sup> | 12               | 10                 | 8.5               |
| <b>Mother's quota</b>        | -                  | -               | 12               | 9 <sup>11</sup>    | 8.5               |

*Table 2 - Leave length with income-related compensation in 2010 (weeks), adapted from Lammi-Taskula et al. (2012)*



The motivation for the different types of parental leave can be very different and have indeed changed over time in the Nordic countries. Maternity leave is most often meant as a period for the mother to gain health after pregnancy and birth whilst paternity leave often comes in the form of a couple of weeks immediately after birth for the father to be at home in order to get to know his child and participate whilst the mother recovers after giving birth. Parental leave serves the purpose of allowing one parent to stay home from work for a period to look after the child, and can be either a family based right where parents decide who will take the leave or an individual right where it is non-transferable with a set time for each parent (Lammi-Taskula et al., 2012).

Since the Nordic countries' welfare systems are built upon the concept of universalism, the right to parental leave is equal for everyone, regardless of income status, hours worked etc. However, the compensation in many cases varies depending on work status in the period before taking out the leave (Lammi-Taskula et al., 2012). Still, there is some form for compensation for all regardless of status (i.e student, unemployed, etc.). The level of compensation can be said to illustrate the value the society put upon caring for the young (Lammi-Taskula et al., 2012), and has proven to be of high importance for fathers uptake of leave. As men in general earn more than women, it is likely that if compensation is low, the family may see too large a loss in income if the man makes use of paternity/parental leave. A high level of income compensation helps this by eliminating the financial costs of men taking up leave. However, father's uptake of leave also depend on cultural factors and as a result several of the Nordic countries are now operating with father's quota's. Father's quotas are non-transferable leave that will fall away if not taken by the father. Iceland has the most gender equal leave policy of the Nordic countries, where mother's and father's both are entitled to 3 months each by quota in addition to 3 months they can freely share between them. In practice, this means that if the father does not make use of his 3 months, the family lose 3 months income compensation and is left with the option of the mother staying home on unpaid leave, or having to arrange childcare in other ways. Both these options carry costs and thus the most financially viable solution is for the father to make use of his 3 months. This policy has proven to be extremely successful in increasing fathers uptake of leave, and therefore also in promoting gender equality, which has lead to the reception of much attention internationally (O'brien et al., 2007).

## 2.8.2 Childcare Arrangements

All of the Nordic countries provide extensive publicly funded childcare. This service is universal in that it is available to all children regardless of parent's income or labour market status. The service is largely organised as institutional care and is delivered all year round. Although mostly a public service, the market fills in the gap between supply and demand in many of the countries without any difference to parents or children as the quality and the cost is similar in both private and public institutions. The focus of Nordic childcare is more on education than on care and is thus seen as a *right of the child* instead of just a service to allow parents to work. The child becomes entitled to a childcare place at an early age, usually around the age of one year or around the time when paid parental leave ends.

There is strict regulation of quality which means that staff is higher educated and better paid, this again ensures a higher status for childcare staff. As required education and wages received has increased in Nordic childcare, it has become a more common profession for men. This is seen as highly positive, especially in relation to the gendered division of labour. Childcare, both public and private, is heavily subsidised and as a result the cost to the parents is low. The combination of high quality childcare and low costs, leads to a high take-up rate where most children attend fulltime time, public, childcare from the age where they become entitled. The table below show the average percentage of income parents spend on childcare per child in the UK and the Nordic countries.

|  | <b>UK</b> | <b>Sweden</b> | <b>Denmark</b> | <b>Norway</b> | <b>Finland</b> | <b>Iceland</b> |
|--|-----------|---------------|----------------|---------------|----------------|----------------|
| <b>Percentage of average income spent on childcare</b> | 34%       | 6%            | 7%             | 12%           | 8%             | 14%            |

*Table 3 - Percentage of income spent on childcare, Adapted from Lammi-Taskula et al. (2012)*

Considering the table above, it is striking that families in the Nordic countries can have two, three or even more children below school age before the costs becomes similar to the costs faced by UK parents with only one child. Hence, when taking into consideration that many families tend to have their children within a relatively short time period of a few years, and that the table above show percentage of family income, not the percentage of women's income; it becomes clear that, from a purely financial viewpoint, it may not pay to work for mothers in families with two or more children, especially in lower income groups. A combination of the above mentioned family policies, with specific gender equality legislation

on areas related to the labour market (such as gender discrimination in hiring/firing, work and pay as well as in politics (i.e. gender quotas)), has led to high FLFP rates as well as the highest levels of gender equality in the world (Leopold et al., 2016)

### 3. Problem context

“There is therefore a potentially serious conflict between two current goals of employment policy in the UK and possibly in the EU more widely; on the one hand the goal of raising the employment rate of seniors in order to improve labour supply and address difficulties in pension provision, and on the other hand the goal of increasing the proportion of mothers in work”. Anne Gray, 2005.

FLFP has been identified as a key area for improvement by the UK government. Mainly due to the government’s 1999 pledge to eradicate child poverty by 2020, but also for reasons such as gender equality and the cultural changes to family structure and organisation in the last few decades. EU legislation on social policy has also contributed to the government’s increased emphasis on increasing the FLFP.

The signification of child poverty in relation to FLFP has been crucial in the UK context. In 2000 the UK had a child poverty rate of 37%, the absolute highest rate of child poverty in Europe (Ostner et al., 2008). However, after accounting for social transfers (i.e. tax credits, allowances etc.) Ostner et al. (2008) calculates that the child poverty rate drops to around 13% of all children in poverty. These numbers tells us two things, firstly that too many children live below the poverty line and secondly that what keeps a majority of children out of poverty is transfers from the state. As research has found that having parents in paid employment has a significant effect on child poverty (see for instance: Gregg and Harkness (2003), Lichter and Eggebeen (1994), Bradshaw (2002)), the UK government naturally embraced the idea of increasing parents labour force participation in order to combat child poverty; and as a side effect, reduce the number of families relying on benefits from the government.

The likelihood of being poor is higher for children living with a lone parent (Gregg and Harkness, 2003), but this risk is drastically reduced if that parent is in *full-time* paid work. The same pattern is found for children living within couple households; if the parents are without work the child is likely to live in poverty, but if *both parents are in full-time work* the risk of child poverty is close to zero (Ostner et al., 2008). The key message to take away from the work of Ostner et al. (2008), is that the full effect of parents labour force participation on child poverty is reached by supporting parents into *full-time* work. However, in the UK context, the problem of increasing parent’s participation can be narrowed down to that of mothers’ participation as men are more likely to increase their labour force participation than to reduce it once becoming fathers (Davies et al., 2000).

The traditional model of a breadwinner family is no longer valid in the UK today. The development of women's rights and women's entry into the paid labour market created changes to the traditional family patterns. Today women have fewer children and they have them later than before; families come in many forms and it is as common with two parent families as it is with one. Women are receiving the same education as men and their expectations to participate in paid work are thus equal as for their male counterparts. The economy and labour market in the UK are no longer providing the 'job for life' as in previous decades, nevertheless the 'family wage' that came with it; and as a result, families are now depending on the participation of both parents in paid work. As the structure of families, their organisation and division of labour has been changing over time, moving from a traditional male-breadwinner model of family towards a dual-earner structure, government policy has struggled to follow.

The development of policy that directly or indirectly affects FLFP in the UK has been strongly influenced by EU legislation and directives (related to social policy, gender equality etc.). It is uncertain how the UK government will continue to deal with the issue after the UK will leave the EU which is due to happen by early 2019 (Dhingra et al., 2016).

Together, all these factors have contributed towards the implementation of a range of policies and initiatives aimed at increasing FLFP since the early 2000's. Common for all the initiatives are that they are aimed at increasing the participation rates for one particular group, namely mothers. Despite the variety of initiatives now in place (parental leave policies, subsidised childcare etc.) as well as changes to previous legislation to reduce disincentives (such as tax reforms), the effect on FLFP has been limited so far.

Since the main policy of interest in this thesis is that of subsidised childcare, the next section will describe the current childcare situation in the UK by explaining the interaction of formal and informal childcare. Subsidies has been increasing since they started in 2000 but are still very limited in terms of the age of children qualified and the number of subsidised hours per child per week; the subsidies are therefore not sufficient in terms of allowing the mother to go back to full-time work without relying on other sources of childcare such as grandmothers. This means that mothers who rely solely on the subsidised hours for childcare can only go back to work part-time, for a limited number of hours a week.

### **3.1 The current childcare situation in the UK**

As of 1990 there were only 59 000 nursery places in England and Wales, this is in comparison to 1.7 million places today (where the majority of new places were created after 2000), and explains to a large extent the historical necessity for women to leave paid work once becoming mothers (Rutter, 2016). However, today, due to major changes to the economic situation, gender equality, and campaigning by activists, all major political parties recognise that parents and children has a right to high quality, affordable childcare (Rutter, 2016).

Most UK parents today rely on a combination of formal and informal childcare to get their childcare needs covered. As mentioned before, the governmental shift in 1997 brought a new focus on social policy; this also meant increased focus on childcare and supporting policies. In 1998 the government introduced the first National Childcare Strategy (Campbell et al., 2003), promoting the uptake of formal childcare by supporting the creation of more nursery places. Although the intention of this new childcare strategy was to increase the use of formal childcare to allow parents (mothers) to free up their time to participate in paid work, the use of informal childcare still prevails as grandparents remains the largest group of childcare providers in the UK (Rutter, 2016).

Despite the government's attempts to intervene in the childcare sector, the market is still largely private and has not expanded with the growing demand. As a result, the steep increase in demand in recent years has pushed prices up to the extreme as the market fails to increase supply (Rutter, 2016). Simon et al. (2015) suggests that the main reason for the market failure in meeting demand is that nursery care work in the UK is low paid, unskilled work, and thus staffing is a major issue. This is consistent with the findings of Vincent et al. (2008), who describes the majority of the childcare workforce as young, unskilled girls who quit working in childcare once they find something better. Thus, the childcare situation for parents in the UK is a dynamic picture with three major issues to be overcome. Firstly, there are not enough formal childcare places available to cover demand. Secondly, the childcare places that do exist are highly expensive. Thirdly, the quality of formal childcare is too low, as this type of care work is low paid, unskilled and therefore low status (Vincent et al., 2008). In light of this, access to high quality, affordable childcare should be the aim of any governmental intervention.

The next sections will provide more details around the different type of childcare that dominates in the UK today and explain the interaction between them.

### **3.1.1 Formal childcare**

Formal childcare refers to childcare that is provided by the public or private market and where payment is covered by parents, by subsidies from the state or as a combination. In this thesis we solely consider childcare for children from birth up to school age, thus after school care is outside the scope of this thesis.

Formal childcare for under school age children in the UK is mostly provided by the private market, (91% in 2016) in the form of day-nurseries (Rutter, 2016). In addition the private market also consists of childminders who care for children in their own home, but this type of childcare provision has been decreasing in the last few decades (Wheelock and Jones, 2002a). The public sector also provides some childcare for this age group, mostly in the form of pre-school classes in the year before children are to start school. Pre-school classes are usually given at school facilities for a limited number of hours a week and are government funded. In recent years there has been a large increase in government spending on EECC, and as of 2016 the UK spent around 1.1% of GDP on subsidising formal childcare hours for pre-schoolers (Organisation for Economic Co-Operation and Development, 2016c).

The UK charity The Childcare Trust has undertaken an annual review of the childcare situation every year since 2002. In the 2016 survey some of the key findings were that although the Childcare Act 2006 states that local authorities are responsible for making sure there is enough formal childcare available for working parents, only 45% of councils covered the demand from parents in full-time work. In addition, cost of childcare in the UK remains the highest in Europe despite the nearly £7.5 billion of government spending on subsidising childcare. Furthermore, as argued by Rutter (2016), the public funding of childcare in the UK remains extremely complicated regardless of increased spending, due to lack of changes to the underlying system.

### **3.1.2 Informal childcare**

Informal childcare refers to childcare that is provided by other family members than a child's parents (i.e. grandparents, siblings etc.), neighbours or friends. Although informal childcare can be paid for, there is evidence that the majority of informal childcare provided in the UK is unpaid care work (Wheelock and Jones, 2002b). For the purpose of this thesis we will only consider informal childcare provided by grandparents, and as evidence suggests that the vast majority of grandparental care is given by grandmothers (Wheelock and Jones, 2002b), we will for simplifying reasons only consider the role of grandmothers.

In a 2011 review requested by the Department of Education, Statham (2011) found that grandparents remains the largest single source of childcare for parents in the UK. This is consistent with the findings of Simon et al. (2015) who states that 31% of all childcare in the UK is provided by grandparents. In general, there seem to be complete agreement within the literature that the high level of grandparent care in the UK is a result of the extremely high costs of formal childcare (Wheelock and Jones (2002), Statham (2011), Simon et al. (2015)). Although this would imply that grandparents would provide *less* childcare if parents paid less for formal childcare, Wheelock and Jones (2002b) argues that parents see grandparents as the ‘next best thing’ and suggests that parents will continue to call upon their own parents to provide childcare unless formal childcare is seen as better for the children. This appears to pose no problem to Wheelock and Jones who finds grandparent care to be given freely as a gift between generations. However, as argued by Statham (2011), grandparents who provide extensive childcare, reports that it has a negative effect on their health and that they would reduce their care hours if it was not of crucial, financial importance to their children’s families. Gray (2005) in turn argues that policymakers has failed to recognise the conflict in increasing pension age, and the promoting of higher labour force participation for seniors and mothers at the same time. This, Gray argues, could result in a major crisis of care unless future childcare policy and provision succeed in accounting for the likely forthcoming grandparent fall-off in care provision.

### **3.2 Governmental policies and its impact**

The governmental policies for supporting families and their interaction with the labour market have since the political shift in the late 1990s been strongly influenced by the New Labour’s ‘third way’. The result is a strong emphasis on flexible working practices, especially in relation to working hours. The political thought behind promoting this flexibility was that parents should be able to fit work around caring for children (Kamerman and Moss, 2009). However, as argued by Lewis (2007), this flexibility has resulted in a gender differentiated pattern where mothers work very short hours, and fathers work the longest hours of all groups (40% of fathers worked more than 48 hours a week). This pattern can be seen as a vicious cycle between mothers and fathers working hours, family income, and childcare. As the family cannot afford to pay for full-time childcare, the mother reduces her working hours accordingly which causes a decrease in family income, this in turn makes the father increase his working hours in order to make up for the loss in family income. As women are likely to earn less than men, it is women who reduce their hours. Lewis (2007) concludes that this



pattern not only reinforces gender equality, but also that it contributes to more inequality between classes as higher educated, better paid women are more likely to afford childcare than women in low paid jobs. Thus, women working in lower paid occupations will become more distanced from the labour market. In light of the above it is clear that governmental intervention to increase access to affordable childcare, especially for lower income families, are crucial.

Nonetheless, the governmental policies for childcare currently in place has received criticism for being a cluster of complex, insufficient, policies that does not cover the needs of parents, children, providers or the economy (Rutter, 2016). Unfortunately, evidence suggests that the childcare system in the UK is complicated and faulty (Rutter, 2016). This is also the finding of the 2016 Childcare Survey which argues that: "... The Government is subsidising childcare costs that are caused by poor policy-making: shortages of provision and poorly-executed funding mechanisms for free early education. This is money that could be saved and re-invested in improving the quality and availability of childcare. It also shows the childcare system is not working and is an argument for childcare reform and a greater channelling of state subsidies directly to providers". This can be illustrated by the table found on the next page which covers the policies currently in action in the UK.

|   | <b>Level of support</b>   | <b>Recipient group</b>   | <b>Date available</b>   | <b>Where available</b>   |
|---|---|--|---|--|
| <b>Childcare element of working tax credit</b>      | 70% of childcare costs up to a maximum of £175 per week for 1 child or £300 for 2 or more children. Families receiving housing or council tax benefits receive extra help, amounting to about 96% of costs in England | Nearly 400,000 low income working families   | Presently available   | UK-wide  |
| <b>Universal credit</b>                             | 85 % of childcare costs with same maximum levels as working tax credit, although no extra help for those receiving housing benefit  | Low income working parents   | Presently available   | UK-wide  |
| <b>Childcare vouchers</b>                           | Worth up to £55 per week for basic rate tax payers  | Working parents but not self-employed and usually excludes those receiving tax credits   | Presently available but will not accept new applicants after 2017 | UK-wide  |
| <b>Tax free childcare</b>                           | 20% of childcare costs up to a maximum of £2,000 per year, families of disabled children receive help up to £4,000 per year   | Working parents not in receipt of tax credits/universal credit whose gross household income is higher than a specified minimum threshold but less than £100,000 per parent | From early 2017   | UK-wide  |
| <b>Care to learn</b>                                | £175 in London and £160 per week outside  | Parents under 20 at school or in further education   | Presently available   | Care to learn applies to England but equivalent schemes elsewhere in the UK          |
| <b>Further education discretionary learner fund</b> | Discretionary   | Parents over 20 in further education   | Presently available   | This fund applies to England but equivalents elsewhere in the UK                     |
| <b>Higher education childcare grant</b>             | £155.24 a week for 1 child, up to £166.15 for 2 or more children  | Parents in full-time higher education who are eligible for student finance   | Presently available   | This fund applies to England but equivalents elsewhere in the UK                     |
| <b>Free early education</b>                         | 570 hours a year, usually 15 hours per week in term-time  | All 3 and 4 year olds and the 40% most income deprived 2 year olds   | Presently available   | England but 3 and 4 year olds elsewhere in the UK also receives free early education |
| <b>Free early education extension</b>               | 1,140 hours per year = 30 hours per week during term-time   | 3 and 4 year old children of working parents falling within same income thresholds as Tax Free Childcare   | After September 2017  | England but a single commitment in Scotland  |

*Table 4 - Current childcare policy and initiatives active in the UK, adapted from Rutter (2016)*

### **3.2.1 The impact on female labour force participation**

The lack of access to affordable childcare for families in the UK impact on FLFP in several ways, both directly and indirectly. As mentioned before, in families where they cannot afford full-time childcare, the mother often reduces her working hours accordingly. The reduction in working hours decreases further with the birth of a second child as having two or more children in childcare is likely to bring the costs of childcare close to or above the average wage for women. This scenario escalates for the lowest income groups. As a result, many women leave the labour force altogether during the years of raising small children. Those who remain in paid work have a tendency to work very few hours. The labour force participation rate for mothers therefore drastically impacts on the total FLFP rate after adjustment for full-time equivalents.

As a second implication, grandmother's contribution as providers of informal childcare also negatively affects the FLFP rate. Since a large proportion of the grandmothers who provide care for small children are still of working age, their reduction in working hours also contributes to lower total FLFP. In addition, the recent increase in retirement age for women is likely to leave many grandmothers in paid work for longer which leaves them unable to care for grandchildren, this will inevitably have a negative effect on mothers participation rates under the current circumstances.

In light of the above it is possible to argue that during the current conditions of childcare there is a negative relationship between women's labour force behaviour at different stages of their lives. As mothers rely on help with informal childcare from grandmothers in order for them to participate in paid work, grandmothers reduce their hours accordingly. This pattern leaves women in part-time work for a large part of their working lives which causes them penalties in terms of career advancement, lower wages and over the long run; a great reduction in pension in comparison to their male counterparts.

Given that grandmothers aged 50 to 69 who are not in paid work are the most likely to provide childcare (Gray, 2005), the plans of the UK as well as other European governments to extend retirement ages and increase female labour force participation at older ages, are likely to conflict with their role in providing childcare, and therefore has significant implications for labour market participation by younger mothers and for pension acquisition and the financial security of mid-life women.

### **3.2.2 The impact on women's pensions and female poverty**

The issues surrounding lack of available and affordable high quality childcare in the UK presented earlier in this thesis causes further, and arguably even more important, problems when taking into account *gender* and *time*. Indeed, the work of Ruspini (1998) suggests that women are by far more prone to falling into poverty than men, mainly due to life events such as the birth of a baby, the risk of lone parenthood, and the implication of such events on women's labour market participation. Ruspini (1998) also offer a comparative analysis of the UK and Germany based on Esping-Andersen (1990) welfare system classification. Her findings were that the liberal UK regime facilitates women's poverty as women are indirectly hindered in their uptake of paid work by the burden of care and household responsibilities (activities that the state partly takes responsibilities for in other regimes). As women are left to a large extent without choice regarding their participation in paid work in periods of their life when they are caring for the dependent, be it children, sick or old; they are left in a position where their social responsibilities leaves them unable to save towards a pension, regardless of their desire to do so. In the UK this enfolds in a pattern where women work few hours, first during their childbearing and rearing years, and then later in life as grandmothers who wish to contribute towards their children's and grandchildren's welfare by allowing parents time to work. With the current political framework for pensions in the UK, the working hours lost by women negatively effects their lifetime earnings and therefore also their pensions. As touched upon by Ruspini (1998), this problem escalates through a lifetime as part-time work means lower wages and less job security, which in turn means less chance of promotion and wage increase, as well as a higher likelihood of becoming unemployed. Periods of part time work or not working at all also means that women do not gain experience at the same rate as men, which contributes to the gendered segregation of women in lower skilled occupations, and also in relation to the gender pay gap. Although the current gender pay gap is standing at 18.1% (Office for National Statistics, 2015), it is the historical gender pay gap that has caused the accumulating effect resulting in one of the highest gender pension gaps in Europe at 43% (Bettio et al., 2009). This effect can be seen as the consequence of societal dominance of the male breadwinner model; as society gradually has shifted away from this model, the welfare state has not responded sufficiently with policy and legislation and as a result citizens needs have not been met. However, the true scope of this issue is best illustrated by looking at poverty after retirement age; where more than twice as many UK women as men live below the poverty line (Price, 2006).

### **3.3 Literature gap**

Although there is a range of literature on the influence of childcare on mothers labour force participation (see for instance: Briar (2006), Chevalier (2002), Thévenon (2013)) as well as on grandparent's role in providing childcare in Britain (see for instance: Gray (2005), Statham (2011), Wheelock and Jones (2002b)), little work has been done on investigating the relationship between mothers and grandmothers labour force participation in relation to childcare practices. This work aims to add to the literature gap by identifying and highlighting the underlying feedback loop that binds together the labour force behaviour of mothers and grandmothers as well as offering a simplified analysis of the UK governmental policy of formal childcare. Furthermore, it makes use of the complete system dynamics model to assess whether policy inspired by the Nordic countries would be sufficient in changing the undesired behaviour of FLFP that is identified as the problem.

In addition, this work adds to system dynamics literature by providing an example of how gender can be included when modelling for policy purposes; this is of particular importance as the failure to include gender can potentially lead to harmful policy that enforces gender inequality (Palmer and Wilson, 2017)

## **4. Methodology**

The research objectives for this thesis will be reached by building a computer simulation model of the underlying feedback system based on insights from the above review of the historical development and the current problem context. The simulation model will be thoroughly described and analyzed in the model and results sections prior to the main discussion. The output from the simulation model will then be used as the main focus for a discussion that aims to give insights into how the system work and what major feedback loops are responsible for the problematic behaviour, as well as the role of social policy in governing the system. Furthermore, issues regarding feasibility, implementation, and the cultural and political environment will be discussed. This section will give a short explanation of system dynamics, what it is and how it is being used, before giving account for how this thesis fit with existing literature in the field of system dynamics.

### **4.1 The system dynamics approach**

System dynamics is an approach for analysis of dynamic problems. It can be applied to problems found in a range of areas such as for instance social, ecological or managerial issues and it is considered a multidisciplinary field with practitioners using system dynamics for research and planning across a variety of areas. System dynamics is about how things change over time, it makes use of the knowledge we already have in order to create computer simulation models that shows how and why a social or physical system behaves in a particular way, by identifying the feedback loops that governs the behaviour of that particular system. These models can be used to identify ways in which to alleviate the problematic behaviour, and thus create policy that successfully changes the way the system behaves and steer it towards the desired behaviour. Thus, system dynamics can be a very useful method as it allows for testing policy options under different conditions and future scenarios without any risks or commitment for policy makers or stakeholders. The insights gained from policy testing and analysis of a simulation model that represent a dynamic system with problematic behaviour, can then be used for guiding the decisions of policy makers.

Yet, despite the benefits of creating a risk free environment for policy and scenario testing, there are several limitations to system dynamics modelling. Firstly, a system dynamics model is designed to represent some aspect of the real world. As an implication of this, if the system dynamics modeller builds on faulty observations and conclusions of how the system works in the real world; the model will also be faulty. Secondly, a system dynamics model will never be a perfect representation of reality; it is a very simplified representation and description of

how a system work based on the modeller's perception of how real world relationships are connected. Therefore, the aim when creating a system dynamics model is not to mimic reality but to create a model that sufficiently identifies the underlying system structure despite a great number of assumptions and generalizations. Thirdly, a system dynamics model cannot be verified and fully validated. The reason for this is nicely pointed out by Sterman (2000) who argues that 'all models are wrong' because of their limitations as simplified versions of the real world.

It is in light of the above that the goal for the model presented in this thesis has not been to match the historical behaviour of the problem but rather to sufficiently highlight how the system works, and it has thus been of great importance to set clear boundaries so as to not lose the purpose by striving for added complexity. The ten step approach to model validation offered by Sterman (2000) has been adopted as the main way of validation for the model presented in this thesis.

Although system dynamics is widely used for the purpose of policy analysis, there is, to my knowledge, few applications found in literature related to gendered issues in social policy. In general, there are few but any examples of system dynamics models that examines issues related to gender. Still, there are some excellent examples of research that shows the power and potential of system dynamics when applied to gendered social problems (see for instance Bleijenbergh et al. (2008)).

In light of the above, this thesis will add to system dynamics literature by providing an example of how the application of system dynamics to gender issues and gendered social policy can provide a useful and clarifying perspective. Furthermore, the thesis also uses system dynamics to uncover a dynamic, social relationship that has been largely unnoticed by social policy research so far.

## **5. The system dynamics model**

The system dynamics model was built using the software Stella Architect and the details around it will be fully explained and presented in this fifth chapter. Firstly, the boundaries of the model will be explained and discussed. Next, the model will be illustrated conceptually through a simplified causal loop diagram (CLD) before going into detail in the form of stock and flow diagrams showing exact parts of the model.

### **5.1 Boundaries**

The model has been built to illustrate the relationship between FLFP at different stages of women's lives, namely during the years of rearing children below school age and as grandmothers later in life. As this relationship is very specific to the UK, the model is spatially bound in the setting of the United Kingdom. The time frame of interest has been limited to the years from 1990 to 2015.

UK women's decisions when it comes to participation in paid work are influenced by a number of diverse variables ranging from social and cultural norms to political policies and economical factors. With the time limitations regarding the completion of this thesis, it was necessary to limit the scope and boundaries in terms of variables to be included. In consideration of these time limitations, the model primarily focuses on the relationship between the labour force participation of mothers and grandmothers in relation to childcare and any childcare subsidies from the state.

Traditional system dynamics models show how behaviour changes over time, with the idea being to follow the element under investigation to observe how this specific element change and develop in the period of analysis. This thesis uses system dynamics modeling slightly different from the traditional way, as instead of following the same people/group of people over time, it considers a specific family type and looks at how a family with certain assigned attributes would be affected by policy at different points in time. Thus, the model does not follow the same family over time but consider any family with the assigned attributes and how such a family would be affected at different points in time.

The model uses subscripts (also referred to as arrays/dimensions) to illustrate how different attributes of a woman's life influence her decision/opportunity to participate in the labour market. As the use of subscripts makes the model more complex to work with, some choices had to be made in terms of what would be included. The three attributes that were identified as the most influential on FLFP was age, number of children, and income level and each of



these are represented by its own array dimension. Other attributes that were considered but excluded due to time constraints were for instance education level and relationship status.

The model measures FLFP in terms of weekly hours available for paid work and a number of assumptions was made in relation to this. Throughout the modelling process it was crucial to make a number of simplifying assumptions. The main ones are listed below:

- It is assumed that women will automatically offer any hours they have available for participation in paid work on the labour market. In reality there would of course be a number of other constraints on women's time that could lead to the choice of not participating or only participating part-time, like for instance the personal preference to stay at home with small children etc.
- It is assumed that the decision to pay for childcare hours is purely based on how large the fraction of childcare costs is in relation to a mother's income. In reality it could also potentially be influenced by the father's income and factors relating to the risk of losing a permanent job if it does not pay for a small period of time.
- Although the number of children a mother may have is considered in the model, it does not consider the age of the different children.
- It is assumed that childcare costs the same for any child under school age, in reality this cost vary with the age of the child.
- It is assumed that hours of subsidised childcare are the same for all children below school age. In reality the complicated childcare system in operation in the UK leads to different numbers of hours provided based on the age of a child, parents income level and local initiatives available such as pre-school, play groups etc.
- Based on evidence from the literature, the assumption that if affordable, high quality childcare is available, grandmothers will not provide informal free childcare is made.
- It is assumed that all informal childcare is provided by grandparents although in reality a smaller percentage of informal childcare is provided by neighbours, friends, older sibling etc. Furthermore, it is assumed that all grandparental care is provided by grandmothers although a small percentage of this care is actually provided by grandfathers.

The list of simplifying assumptions above is not complete in terms of all assumptions and generalisations made, but illustrates the main assumptions that were identified as necessary. A variety of additional assumptions was left out of this list on the basis that, due to the scope of

the problem, the list would become incredibly long if all simplifying assumptions was to be included.

## **5.2 The main feedback loops**

As mentioned in the previous section, FLFP is influenced by a variety of conditions and processes that it would have been possible to include in the model. However, the model boundaries set out above, lead to the development of a model structure that successfully captures the main dynamics of the relationship in question in a clear and simple way that facilitates understanding. A simplification of the conceptual foundation for the model is illustrated in the CLD on the next page.

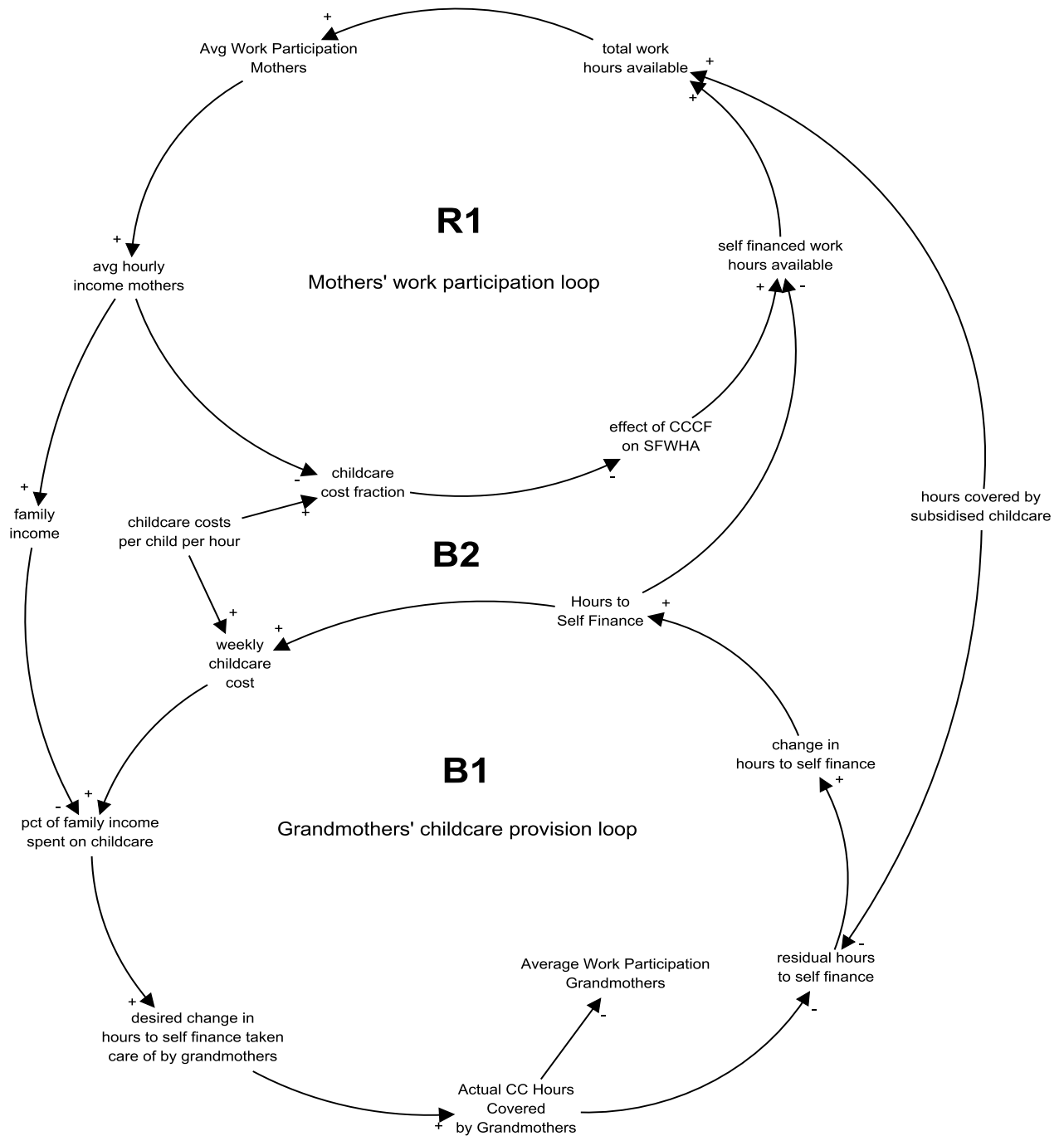


Figure 2 – Simplified causal loop diagram

The CLD shows the three major feedback loops that together govern the relationship between mothers and grandmothers labour force behaviour. The loop named R1 is a reinforcing feedback loop that illustrates how an increase in mothers' available work hours through subsidised childcare, leads to higher income per hour based on the assumption that a full-time job pay better than part-time. An increase in income reduces the "childcare cost fraction" which works as a comparison of the hourly costs for childcare with the hourly income of mothers. The "childcare cost fraction" has an effect on the self financed work hours a mother

has available under the assumption that, if a mother earn the same per hour as it costs for childcare, she will not have any self financed hours available, as it would not pay for her to work those hours. An increase in the “effect of CCCF on SFWHA” causes an increase in the “self financed work hours available” and hence an increase in the “total work hours available”, this again leads the “average work participation” to increase and yet again the “average hourly income mothers” will rise.

The second loop is a major balancing loop, B2, which illustrates the provision of informal childcare by grandmothers. Here, the “desired change in childcare hours provided by grandmothers” is influenced by the “percentage of family income spent on childcare” which aims to represent the decision rule that grandmothers provide childcare hours in correspondence with the financial situation of her family. The “desired change in childcare hours provided by grandmothers” is also influenced by the “actual childcare hours covered by grandmothers”; an increase in the “percentage of family income spent on childcare” triggers an increase in the “desired change in childcare hours provided by grandmothers” which in turn increases the “actual childcare hours covered by grandmothers”. The increase in “actual childcare hours covered by grandmothers” leads to a reduction in “average work participation grandmothers”.

The two major loops described above interact through a large balancing loop, (B2 in figure 2). This loop influences the “desired change in childcare hours provided by grandmothers” through the impact a change in “average hourly income mothers” has on “family income” and, therefore, also on the “percentage of family income spent on childcare”. As the “percentage of family income spent on childcare” is reduced by the reinforcing behaviour found in R1, the “desired change in childcare hours provided by grandmothers” goes down and triggers B1 to a drop in “actual childcare hours provided by grandmothers”. As a drop in free childcare hours provided by grandmothers mean an increase in the hours parents need to self finance, the “hours to self finance” increase and causes a reduction in “self financed work hours available”, thus the reinforcing behaviour of R1 is staggered by the balancing behaviour of B2.

### **5.3 The model structure**

This section will firstly go through the details regarding the different array subscripts used in the model and how these contribute to the level of complexity in the model. Next the model

will be thoroughly explained by going through stock and flow diagrams of each part of the model.

### **5.3.1 The array subscripts**

Arrays are used to give the model different layers, each representing a different dimension/attribute. Each dimension is divided into several elements which represent the different variations available. The model has three dimensions, age group, income level and number of children below school age which are all fully explained below.

#### ***Age group***

The age group dimension is split into three different elements, namely “16 to 25”, “26 to 35” and “36 to 45”. These three age groups cover the average fertile years for a woman. This dimension was included to represent how the conditions surrounding a mothers decision to participate in paid work or not changes with age. For example will the chance of any grandparent being below retirement age be much higher for a mother who is in the age group 16 to 25 than for a mother who is in the age group 36 to 45.

#### ***Income Level***

The income level dimension is also split into three different elements: low, medium and high income. This dimension was included to represent how a family’s income level impacts on a mother’s labour force participation. For instance will the “childcare cost fraction” be much higher for a mother in a low income family and thus she will have less incentive to work than mothers in higher income groups.

#### ***Number of children below school age***

The dimension called number of children below school age refers to how many children a mother may have between 0 and 5 years of age. The elements of this dimension range from 1 to 3 as it is unlikely that a mother has more than 3 children in that age group at the same time. This dimension was included to illustrate how the presence of any additional children means higher childcare costs and thus influences the “childcare costs fraction” and therefore also mothers decisions to work.

These three dimensions work together to give insights into mothers labour force participation under a variety of conditions. For each age group there are 9 different conditions depending on income level and number of children below school age. In practice this means that the model produces insights into mothers labour force participation for a total of 27 distinct

family scenarios. In addition, the different conditions also influence the decision of grandmothers to provide childcare and thus the model produces insights into grandmother’s labour force behaviour for the same amount of family scenarios.

**5.3.2 The model split into parts**

As explained through the CLD in the previous section, the model consists of several feedback loops that are influenced by each other. The following section will show stock and flow diagrams of the different loops and explain how they are connected.

Figure 3 below shows a stock and flow diagram of the mothers work participation loop, this loop is responsible for adjusting mothers work participation hours.

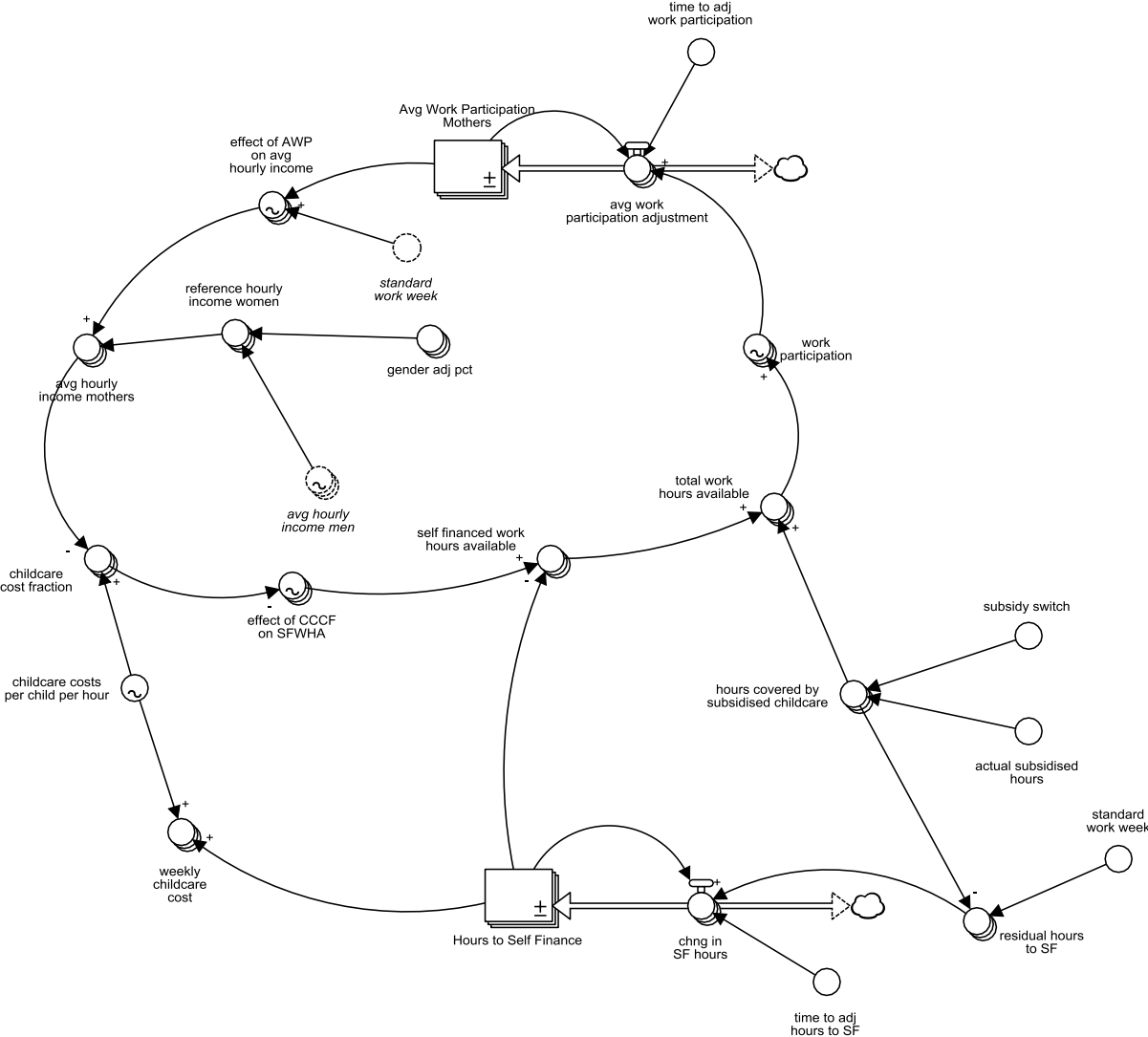


Figure 3 – Stock and flow diagram of mothers work participation loop

The work participation is determined by the variable “total work hours available” which add up the “hours covered by subsidised childcare” and the “self financed work hours available”. The “self financed work hours available” is determined by the stock “hours to self finance” multiplied with the “effect of the CCCF on SFWHA” (effect of childcare cost fraction on self-financed work hours available). This effect is based on the assumption that mothers who earn less or just above childcare costs are unlikely to pay for any childcare hours as in practice it does not pay for them to do so whereas the decisions of mothers who earn 50% or more than their childcare costs are unlikely to be forced to reduce their hours due to them being unable to afford childcare or it not paying to work. The “childcare cost fraction” divides the “childcare costs per child per hour” on “average hourly income mothers”. “Average hourly income mothers” is given by “reference hourly income women” which is based on the “average hourly income men” but adjusted for gender difference in accordance with the historical gender pay gap, the reference income is influenced by an “effect of average work participation on average hourly income” in order to give “average hourly income mothers”. The “effect of average work participation on mothers average hourly income” represent the assumption that the larger the number of hours you participate in paid work, the higher the percentage job position you hold, the higher position percentage the higher the wage and is thus given by the stock “average work participation mothers”. This stock changes through the flow of “average work participation adjustment” which is affected by the variable “time to adjust work participation” which is one year, as well as the variable “work participation” which is a first degree smooth delay of “total work hours available”.

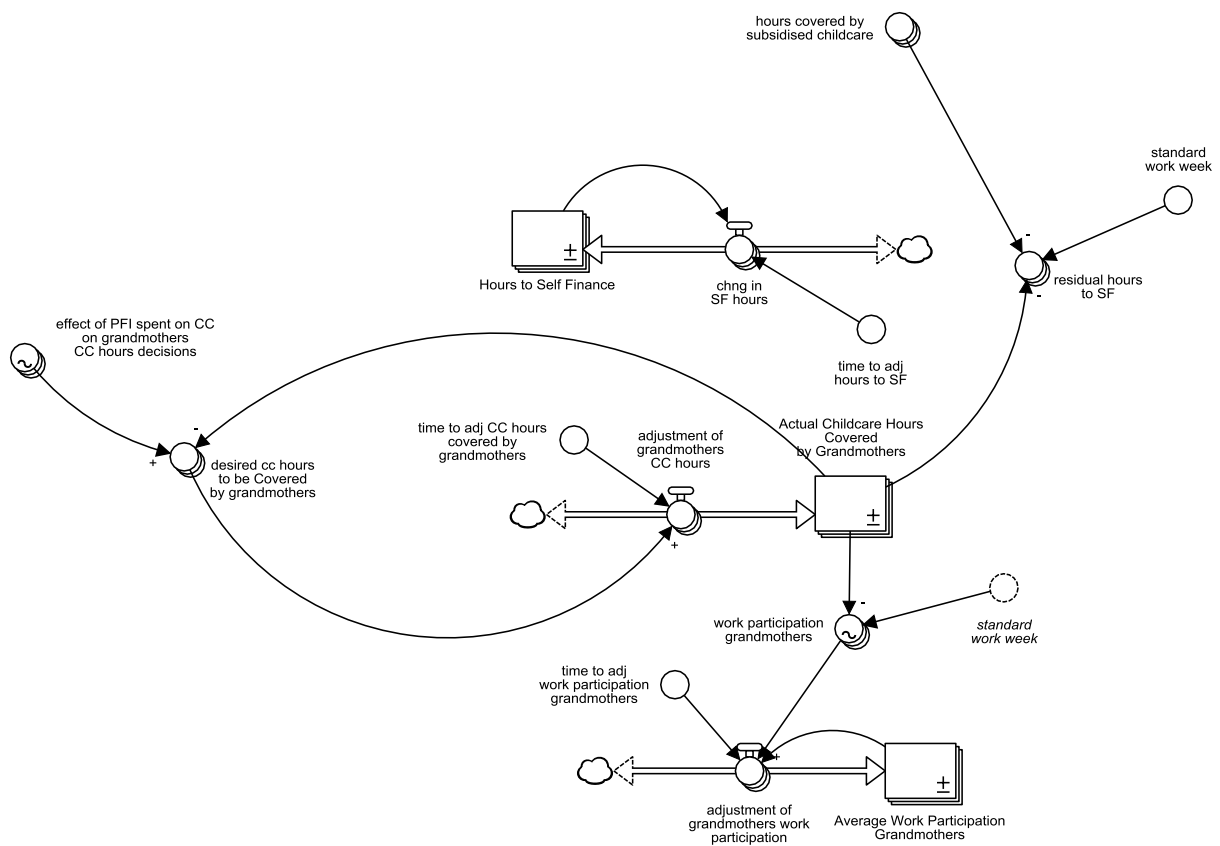


Figure 4 – Stock and flow diagram of grandmothers’ work participation loop

In figure 4 above we can see how the mothers work participation loop is influenced by the grandmothers’ work participation loop through the connection of the stock of “hours to self finance”. The variable “residual hours to self-finance” deducts the “actual childcare hours covered by grandmothers” and the “hours covered by subsidised childcare” from the “standard work week” (40 hours) in order to give the actual number of hours parents have to self-finance for them to hold full time work under the assumption that the parent which hours it will compromise is the mother. The “desired hours to self-finance” changes the stock of “hours to self finance” through the flow called “change in SF hours”, this flow is also affected by the variable “time to adjust hours to self finance” which is set to one year. “Residual hours to self finance” is as mentioned before influenced by the stock “actual childcare hours covered by grandmothers”, this stock changes through the flow of “adjustment of grandmothers CC hours”. This flow is influenced by a “time to adjust childcare hours covered by grandmothers” of one year, as well as by the variable “desired cc hours to be covered by grandmothers”. “Desired cc hours to be covered by grandmothers” multiplies the “actual childcare hours covered by grandmothers” with the “effect of PFI spent on CC on grandmothers CC hours decisions”. This effect is based on the assumption that the higher the



percentage of total family income is spent on childcare the more likely grandmothers are to provide childcare, it is arrayed and gives a different effect for the different levels of income as theory suggests grandmothers of low income families provide more childcare and grandmothers of high income families provide less. The stock of “average work participation grandmothers” changes through the flow called “adjustment of grandmothers work participation”, which in turn is affected by the “time to adjust work participation grandmothers” which is an estimate of two years, and by a variable called “work participation grandmothers”. The variable “work participation grandmothers” deducts the “actual childcare hours covered by grandmothers” from the “standard work week” to give the hours grandmothers have available for work. It is built as a graphical effect built on the assumption that the more hours you have available the more you work but that if you only have very few hours available you may choose to not work at all as the effort to do so is too large compared to the gain. It is also based on the assumption that even though grandmothers may have a full standard work week available they may work less due to other constraints i.e. part-time work being the only work available etc.

In figure 5 below we can see how the two loops of mothers and grandmothers work participation interacts through the "effect of PFI spent on childcare on grandmothers childcare hours decisions" which uses the "percentage of family income spent on childcare" as input. The "percentage of family income spent on childcare" divides the "weekly childcare costs" on the "family income" and multiplies with the variable "percentage" (100). "Weekly childcare cost" multiplies the "childcare cost per child per hour" with "hours to self finance" and adjusts for number of children in the family. "Family income" adds together the average weekly income of women and men to give the total family income. "Average weekly income men" multiplies the exogenous variable "average hourly income men" with the "standard work week" whilst "average weekly income women" multiplies "average hourly income mothers" with the stock "average work participation mothers".

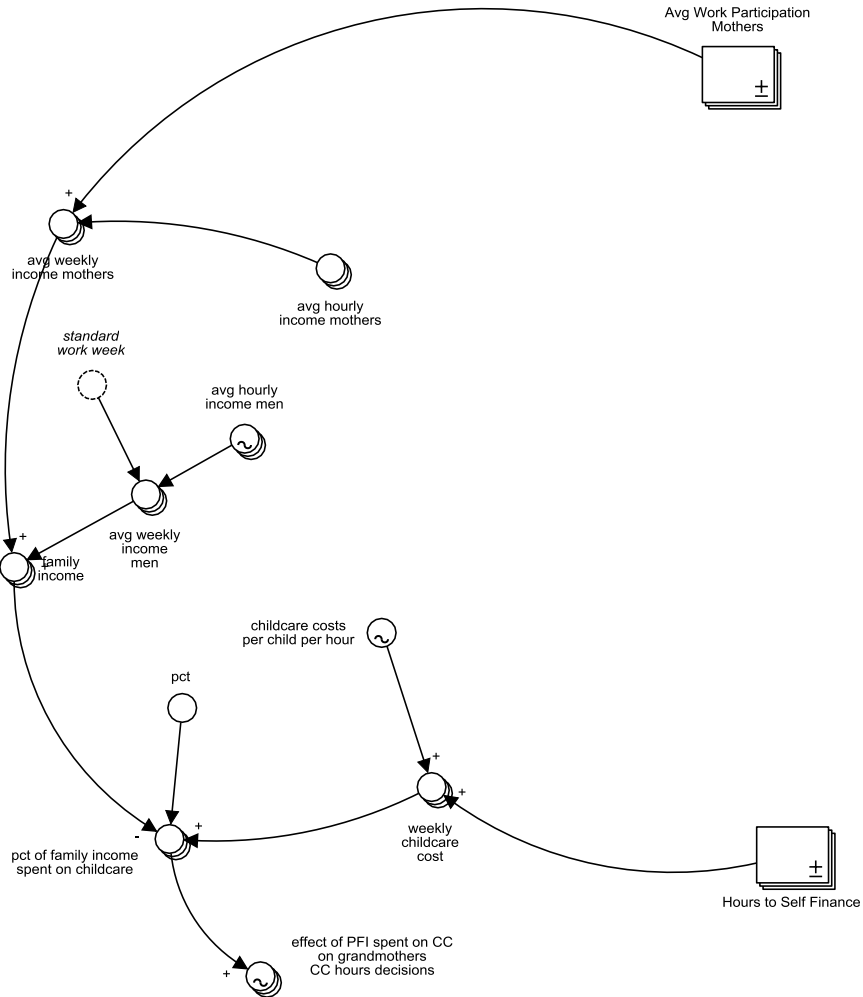


Figure 5 – Stock and flow diagram of the connection between the mothers and grandmothers work participation loops through the effect of percentage of family income spent on childcare on grandmother’s childcare hours decisions

A stock and flow diagram of the model in its entirety is available in Appendix A.

### **5.3 Validation and model testing**

As long established by leaders within the field of system dynamics, models cannot be fully validated or verified as they are very limited and simplified representations of reality; thus models do not represent the truth and cannot be proven (Sterman, 2000). However, despite the view that “all models are wrong” (Sterman, 2002), Sterman logically argues for continuous testing throughout the modeling process in order to uncover any modeling errors or flaws in the models design. In light of this, Sterman’s idea about “reflective modeling” was adopted in the modeling process of this thesis and testing was performed continuously through the modeling steps. Due to the particular context in which the model was built some tests was more useful and applicable than others. The tests that were conducted were based on the suggestions by Sterman (2000) and will each be explained individually.

#### ***Dimensional consistency***

The model was built using the idea of dimensional consistency from the very first variable added. Each variable added was reflected upon to make sure of its real world meaning, these steps ensured that any variable created was a logical addition to the model and that each equation was dimensionally consistent before implemented. To ensure dimensional consistency the unit tools in the modeling software was used in addition to human inspection of the logic in all variables and their respective equations.

#### ***Parameter assessment***

As all model parameters have real world counterparts their values was mostly identified via extended archive searches in order to find numerical knowledge of the system. This was sufficient in order find values for variables related to wages and income, hours worked etc. However, some parameter values, such as adjustment times, had to be established using logic and reason. In these cases partial model tests was used to calibrate the system.

#### ***Structure assessment***

As the purpose of this thesis is to highlight a relationship largely overlooked in literature, the structure of the system had to be established largely by extracting information about different system parts from a wide range of different theoretical and statistical sources (see chapter 2 and 3). Each of these sources provided small amounts of relevant knowledge about the structure of the system which was then together used to build the model structure.

#### ***Extreme conditions***

The model was tested with extreme conditions at several stages during the modeling process. The constants referring to income, hours of work and subsidies were tested for large shocks

using a “step” function as well as tests for behaviour during the circumstance of 0. These tests proved extremely useful and helped uncover faults in the models equations.

***Boundary adequacy***

The model includes the work participation of both mothers and grandmothers as endogenous in the model. The policy of subsidised childcare hours are not modelled endogenously as the purpose of the thesis is not to suggest policy but rather to point to why the policy has not had satisfactory effect to this date. Although it was considered to model the childcare policy endogenously in terms of GDP and the percentage of it set aside for family policies, it was found to be outside the time constraints of this thesis.

***Integration error***

The model was tested with the range of integration methods available in the Stella Architect modeling software as well as with a variety of different time steps. The model behaviour was found to be consistent regardless of time step or integration method.

## **6. Results**

In this section the behaviour of the model will be presented and explained through a series of graphs showing output from the model. First, we will look at the general behaviour of the model before taking a closer look at some specific examples relating to different family scenarios before touching upon policy and its implications. Lastly, the model's limitations will be discussed. Note that the results presented in this chapter refer to a range of hypothetical family scenarios and how work participation of mothers and grandmothers in these families respond to the policy of subsidised childcare. These hypothetical family scenarios are highly simplified representations, and as such, do not conform to reality.

### **6.1 General model behaviour**

The reference mode presented in the introduction shows the total female labour force participation rate from 1990 to 2015 adjusted for full-time equivalent. The data used as base for the reference mode is publicly available, but unfortunately it was not possible to source any data that separate female labour force participation by age groups, presence of children, actual number of hours worked, and marital status. This made it necessary to estimate initial values based on the assumptions presented in the previous chapter. This, in combination with the model's focus being on a very particular group of women, namely mothers of children below school age in a two parent relationship and the grandmothers in such families who are active in the labour force; implies that the model behaviour cannot easily be compared to the reference mode and the results must, for these and other reasons, not be confused with reality. Yet, the model behaviour does give useful insights into how mothers and grandmothers work participation is affected by the presence of subsidised childcare hours, and how subsidies affect mothers differently based on the circumstances of their life.

The general model behaviour is in accordance with the theory and concepts presented in chapter 2. The average work participation of mothers varies greatly depending on their income. The number of children a mother has (referring to the number of children aged 0-5) also influence her work participation. Mothers work participation is determined by the number of hours they have available for paid work (i.e. the number of hours they are able to access care for their children). The family income level greatly affects this, and mothers in low income families therefore work the least as they cannot afford to pay for many hours of childcare and thus rely on the hours grandmothers can provide. Hence, grandmothers in low income families work the least hours, as the incentive for them to reduce their hours to

provide childcare is large because of the high percentage of family income that low income families need to spend on childcare in order for the mother to participate in paid work.

The greater the number of children a mother has below school age, the fewer hours she works. This holds true for all age groups and income levels. However, the higher a mother’s income is, the less her number of children affects work participation. This reflects the findings of Viitanen (2005) that higher income mothers can afford childcare and thus are less likely to reduce work hours due to the financial impact of childcare costs.

The main result that will be discussed when trying to answer the research questions is the impact of subsidised childcare hours on the work participation of mothers from different family types and with different numbers of children.

**6.1.1 The case of low income families**

In figure 6 below we can observe how the work participation of mothers in low income families develop throughout the period of analysis.

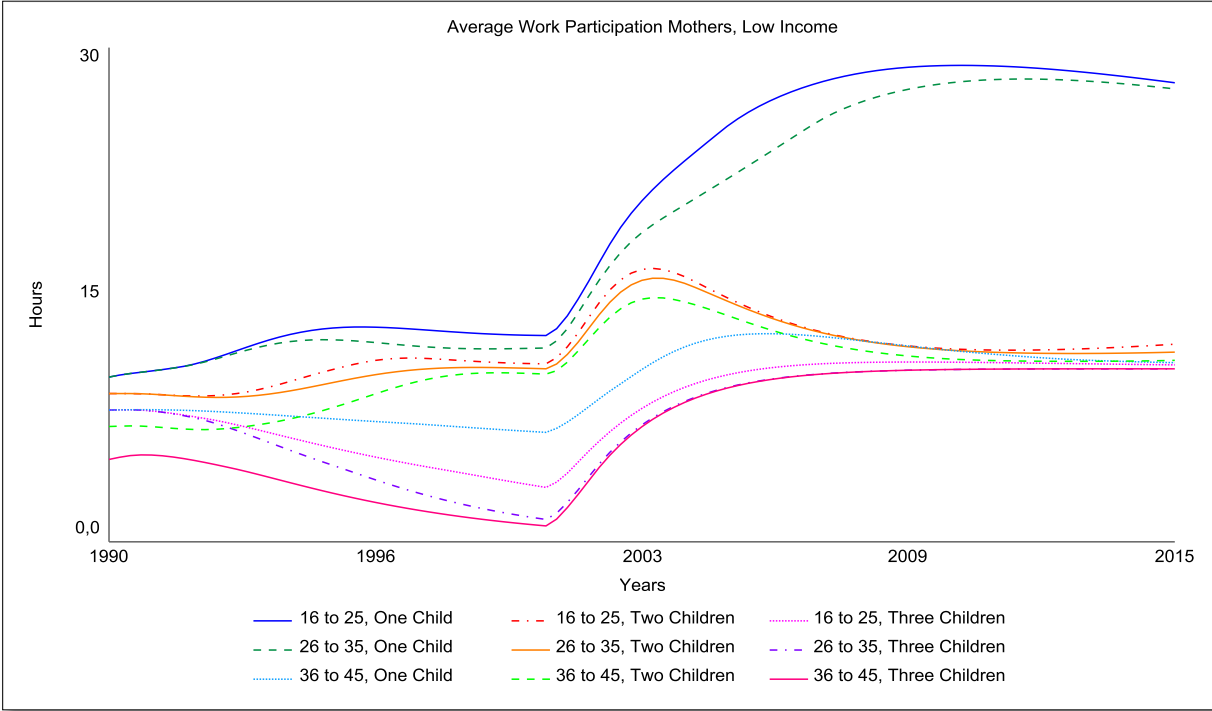


Figure 6 – Average work participation mothers of low income families by age group and number of children

During the period before subsidies start in 2000, work participation is 13 hours a week or less for all low income mothers regardless of age group or number of children. The 15 hours of subsidised childcare per child available from year 2000 causes a steep increase in work

participation during the first few years of the policy. However, the effect is much greater for mothers with only one child than for mothers with two or three children below school age. The exemption is mothers aged 36 to 45 with one child as the grandmothers in such families are highly likely to be older and thus less likely to provide childcare. The reason subsidies causes a greater response in mothers with only one child below school age, is that the costs multiplies with the number of children a mother needs to cover with childcare. The more children below school age present in a family, the higher the percentage of the family income would be needed to pay for childcare in order for the mother to participate in paid work, as illustrated in figure 7 below.

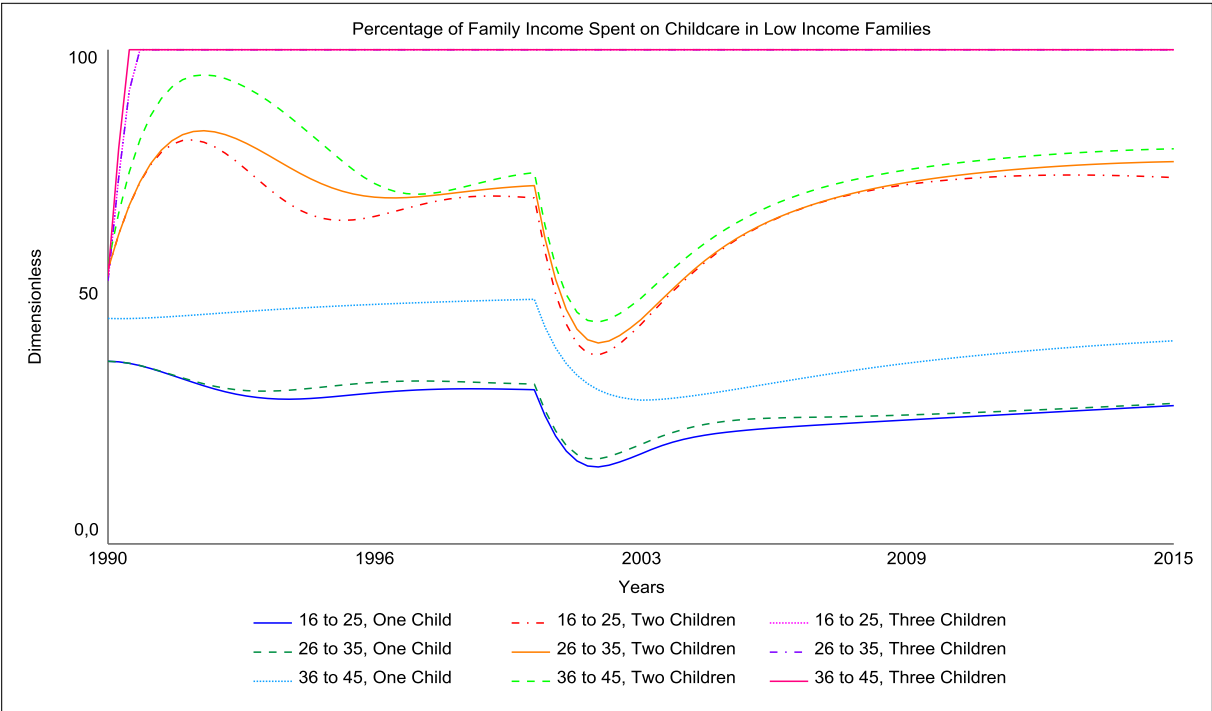


Figure 7 – Percentage of family income spent on childcare in low income families

Although initially favourable, the effect seem to fade after only a few years and after 2005 we see a decreasing behaviour towards lower level of participation for all but the mothers with only one child in the age group. This behaviour is due to the percentage of family income spent on childcare. Childcare prices rose significantly in the period, and much faster than wages. Thus, while the 15 hours of subsidised childcare per child caused the percentage of family income spent on childcare to drop drastically initially, around 2003 the percentage of family income spent on childcare started to rise again because of to the increase in childcare prices in comparison to wages.

In figure 8 we can observe how the subsidised childcare hours initially caused a drop in weekly childcare costs for low income families. However, by 2015, the weekly childcare costs had risen above the level it had before subsidies were introduced. Although wages also increased during the period, this was not sufficient to counteract the effect of the increased childcare prices. This is evident in figure 7 above portraying the percentage of family income spent on childcare. Comparing the development of this percentage of family income spent on childcare with the development of weekly childcare costs in figure 8 below, we can see how both these variables exhibit an initial favourable reaction to the subsidies in year 2000, only gradually starting to return towards previous levels after a few years, despite the fact that families are having to self-finance fewer hours than before.

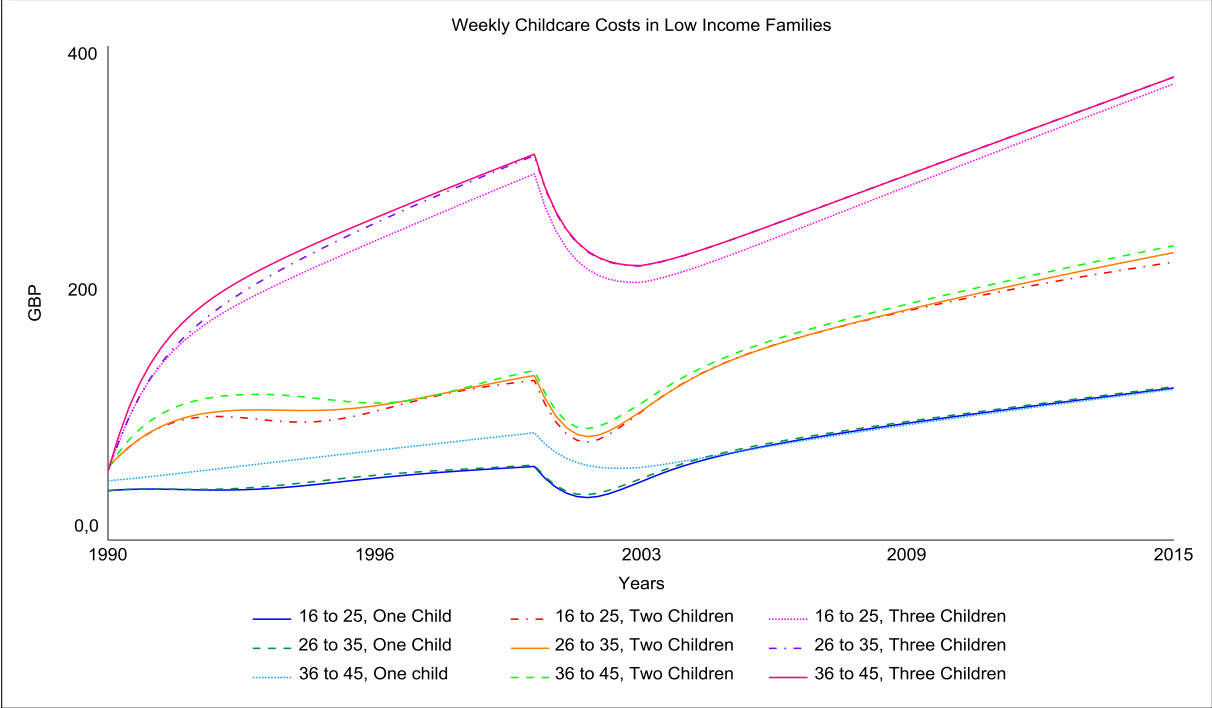


Figure 8 – Weekly childcare costs in low income families

Grandmothers provide informal childcare as a response to families need. A high percentage of family income to be spent on childcare (under full formal care), works as an incentive for grandmothers to reduce their hours of paid work in order to provide free, informal childcare for grandchildren and thus give families less formal childcare hours to cover. The behaviour of grandmothers work participation and childcare hours covered in the case of low income families are shown in figure 9 and 10 below.



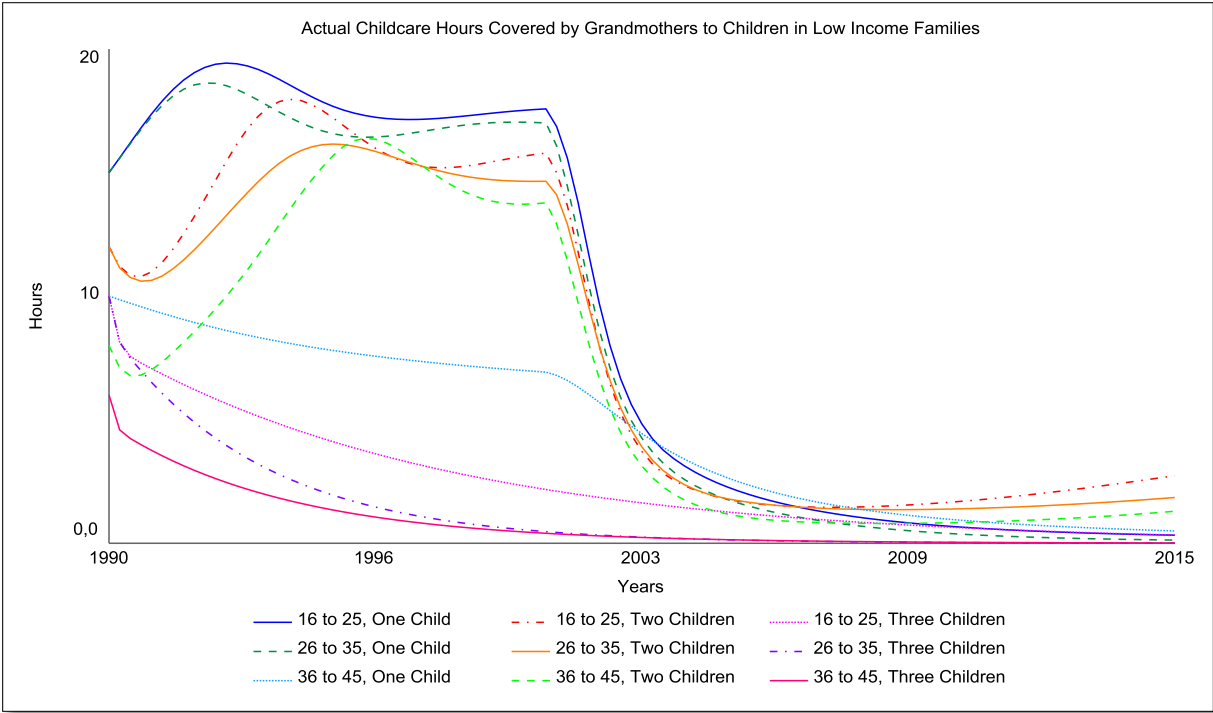


Figure 9 – Actual childcare hours covered by grandmothers to children in low income families

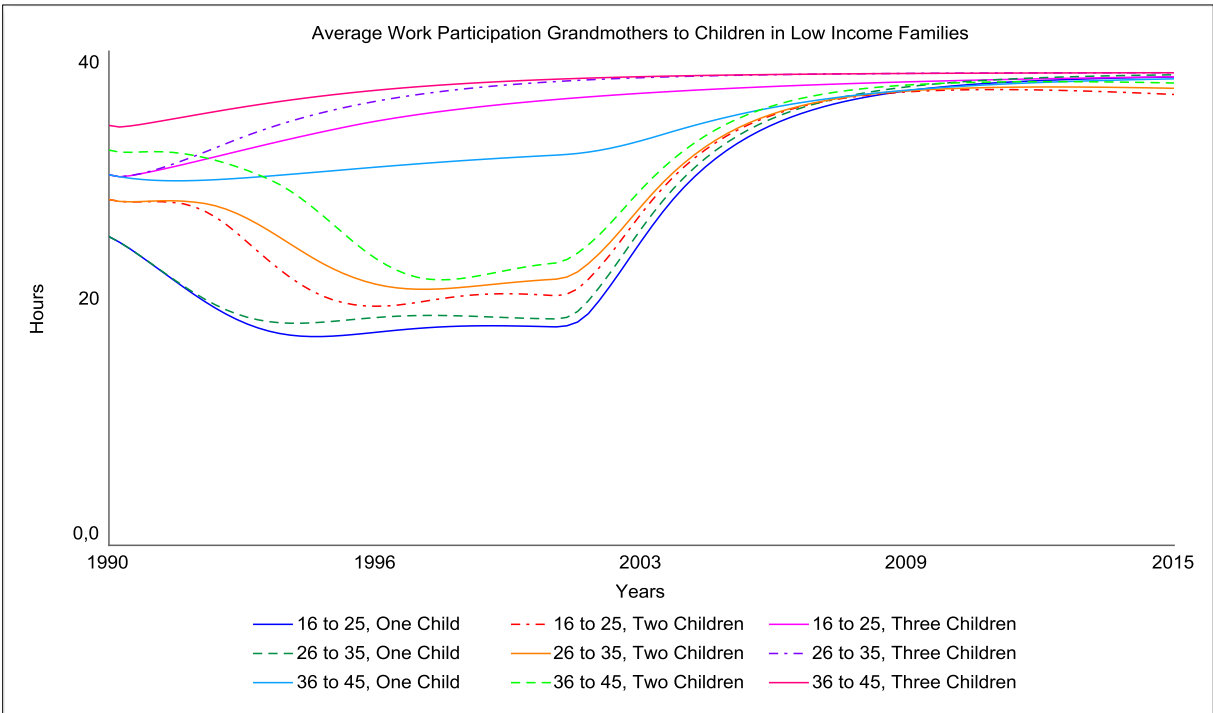


Figure 10 – Average work participation grandmothers to children in low income families

As the above graphs show, the more childcare hours a grandmother provide, the less hours she spends in paid work. The number of childcare hours provided by grandmothers depend both on the percentage of family income spent on childcare as mentioned earlier, but also on the

age group the mother belong to younger mothers are more likely to have younger mothers themselves. In addition, the number of grandchildren present will impact on the childcare hours covered by grandmothers as it can be both difficult and tiring caring for several children below school age at the same time. In figure 9 we can observe that grandmothers in low income families provide extensive number of childcare hours and that these hours drop in response to the subsidised childcare hours available from year 2000. In figure 10 we see how the grandmothers work participation becomes adjusted to the fewer hours of childcare provided, and thus work participation increase in response. Still, grandmothers continue to provide some hours of childcare.

**6.1.2 Medium and high income families**

Medium and high income families respond slightly differently to the subsidised childcare hours than low income families. This is due to the percentage of family income spent on childcare being much smaller than in low income families (in most of the cases). When considering figure 11 and 12 below in comparison to figure 7 (which showed percentage of family income spent on childcare in low income families) it is notable that, in none of the sample families of medium and high income, the percentage of family income spent on childcare reaches 100 percent.

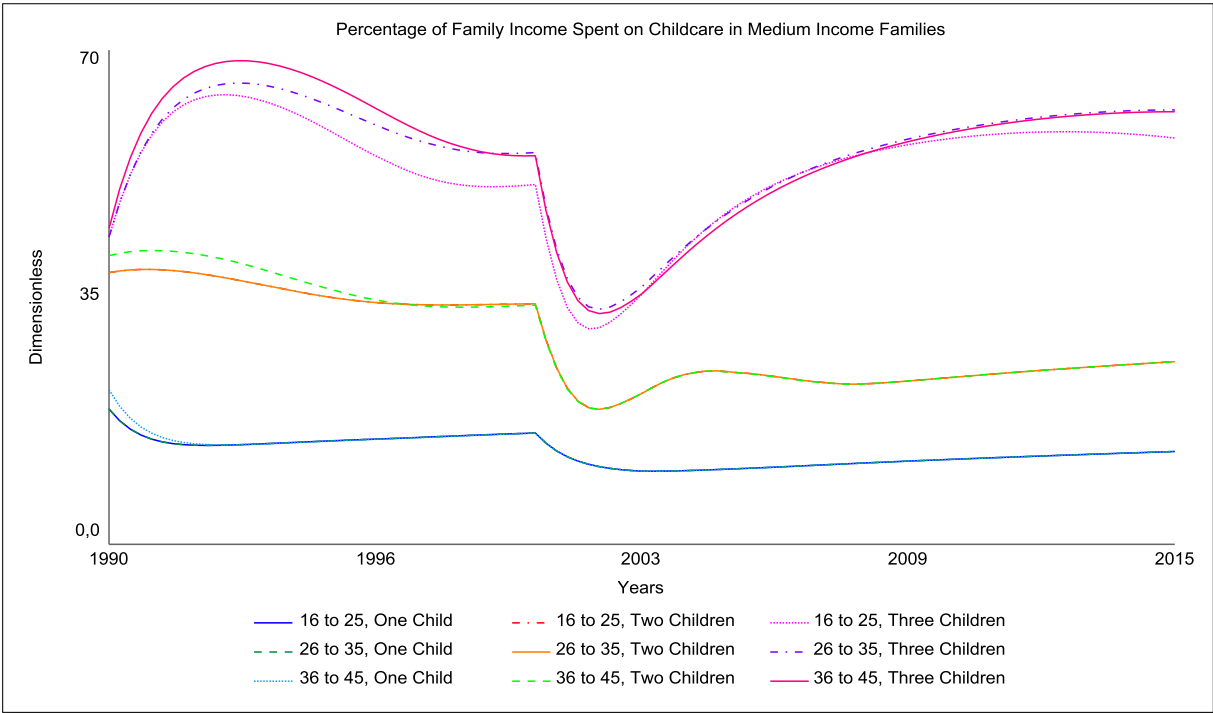


Figure 11 – Percentage of family income spent on childcare in medium income families

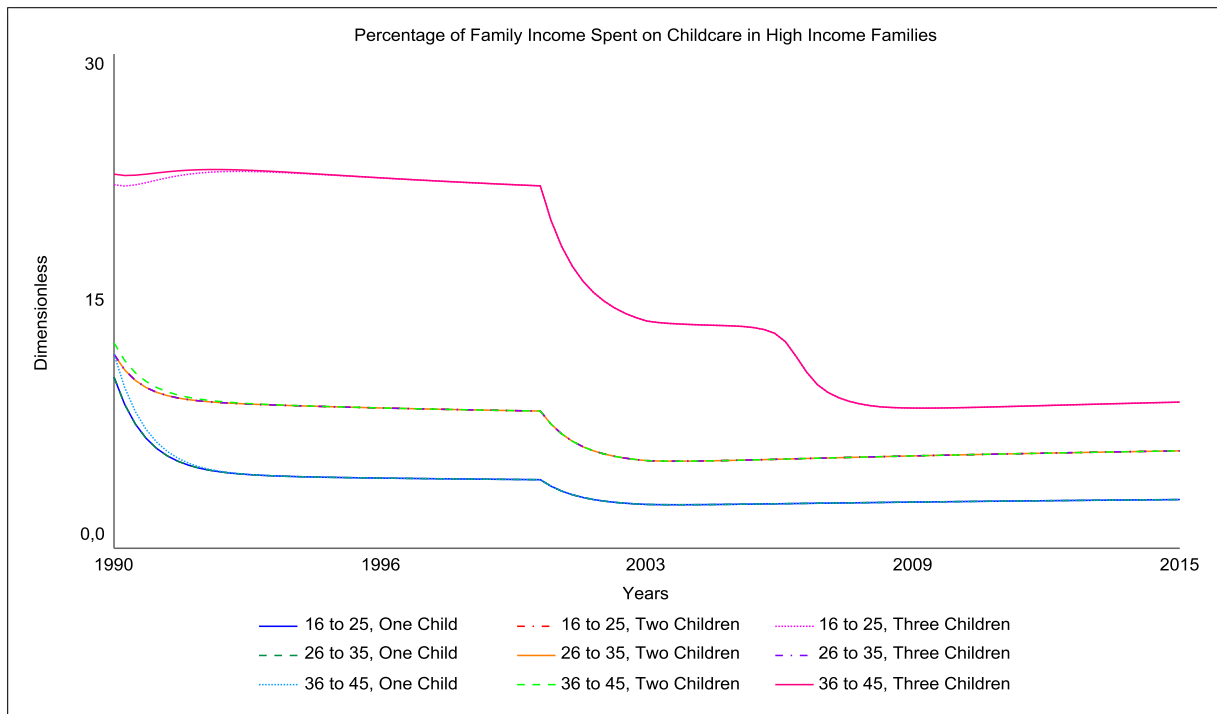
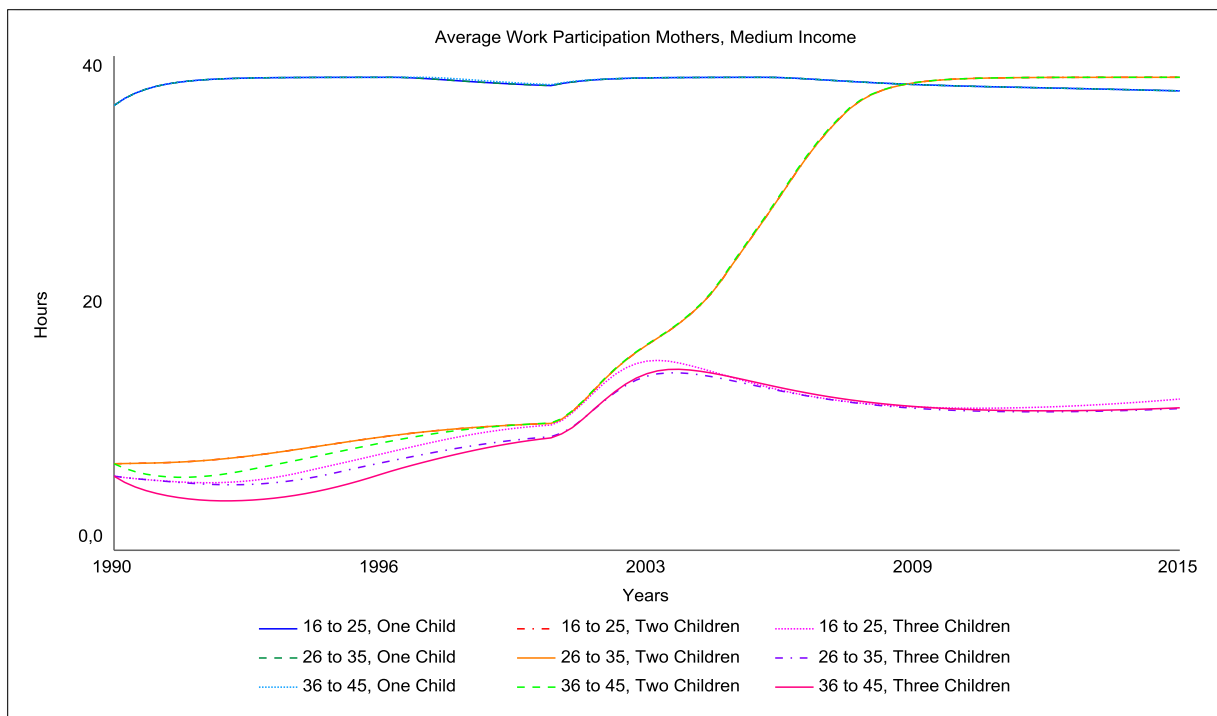


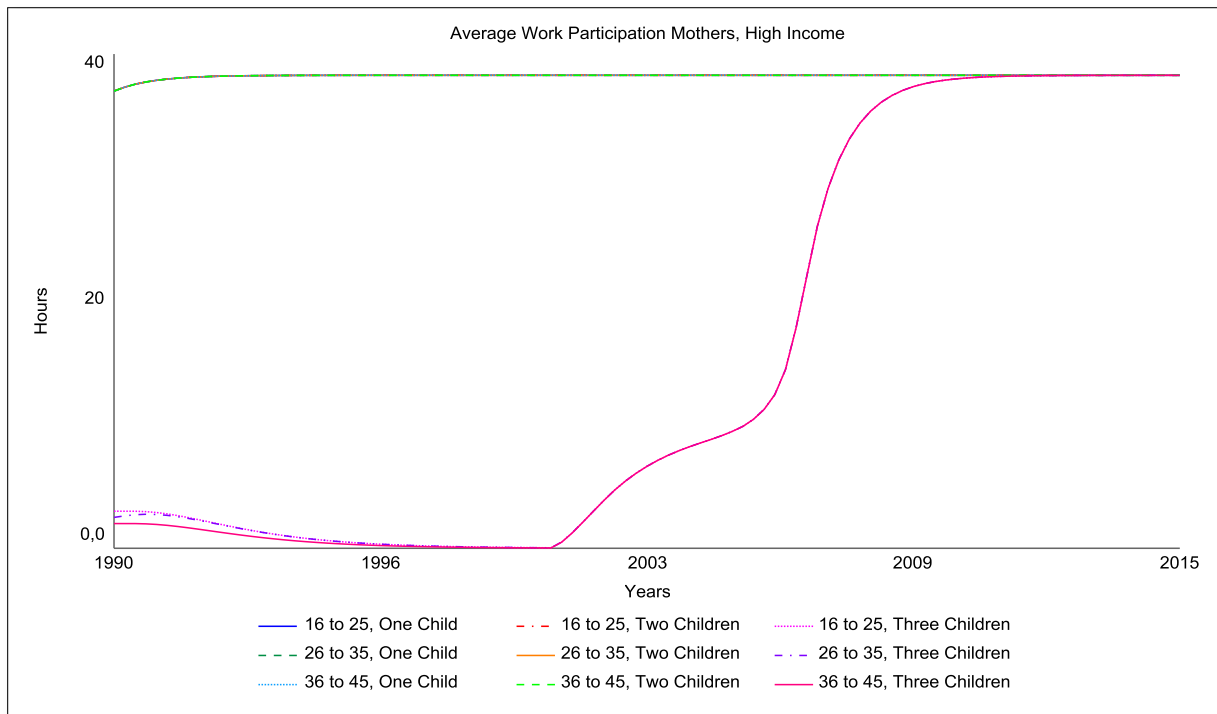
Figure 12 – Percentage of family income spent on childcare in high income families

Since the percentage of family income spent on childcare is smaller in medium and high income families, the work participation of mothers and grandmothers are higher in these families. However, medium income mothers with two or three children under school age have very low work participation compared to mothers with only one child. This is due to the “childcare costs fraction” which divides the childcare costs over income to give an effect on the “self financed work hours available”. In the case of medium income mothers, the rise in childcare costs that come with any additional children above one, cause such a large increase in the “childcare costs fraction” that it does not pay to work any additional hours than those that can be accessed with no cost, through grandmothers care hours or subsidised childcare hours. This effect can be observed in figure 13 below.



*Figure 13– Average work participation mothers of medium income families by age group and number of children*

In the case of high income families, subsidies have little effect on the work participation of mothers with one or two children as their income sufficiently cover formal childcare and thus their work participation is already high. However, mothers in this group with three children have very low work participation in the years before subsidies start as can be observed in figure. This is due to the assumption that grandmothers in high income families provide the least informal childcare, in combination with the total cost of three children in formal care being close to the average weekly income for mothers in this group. Thus, subsidies has a large effect on high income mothers with three children as the 15 hours per child brings the cost down to a level where these mothers has a large financial incentive to partake in paid work due to their high hourly wages.



*Figure 14 – Average work participation mothers of high income families by age group and number of children*

Grandmothers in medium and high income families provide fewer hours of childcare than grandmothers in low income families. Still, some of the medium income families do rely on the free hours of childcare accessible through grandmothers. As we can observe in figure 15, the grandmothers in medium income families with more than one child below school age provided a significant and increasing number of childcare hours in the period before subsidies started. After the 15 hours of subsidised childcare became available in year 2000 the number of childcare hours provided by grandmothers in the above mentioned families drops dramatically. Yet, when taking a closer look at the graph in figure 15, it is notable that for families with three children the childcare hours provided by grandmothers starts to rise again after only a few years of subsidies. As the actual childcare hours provided by grandmothers impact on the work participation of grandmothers, the behaviour discussed above is reflected in the work participation of grandmothers in medium income families which can be observed in figure 16.

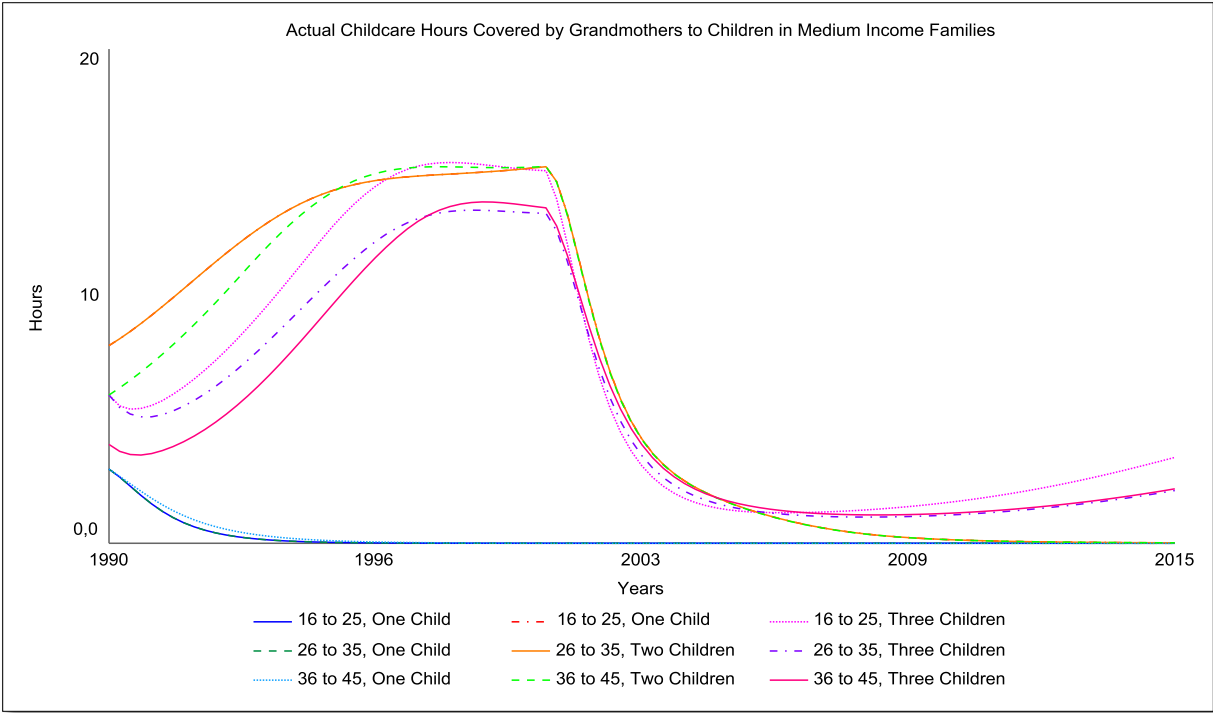


Figure 15 – Actual childcare hours covered by grandmothers to children in medium income families by age group and number of children

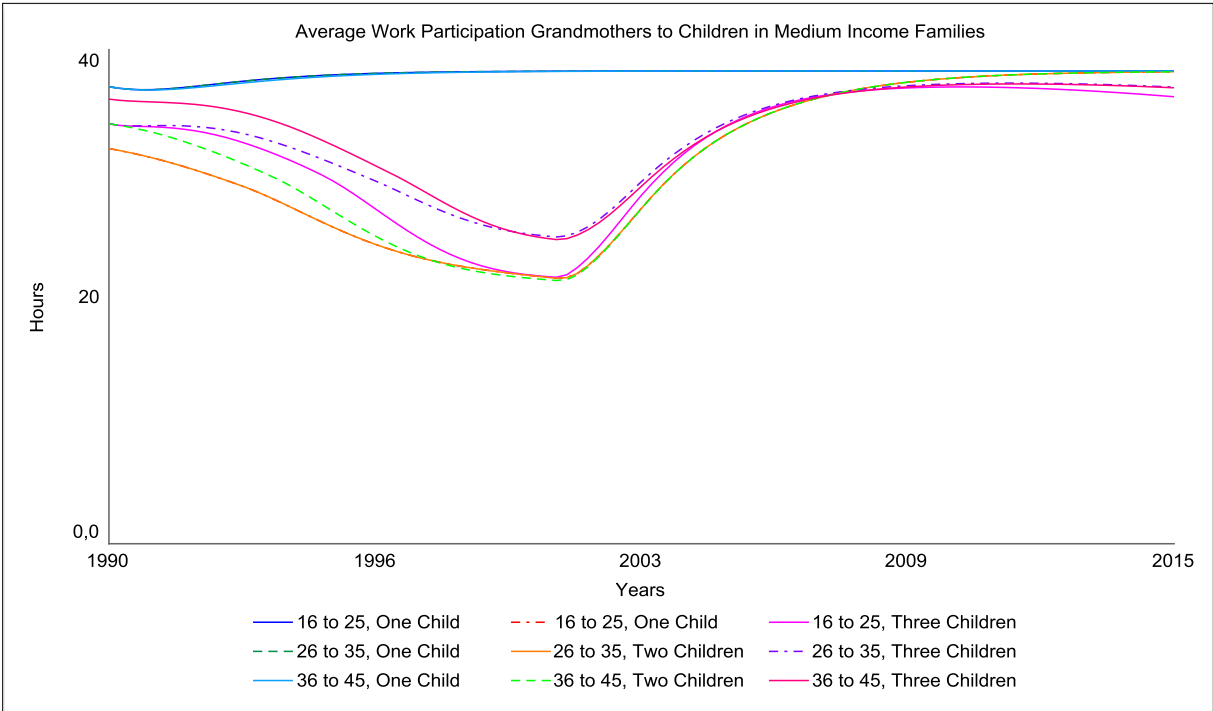


Figure 16 – Average work participation grandmothers of medium income families by age group and number of children

The childcare subsidies have little or no effect on the work participation of grandmothers in high income families, as they do not provide much childcare since the income levels in these families are too high to provide an incentive for grandmothers to reduce their hours. In figure 17 below we can observe how the initial level of work participation vary slightly, due to the estimated initial values of childcare provided, before the average work participation for all groups stabilise at full work participation.

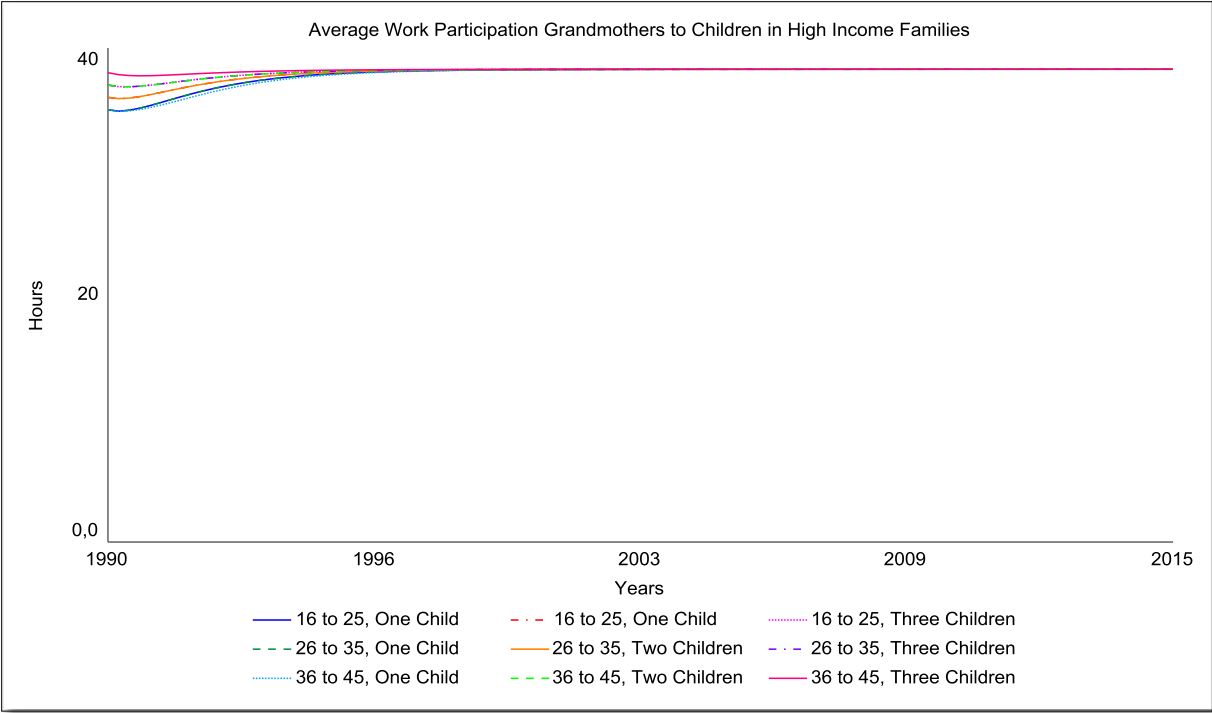
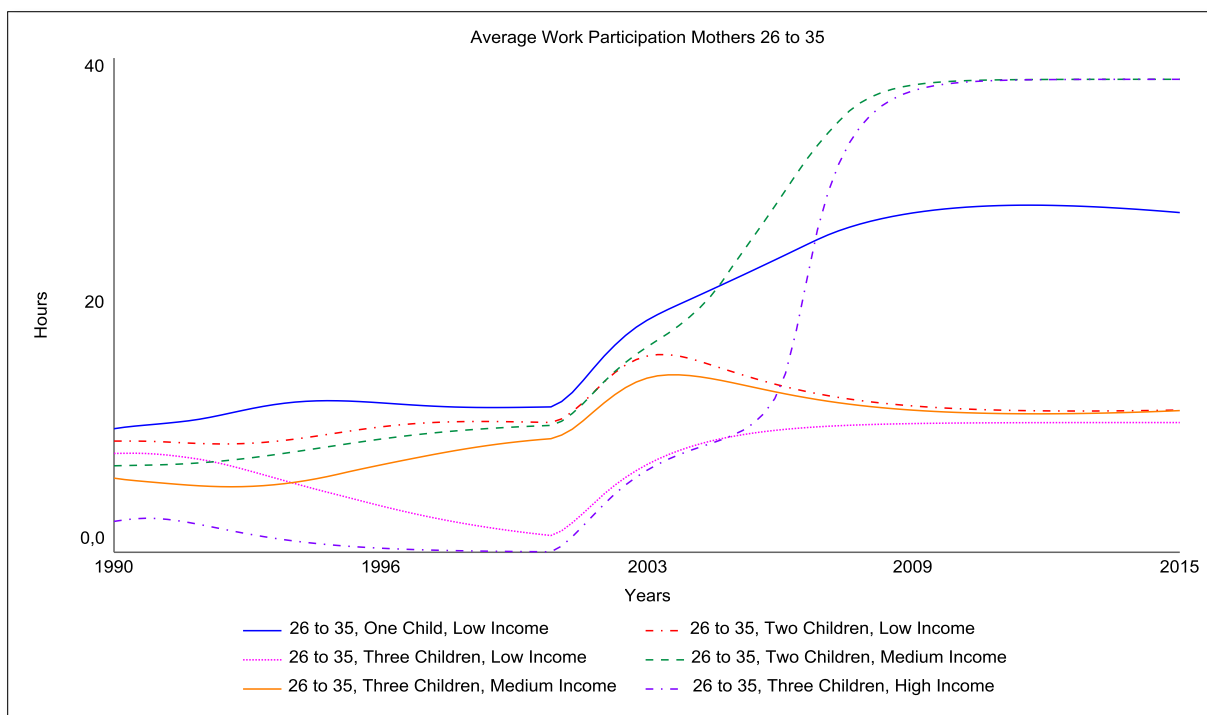


Figure 17– Average work participation grandmothers of high income families by age group and number of children

**6.2 The impact of subsidies**

The results presented through the graphs show that the work participation of mothers and grandmothers in certain family types, were more affected by the childcare subsidies than women from other family types. More specifically, mothers and grandmothers of low income families, mothers with two and three children in medium income families and mothers with three children in high income families saw the most benefit in the years after the subsidies were introduced. The work participation behaviour of the mothers in these families can be observed in the example found in figure 18 below that shows the age group 26 to 35, in the families with the largest response to the policy.



*Figure 18 – Average work participation mothers aged 26 to 35, families with largest response to policy*

Note that, in the example from age group 26 to 35 in the figure above, it is the mothers of two children in medium income families and mothers of three children in high income families that have the largest increase in work participation in response to policy. These findings suggests that the policy of subsidised childcare hours do not work satisfactorily for the families that needs it the most, namely all low income families and medium income families with three children.

### **6.3 A note on policy and future scenarios**

The aim of this thesis has not been to suggest or develop any policy as the problem in question is related to the limitations of existing policy rather than the complete lack of that policy. As evidence from the Nordic countries suggest that subsidising childcare hours is indeed a very effective way of increasing female labour force participation (Lammi-Taskula et al., 2012), the goal of this thesis has been to investigate why the UK has not seen similar results as the Nordics despite the policy seemingly being the same. The model therefore represents the current policy exogenously, and merely changes the value of the exogenous variable that represents subsidised childcare hours to show how behaviour could change depending on future development in the number of subsidised childcare hours. Although the government have presented ambitious plans for developing social policy aimed at families and childcare in the future, the 2016 referendum vote to exit from the EU could potentially



lead to changes to such plans, especially in light of the current period of austerity in the country.

In the figures presented on the next pages we can observe how work participation for mothers in the families from the example used previously, would respond to three different scenarios for future policy. The scenarios are as follows:

- Scenario 1 – the hours of childcare that are subsidised do not change and remain 15 hours a week towards 2030 (base case).
- Scenario 2 - the hours of childcare that are subsidised double to 30 hours in 2017 and remain at that level towards 2030.
- Scenario 3 - the hours of childcare that are subsidised are reduced to 0 and kept at that level until 2030.

These scenarios are meant as examples to illustrate how the number of subsidised childcare hours has a direct effect on mothers’ work participation, as well as to illustrate how mothers’ work participation must reach a certain level before it has full effect for all families.

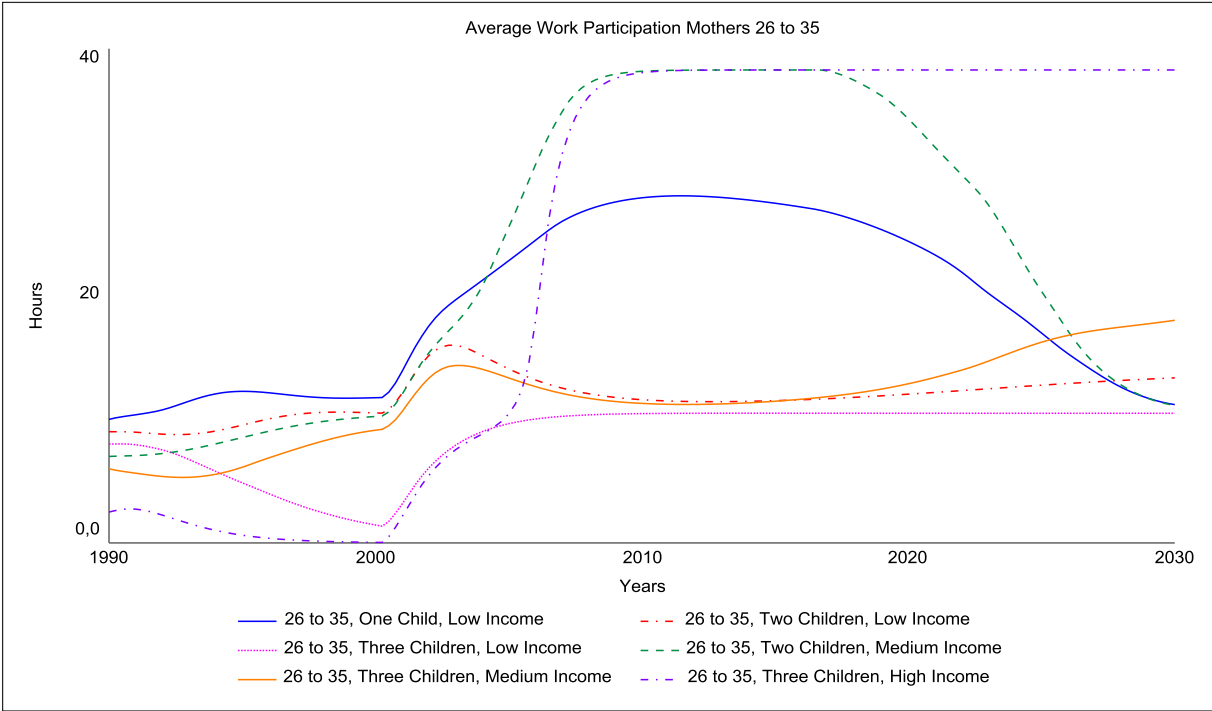


Figure 19 – Development of average work participation mothers aged 26 to 35, families with largest response to policy, under scenario 1 conditions

Figure 19 above shows the development of work participation under the condition of scenario 1, the work participation of the mothers in the example families remains at similar levels for

most of our sample families. However, in the case of low income families with only one child the work participation is gradually decreasing towards the level of work participation of the other low and medium income families. It is only the work participation of high income mothers with three children that comes close to full work participation and which remains high in the time period.

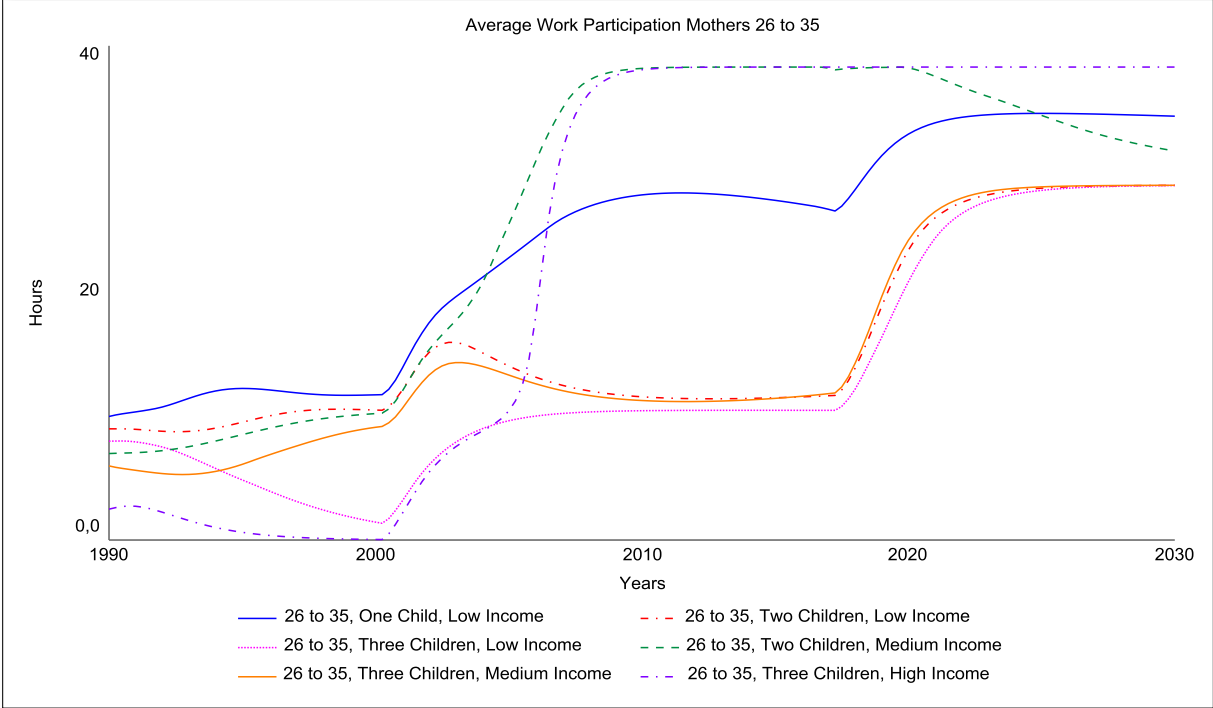


Figure 20 – Development of average work participation mothers aged 26 to 35, families with largest response to policy, under scenario 2 conditions

Figure 20 above shows scenario 2, here the subsidised childcare hours was doubled in 2017. This is the most favourable one of the example scenarios; work participation for mothers in all the sample families increased to between 30 and 40 hours a week. Note that, although the model was run until year 2030 in the presented figures, the model was run for much longer timeframes during testing and the results of increasing subsidies to 30 hours seem to be a lasting effect which stabilised work participation at these levels. As the UK government defines full-time work as 30 hours or more, we may conclude that, with scenario 2 conditions full-time work becomes possible for all our sample mothers. This can be traced back to the percentage of family income spent on childcare; in scenario 2, no families spend more than 30 percent of their income on childcare. The large increase in the hours a mother has available for paid work allows her to access full-time employment, and thus family income is increased.

The result of scenario 3, a drop back to 0 subsidised childcare hours, is found in figure 21 below. Here we can see how work participation for the sample mothers gradually drop after the subsidies are cut.

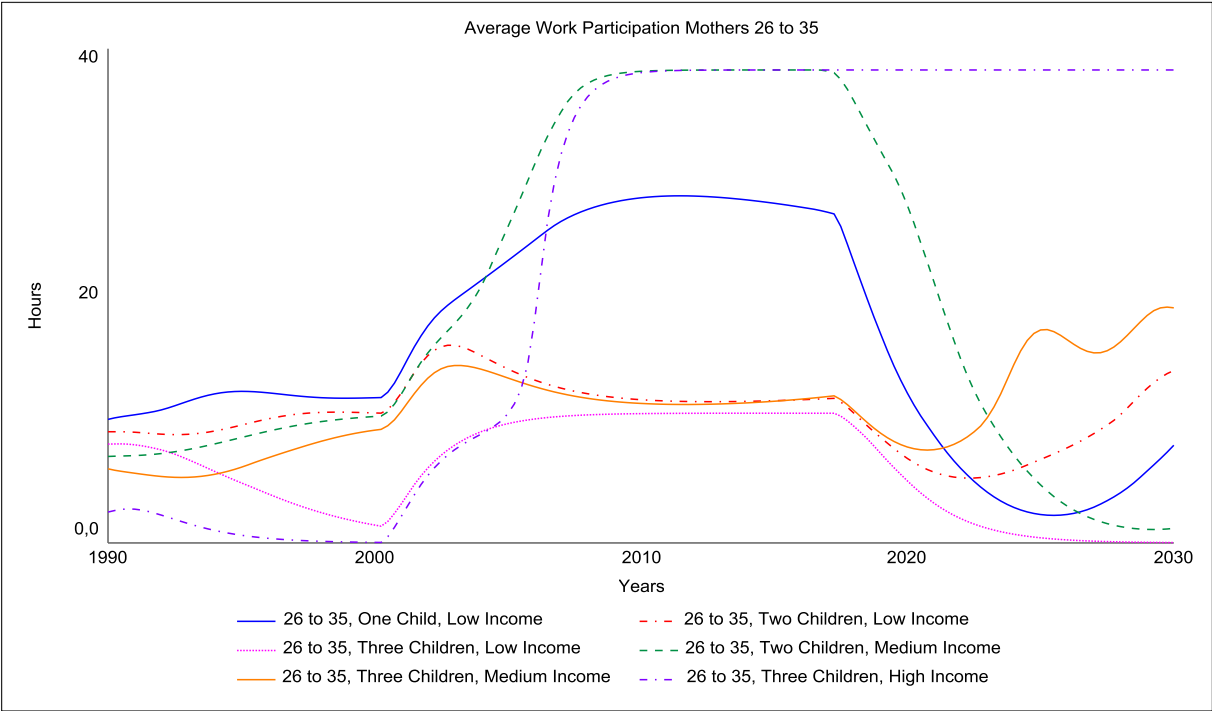


Figure 21 – Development of average work participation mothers aged 26 to 35, families with largest response to policy, under scenario 3 conditions

For most of the mothers, work participation drops below the level it was before subsidies first were introduced in 2000. This is due to the relationship between wages and childcare costs. As both wages and childcare costs are extrapolated when the model is run into the future, the trend of childcare costs increases faster than wages continue. This means that mothers can afford fewer childcare hours than they could before 2000 as the gap between wages and childcare costs were smaller then. Of all the families used in this example there is only one exemption to this behaviour. The work participation of high income mothers remains high and does not seem to be affected by the drop in the subsidies.

The general results and different scenario outcomes will be further explained and discussed in the next chapter.

**6.4 Limitations**

When modeling something as complicated and diverse as female labour force participation, many difficulties arise. Thus simplifications and generalisations had to be made in order to end up with a model of a reasonable size and scope, and that at the same time could replicate,

to some extent, the labour force behaviour and decisions made by women. However, the goal was never to create a complete model that fully explains women's labour force participation, rather to use it to illustrate the dynamic relationship between the labour force participation behaviour of mothers and grandmothers and how it is affected by aspects of family policy.

The model boundaries are very narrow and consider only the work participation of mothers with children below school age, who are in a dual-earner family and grandmothers who are healthy and below retirement age. Furthermore, the model does not represent aspects such as wages and policy measures endogenously. Other important factors, such as employment and government budget for childcare, are left out entirely. In addition, the model does not consider the constraints related to supply within the childcare sector or other aspects related to the actual delivery of the subsidised childcare hours, such as complicated processes before childcare can be accessed, costs, staff supply, quality etc.

In light of the above, the results and the model behaviour must be considered with caution. Still, when viewed in the background of existing literature, the results do provide some insights into the labour force behaviour of the groups of women considered within these boundaries, and how they respond to the family policy of subsidised childcare hours.

## **7. Discussion**

The purpose of the model presented above is, as mentioned earlier, not to replicate reality, but to illustrate and provide insight into a relationship that is largely overlooked in literature to date. The behaviour of the model does indeed show that there is a relationship between the labour force participation of mothers and grandmothers in terms of the hours available for participating in paid work. This relationship is strongly influenced by the social policy of subsidised childcare hours, which is evident when considering the reduction in childcare hours provided by grandmothers, as a response to the lowered percentage of family income spent on childcare after subsidies were introduced. Nevertheless, the initial positive effect did not last due to a second factor related to the increase in cost of formal childcare.

This chapter will first discuss how politics and more specifically, policy, influences female labour supply. Second, the discussion will narrow in on why the effect of the implemented policies is limited, and how the policy in question is insufficient in providing the desired result. Next, the possible effect of adopting the Nordic way, seen as ‘best practices’ in social policy, in the UK will be discussed in relation to concepts such as child poverty, the phenomenon of the aging population and the suggested crises of care that could potentially go with it.

### **7.1 The effect of policy on female labour force participation**

Political decisions relating to social policy and childcare policies in particular, have considerable consequences for UK women’s ability to participate in paid work. In a country where the male breadwinner structure of the family prevails to such an extent, causing both a double-burden effect for working mothers, as well as staggering development in gender equality and discrimination measures; the labour force participation of UK women remains limited despite a range of policy measures implemented.

In order to investigate why the policies found in the UK have not given the expected results, it is necessary to revisit evidence presented in the theoretical foundation and historical development section (chapter 2). The policies implemented since New Labour came to power in the late 1990’s have all clearly been inspired by policies found in the Nordic countries, yet the results in terms of increased FLFP are nothing close to the levels reached in the Nordic countries. Taking a closer look at how the childcare policies differ in the Nordic countries in comparison to the UK, there are two factors that dramatically stand out, namely the level of subsidies in relation to family income and how the childcare is delivered to the market.

The first of these factors, the level of subsidies in relation to family income is present in the system dynamics model used in this thesis. The rise in costs of childcare during the period 2000-2015 seem to have limited the benefit of subsidised childcare hours significantly as the percentage of family income spent on childcare keeps increasing instead of decreasing (or remaining stable). The large percentage increase in childcare costs, which by far outweighs growth in wages in the period, amplifies the argument made by Rutter (2016) that the supply and demand functions in the childcare market does not work sufficiently. Considering this supply and demand function in reference to the widely interpreted concept of the invisible hand (first introduced by Smith in 1776 (Smith, 2000)), the market does not respond as desired to the increase in demand.

### **Supply and demand in the childcare market**

As supply does not increase in correspondence with demand, prices rise as demand rises towards much higher levels than supply. This leads us back to the second factor that is particularly different in the delivery of subsidised childcare in the UK versus the Nordic countries: the delivery of childcare to the market. In the Nordic countries, childcare is delivered through a combination of private and publicly owned childcare facilities. This ensures that demand is met as public childcare services are scaled up and down in response to demand. As most Nordic children are entitled to childcare after the parental leave period ends, usually when the child is around 1 year old, birth rates in an area can be used as an indication to scale public childcare supply up or down. In many cases, temporary childcare facilities will be built in areas which are highly populated with young families, and taken down once demand decreases as the demographic make-up in the area changes over time. Although demand is met both through private and public childcare services, the cost to the families are the same due to the simple structure delivering subsidised childcare: parents pay a fixed price regardless if the service provider is private or publicly owned. This is very different from the UK where childcare is delivered solely through privately owned childcare facilities, and where prices can vary significantly from provider to provider and between areas. The state funded subsidised childcare hours available are aimed at reducing the high costs to families, yet the costs have only reached such levels because of a lack of response to the increased demand amongst UK private childcare suppliers. Thus, the problem cannot be solved by subsidising childcare hours as this only treats the symptoms and not the root cause of the problem.

## **Revisiting the research questions and hypothesis**

The argument made above provides a possible answer to the first hypothesis introduced in chapter 1:

*H<sub>1</sub>: “Inefficient social policies for work/family balance are responsible for the stagnation in development of female labour force participation in the UK.”*

As the policy in action can be seen to treat the symptoms (i.e. high childcare prices) but not the underlying cause (supply does not meet demand), costs are driven upwards. The current level of 15 subsidised childcare hours per child per week (for children in the qualifying age group) is not sufficient because the percentage of family income many families will have to spend on childcare at this level, remains so high that it cannot be justified for many mothers to work full-time. Thus, many mothers persist in situations where they cannot afford to work more than part-time hours; or in the case of low income families with several children below school age, not at all. Therefore, mothers keep turning to grandmothers to supplement formal childcare with free informal childcare to keep childcare costs down. The few subsidised childcare hours available are not enough for parents to make a full switch from a combination of formal and informal care to purely formal care for their children and so FLFP remains low as both mothers and grandmothers participation is staggered by the inefficient childcare policy. This leads us back to our second hypothesis:

*H<sub>2</sub>: “A social investment policy package inspired by the Nordic countries can bring female labour force participation towards the desired level.”*

Although the delivery of childcare services (and hours) was deemed outside the boundaries and scope of this thesis, it seems fair to say that in reference to the proposed answer to H<sub>1</sub>, a childcare policy which treated the underlying cause (the supply side of the childcare market) in addition to the symptom of high childcare costs, could potentially lead to positive development in FLFP in the UK. Such a policy could be similar to those seen in the Nordic countries where the childcare demand is met not only by private companies but also by public childcare services where and when it is necessary.

The model itself can be seen as an answer to the main hypothesis of this thesis which was stated as: ***How does policy influence FLFP?*** The model shows, in a clear and simplified way, how the subsidised hours of childcare influence FLFP by increasing the hours mothers have available for participating in paid work. In addition, the model shows how these

additional hours of participation make the total family income increase, which reduces the percentage of family income spent on childcare and thus lowers the incentive for grandmothers to provide childcare hours. Thus, childcare policy influence women's labour market decisions during several stages of their lives.

### **How families are affected differently by policy**

The model results presented in the previous chapter illustrates how the current policies affect families very differently depending on the attributes of the family in question. As a consequence, it is the families with the least resources that are in the worst position. Many of the women, who cannot find affordable childcare for enough hours to participate in paid work, are in a helpless situation of the double burden; their children need care, but the family also needs more income to avoid of poverty. Hence, women desperately struggle to combine caring and earner responsibilities in the most beneficial way for their families. This double burden is frequently relieved by the intervention of grandmothers who agree to reduce their own working hours to allow their daughters to participate in paid work. The necessity for and use of grandmothers in childcare is particularly large amongst low and middle income families. In a low income family, with no grandmothers available to provide informal childcare, it is very unlikely that the mother can afford to work even only a few hours more than what is provided through childcare subsidies. This problem escalates with the number of children in the family and as the examples from the model showed, for low income families the presence of two or more children below school age will imply that in many cases the mother cannot afford to work. In light of the heavy reliance on grandmothers as providers of childcare, and the government's acceptance and considerations of it when deciding on policy (Gray, 2005), the policies in practice today are truly unfair to many families and especially to those without access to free informal childcare.

### **7.2 The mismatch in policy and desired outcomes**

The government's positive attitude towards grandmother's role in providing free informal childcare (without any compensation towards pension, etc.) can be seen not only as unsustainable in the context of the aging population, with the growing need for older people to stay in work for longer, but the situation also has normative implications. The government's reliance on informal childcare in the form of grandparents, to fill the gaps in childcare that the government itself has not been able to prevent with policy and contributes to reinforcing and uphold of the traditional 'male breadwinner' structure, as it is mostly women who provide this free care work and is thus kept away from paid work. A shift to formal



childcare is therefore necessary not only to make a full switch towards dual-earner families where both parents have equal access to participate in paid work, but also in order to allow older women the same access to paid work as their male counterparts. Allowing older women full access to participation in paid work (without any informal care burden) would impact positively on pension inequalities and the poverty trap for older women.

Although the factors discussed above may seem obvious in terms of what should be politically accepted there is a vast amount of evidence that suggests that the UK government has not yet found the best way to develop social family policy. Firstly, many of the policies implemented so far are faulty or insufficient when it comes to gender equality. Examples of this are the acceptance of and reliance on grandparental care mentioned above, as well as the very limited rights to paternity leave in parental leave policy. The states exclusion of fathers in family policy such as parental leave, reinforces the traditional 'two spheres' structure of society which implies that it is not men's responsibility to deal with children, care, and the home.

The lack of desire/capability to make policy gender equal may result from the motivation behind the policies in question. Evidence presented earlier in this thesis suggests the motivation for the policies currently in place has been mainly a combination between the government pledge to eradicate child poverty and a responsibility to comply with EU laws and legislation. Although reducing child poverty is a noble goal to pursue for any government, child poverty itself is a symptom of other underlying problems, such as gender inequality. In light of this, the reduction of gender inequalities in terms of access to paid work and economic rights could lead to higher FLFP and thus in turn less child poverty. Despite the government's recognition of this relationship and efforts towards increasing FLFP in recent years, the motivation behind it may be the reason for the lack of results so far. When considering the evidence regarding the role of family policy in raising FLFP in the Nordics from chapter 2, it becomes possible to benchmark against the development of family policy in the UK. Such a comparison is useful in terms of assessing where the problem lie in UK policy making. In light of this one can raise the question of whether policies in the UK so far is true social investment or if it is a half hearted attempt, motivated by the wrong reasons. It is also possible to suggest that the underrepresentation of women in politics could be one of the main reasons why policies have been insufficient so far; it may not be possible to create effective policy without largely including the gender the policy is supposed to influence in the process. This view is enforced by the evidence from the Nordics, which suggests that women's

political representation must increase above the 30 percent mark before gender equality picks up pace both in terms of policy and cultural measures. In the political context of the social democratic Nordic countries, the 30 percent mark was reached through a combination of both political measures (such as quotas) and the effect of time on culture itself. The evidence presented in chapter 2, suggests that the level of gender equality in the Nordic countries has been reached gradually ever since women gained their vote in these countries in the first 2 decades of the 20<sup>th</sup> century; benchmarking this development against the UK suggests that development there has stagnated significantly.

The creation of policy is a political matter and will always be a product of the political system in practice as well as of the policymakers involved. Although the UK has taken a step away from the classical neo-liberalistic way of doing welfare and moved towards welfare policies seen in social democracies like the Nordics, the policies implemented have not been successful so far. UK politicians and therefore also policymakers work under the strain of re-election every four years. This is very much reflected in the social policies found in the country which seem to have been created without the long term view of changing deep rooted, cultural and social problems related to family organisation and gender inequalities. It is, however, this type of view that was the foundation for the policies created in the Nordic countries, which has been gradually changed and built upon for decades before leading to the results we find today in terms of FLFP and gender equality measures.

## **8. Conclusions and recommendations for further research**

The aim for this thesis work was to use system dynamics to analyse the FLFP of mothers and grandmothers in relation to social policy, and subsidised childcare hours in particular. The model developed for this purpose is a simplified representation of reality, and as such, does not consider all aspects that affect mothers' and grandmothers' work participation decisions. Yet, the results suggest that the model provides useful insights into the labour force behaviour of UK mothers and grandmothers. Although childcare subsidy policies in, for instance, countries like the Nordics has proven effective in raising female labour participation, the policies available in the UK have been critiqued of being delivered through unnecessarily complicated systems; together with the highest childcare costs in Europe (despite the policies) this creates an environment where take up is limited to those who can afford the additional cost or access free informal childcare and where the mothers in families who need the second income the most, still cannot afford to work as many hours as they desire. In practice, the costs of childcare as a percentage of family income that would need to be spent on childcare in order to cover enough hours for both parents to partake in full-time paid work, is above the threshold where it pays to work for many mothers.

The extremely high childcare costs are caused by a fault in the system mechanism that adjusts supply to demand in market driven economies, and therefore needs to be addressed by policy. Although the childcare policies implemented in the UK in theory are valid policies as a means to solve the supply/demand issues, the policies fail due to the fact that state funded childcare does not outweigh price increases in the sector, as demand is much higher than supply and as such push the prices upwards. The fixed hours of subsidised childcare available to families in the UK were intended as a means to increase FLFP in the process of combating child poverty. Unfortunately due to the fault in the market supply/demand mechanism, the fixed subsidised childcare hours only help stagger the negative effects instead of resulting in positive changes to behaviour.

Increasing FLFP can be beneficial in many ways and for many areas of society. On a family level, increased FLFP can bring about a larger family income and as such, it can be a step out of poverty. Reduction of poverty through facilitating for higher work participation amongst mothers can be expected to reduce child poverty dramatically. On a society level, increased FLFP can lead to higher gender equality which would contribute towards closing the gender gap, give higher political representation for women, and thus more democratic rights. Increasing FLFP also reaps positive effects in terms of reducing pension inequalities and

poverty amongst older women. At a country level, increased FLFP will reduce the effect of the aging population and could result in increased productivity levels; with a corresponding rise in GDP.

In light of the benefits of increasing FLFP and evidence from social policy research, the policies available can be deemed feasible; the majority of the issues are related to implementation, range and scale of the policies.

### **Reflections and recommendations**

All things considered, further research is necessary. Not only to examine at what level subsidies will give greater effect for the low and medium income families who are relying on mothers bringing in a full second income, but also in order to investigate how the delivery and implementation of subsidised childcare hours can be simplified in order to improve uptake.

There are many routes to take for future research into the problems relating to FLFP and social policy in the UK. Firstly, the system dynamics model in its current state of development only provides insight into a few aspects that affect FLFP and family income. By modelling the policy endogenously, one could potentially conduct a much more advanced analysis. Secondly, there could be great potential in adapting the model to the national economy level to show how FLFP impact on the country's overall labour force and economy, and how the economical and political context influences social policy measures.

The use of subscripts when modeling policy that affects particular groups differently from each other has proven extremely powerful. Yet, during the modeling process for this thesis work, it became evident that the software available could benefit from improvements that simplify the use of subscripts and makes it easier to work with the various dimensions in the model. At the point of writing, the software does not provide a sufficient way to quickly change, adapt and test an arrayed model. It was also disappointing that the software's storytelling feature did not work with the arrayed model, hopefully this will be available in future versions of system dynamics software.

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## Appendix B – Sources for model data and estimates

The model uses limited data input due to the difficulty in finding data for the specific groups of women considered. Thus, the model builds on a range of assumptions and estimates which origins in a wide range of readings. The main sources for the data input and estimates used in the model are found in the table below.

| <b>Variable</b>                              | <b>Source</b>  |
|--|--|
| Avg hourly income men                        | Office for National Statistics (2014)  |
| Childcare costs per child per hour           | Hankin (2014), Viitanen (2005)   |
| Actual subsidised hours                      | Organisation for Economic Co-Operation and Development (2016c), Emmerson et al. (2014) |
| INIT Actual CC Hours Covered by Grandmothers | Statham (2011), Wheelock and Jones (2002a)   |
| Gender adj pct                               | O'reilly et al. (2015), Leopold et al. (2016), Azmat (2015)                            |
| INIT avg WP mothers                          | Chevalier (2002), Davies et al. (2000), Jaumotte (2004)                                |

## Appendix C – Model Equations

The list below gives the source code for the equations from the Stella model. As the model is arrayed, the list below only shows equations for the top level model. Due to the software adding all relevant dimensions as an ending to each variable's name, the naming in the equation list became long and therefore also hard to present in a straightforwardly way.

The model has 43 (805) variables (array expansion in parenthesis).

Stocks: 4 (108) Flows: 4 (108) Converters: 35 (589)

Constants: 11 (91) Equations: 28 (606) Graphicals: 7 (139)

There are also 135 expanded macro variables.

### Top-Level Model:

Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level](t) =  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level](t - dt) +  
(adjustment\_of\_grandmothers\_CC\_hours[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level]) \* dt  
INIT Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level] =  
INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers

UNITS: Hours

INFLOWS:

adjustment\_of\_grandmothers\_CC\_hours[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level] =  
(desired\_cc\_hours\_to\_be\_Covered\_by\_grandmothers-  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers)/time\_to\_adj\_CC\_hours\_covered\_by\_g  
randmothers

UNITS: Hours/Years

Average\_Work\_Participation\_Grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level](t) =  
Average\_Work\_Participation\_Grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level](t - dt) +  
(adjustment\_of\_grandmothers\_work\_participation[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level]) \* dt  
INIT Average\_Work\_Participation\_Grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level] =  
INIT\_Average\_Work\_Participation\_Grandmothers

UNITS: Hours

INFLOWS:

adjustment\_of\_grandmothers\_work\_participation[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level] =  
(work\_participation\_grandmothers-  
Average\_Work\_Participation\_Grandmothers)/time\_to\_adj\_work\_participation\_grandmothers

UNITS: Hours/Years

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, Low\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, Low\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, One\_Child, Low\_Income]}) * dt$$

$$\text{INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, Low\_Income]} =$$

$$\text{INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Low\_Income, One\_Child]}$$

UNITS: Hours

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]}) * dt$$

$$\text{INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]} =$$

$$\text{INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Medium\_Income, One\_Child]}$$

UNITS: Hours

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, High\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, High\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, One\_Child, High\_Income]}) * dt$$

$$\text{INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, One\_Child, High\_Income]} =$$

$$\text{INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, High\_Income, One\_Child]}$$

UNITS: Hours

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]}) * dt$$

$$\text{INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]} =$$

$$\text{INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Low\_Income, Two\_Children]}$$

UNITS: Hours

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]}) * dt$$

$$\text{INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]} =$$

$$\text{INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Medium\_Income, Two\_Children]}$$

UNITS: Hours

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, Two\_Children, High\_Income]}) * dt$$

$$\text{INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income]} =$$

$$\text{INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, High\_Income, Two\_Children]}$$

UNITS: Hours

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]}(t) =$$

$$\text{Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]}(t - dt) +$$

$$(\text{avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]}) * dt$$

INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Low\_Income, Three\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income](t - dt) + (avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Medium\_Income, Three\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, High\_Income](t) = Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, High\_Income](t - dt) + (avg\_work\_participation\_adjustment[sixteen\_to\_twentyfive, Three\_Children, High\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, High\_Income, Three\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, Low\_Income](t) = Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, Low\_Income](t - dt) + (avg\_work\_participation\_adjustment[twentysix\_to\_thirtyfive, One\_Child, Low\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] = INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, Low\_Income, One\_Child]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income](t - dt) + (avg\_work\_participation\_adjustment[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] = INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, Medium\_Income, One\_Child]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, High\_Income](t) = Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, High\_Income](t - dt) + (avg\_work\_participation\_adjustment[twentysix\_to\_thirtyfive, One\_Child, High\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, One\_Child, High\_Income] = INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, High\_Income, One\_Child]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income](t) = Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income](t - dt) + (avg\_work\_participation\_adjustment[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] = INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, Low\_Income, Two\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income](t - dt) + (avg\_work\_participation\_adjustment[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income] = INIT\_avg\_WP\_mothers[twenty-six\_to\_thirty-five, Medium\_Income, Two\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Two\_Children, High\_Income](t) = Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Two\_Children, High\_Income](t - dt) + (avg\_work\_participation\_adjustment[twenty-six\_to\_thirty-five, Two\_Children, High\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Two\_Children, High\_Income] = INIT\_avg\_WP\_mothers[twenty-six\_to\_thirty-five, High\_Income, Two\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income](t) = Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income](t - dt) + (avg\_work\_participation\_adjustment[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income] = INIT\_avg\_WP\_mothers[twenty-six\_to\_thirty-five, Low\_Income, Three\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income](t - dt) + (avg\_work\_participation\_adjustment[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income] = INIT\_avg\_WP\_mothers[twenty-six\_to\_thirty-five, Medium\_Income, Three\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, High\_Income](t) = Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, High\_Income](t - dt) + (avg\_work\_participation\_adjustment[twenty-six\_to\_thirty-five, Three\_Children, High\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[twenty-six\_to\_thirty-five, Three\_Children, High\_Income] = INIT\_avg\_WP\_mothers[twenty-six\_to\_thirty-five, High\_Income, Three\_Children]

UNITS: Hours

Avg\_Work\_Participation\_Mothers[thirty-six\_to\_forty-five, One\_Child, Low\_Income](t) = Avg\_Work\_Participation\_Mothers[thirty-six\_to\_forty-five, One\_Child, Low\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirty-six\_to\_forty-five, One\_Child, Low\_Income]) \* dt

INIT Avg\_Work\_Participation\_Mothers[thirty-six\_to\_forty-five, One\_Child, Low\_Income] = INIT\_avg\_WP\_mothers[thirty-six\_to\_forty-five, Low\_Income, One\_Child]

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income]) * dt$

$INIT\ Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Medium\_Income, One\_Child]$

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, One\_Child, High\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, One\_Child, High\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, One\_Child, High\_Income]) * dt$

$INIT\ Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, High\_Income, One\_Child]$

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income]) * dt$

$INIT\ Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Low\_Income, Two\_Children]$

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income]) * dt$

$INIT\ Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Medium\_Income, Two\_Children]$

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income]) * dt$

$INIT\ Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, High\_Income, Two\_Children]$

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income]) * dt$

$INIT\ Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Low\_Income, Three\_Children]$

UNITS: Hours

$Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income](t) = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive,$



Three\_Children, Medium\_Income](t - dt) +  
 (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive, Three\_Children,  
 Medium\_Income]) \* dt  
 INIT Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children,  
 Medium\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Medium\_Income,  
 Three\_Children]  
 UNITS: Hours  
 Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income](t)  
 = Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children,  
 High\_Income](t - dt) + (avg\_work\_participation\_adjustment[thirtysix\_to\_fourtyfive,  
 Three\_Children, High\_Income]) \* dt  
 INIT Avg\_Work\_Participation\_Mothers[thirtysix\_to\_fourtyfive, Three\_Children,  
 High\_Income] = INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, High\_Income,  
 Three\_Children]  
 UNITS: Hours  
 UNITS: Hours  
 INFLOWS:  
 avg\_work\_participation\_adjustment[Age\_Group, Number\_of\_Children\_under\_School\_age,  
 Income\_Level] = (work\_participation-  
 Avg\_Work\_Participation\_Mothers)/time\_to\_adj\_work\_participation  
 UNITS: Hours/Years  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Low\_Income](t) =  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Low\_Income](t - dt) +  
 (chng\_in\_SF\_hours[sixteen\_to\_twentyfive, One\_Child, Low\_Income]) \* dt  
 INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Low\_Income] =  
 INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Low\_Income, One\_Child]  
 UNITS: Hours  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Medium\_Income](t) =  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Medium\_Income](t - dt) +  
 (chng\_in\_SF\_hours[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]) \* dt  
 INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] =  
 INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Medium\_Income, One\_Child]  
 UNITS: Hours  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, High\_Income](t) =  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, High\_Income](t - dt) +  
 (chng\_in\_SF\_hours[sixteen\_to\_twentyfive, One\_Child, High\_Income]) \* dt  
 INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, High\_Income] =  
 INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, High\_Income, One\_Child]  
 UNITS: Hours  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Low\_Income](t) =  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Low\_Income](t - dt) +  
 (chng\_in\_SF\_hours[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]) \* dt  
 INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] =  
 INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Low\_Income, Two\_Children]  
 UNITS: Hours  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income](t) =  
 Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income](t - dt) +  
 (chng\_in\_SF\_hours[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]) \* dt  
 INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] =  
 INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Medium\_Income, Two\_Children]

UNITS: Hours

Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, High\_Income](t) =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, High\_Income](t - dt) +  
(chng\_in\_SF\_hours[sixteen\_to\_twentyfive, Two\_Children, High\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, High\_Income] =  
INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, High\_Income, Two\_Children]

UNITS: Hours

Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Low\_Income](t) =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Low\_Income](t - dt) +  
(chng\_in\_SF\_hours[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] =  
INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Low\_Income, Three\_Children]

UNITS: Hours

Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income](t) =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income](t - dt) +  
(chng\_in\_SF\_hours[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] =  
INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Medium\_Income, Three\_Children]

UNITS: Hours

Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, High\_Income](t) =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, High\_Income](t - dt) +  
(chng\_in\_SF\_hours[sixteen\_to\_twentyfive, Three\_Children, High\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, High\_Income] =  
INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, High\_Income, Three\_Children]

UNITS: Hours

Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Low\_Income](t) =  
Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Low\_Income](t - dt) +  
(chng\_in\_SF\_hours[twentysix\_to\_thirtyfive, One\_Child, Low\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] =  
INIT\_Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, Low\_Income, One\_Child]

UNITS: Hours

Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income](t) =  
Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income](t - dt) +  
(chng\_in\_SF\_hours[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] =  
INIT\_Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, Medium\_Income, One\_Child]

UNITS: Hours

Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, High\_Income](t) =  
Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, High\_Income](t - dt) +  
(chng\_in\_SF\_hours[twentysix\_to\_thirtyfive, One\_Child, High\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, High\_Income] =  
INIT\_Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, High\_Income, One\_Child]

UNITS: Hours

Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income](t) =  
Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income](t - dt) +  
(chng\_in\_SF\_hours[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income]) \* dt  
INIT Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] =  
INIT\_Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Low\_Income, Two\_Children]

UNITS: Hours



$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income}](t) =$$

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income}](t - dt) +$$

$$(\text{chn\_in\_SF\_hours}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income}]) * dt$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income}] =$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Low\_Income, Two\_Children}]$$
 UNITS: Hours

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income}](t) =$$

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income}](t - dt) +$$

$$(\text{chn\_in\_SF\_hours}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income}]) * dt$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income}] =$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Medium\_Income, Two\_Children}]$$
 UNITS: Hours

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, High\_Income}](t) =$$

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, High\_Income}](t - dt) +$$

$$(\text{chn\_in\_SF\_hours}[\text{thirtysix\_to\_fourtyfive, Two\_Children, High\_Income}]) * dt$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Two\_Children, High\_Income}] =$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, High\_Income, Two\_Children}]$$
 UNITS: Hours

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income}](t) =$$

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income}](t - dt) +$$

$$(\text{chn\_in\_SF\_hours}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income}]) * dt$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income}] =$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Low\_Income, Three\_Children}]$$
 UNITS: Hours

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income}](t) =$$

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income}](t - dt) +$$

$$(\text{chn\_in\_SF\_hours}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income}]) * dt$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income}] =$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Medium\_Income, Three\_Children}]$$
 UNITS: Hours

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, High\_Income}](t) =$$

$$\text{Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, High\_Income}](t - dt) +$$

$$(\text{chn\_in\_SF\_hours}[\text{thirtysix\_to\_fourtyfive, Three\_Children, High\_Income}]) * dt$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, Three\_Children, High\_Income}] =$$

$$\text{INIT Hours\_to\_Self\_Finance}[\text{thirtysix\_to\_fourtyfive, High\_Income, Three\_Children}]$$
 UNITS: Hours

UNITS: Hours

INFLOWS:

$$\text{chn\_in\_SF\_hours}[\text{sixteen\_to\_twentyfive, One\_Child, Low\_Income}] =$$

$$(\text{residual\_hours\_to\_SF}[\text{sixteen\_to\_twentyfive, One\_Child, Low\_Income}] -$$

$$\text{Hours\_to\_Self\_Finance}[\text{sixteen\_to\_twentyfive, One\_Child, Low\_Income}]) / \text{time\_to\_adj\_hours\_to\_SF}$$
 UNITS: Hours/Years

$$\text{chn\_in\_SF\_hours}[\text{sixteen\_to\_twentyfive, One\_Child, Medium\_Income}] =$$

$$(\text{residual\_hours\_to\_SF}[\text{sixteen\_to\_twentyfive, One\_Child, Medium\_Income}] -$$

$$\text{Hours\_to\_Self\_Finance}[\text{sixteen\_to\_twentyfive, One\_Child, Medium\_Income}]) / \text{time\_to\_adj\_hours\_to\_SF}$$
 UNITS: Hours/Years

UNITS: Hours/Years

$$\text{chn\_in\_SF\_hours}[\text{sixteen\_to\_twentyfive, One\_Child, High\_Income}] =$$

$$(\text{residual\_hours\_to\_SF}[\text{sixteen\_to\_twentyfive, One\_Child, High\_Income}] -$$

Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, High\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] = (residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]-Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Low\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = (residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]-Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = (residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Two\_Children, High\_Income]-Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, High\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = (residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]-Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Low\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = (residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]-Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = (residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Three\_Children, High\_Income]-Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, High\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[twentsix\_to\_thirtyfive, One\_Child, Low\_Income] = (residual\_hours\_to\_SF[twentsix\_to\_thirtyfive, One\_Child, Low\_Income]-Hours\_to\_Self\_Finance[twentsix\_to\_thirtyfive, One\_Child, Low\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[twentsix\_to\_thirtyfive, One\_Child, Medium\_Income] = (residual\_hours\_to\_SF[twentsix\_to\_thirtyfive, One\_Child, Medium\_Income]-Hours\_to\_Self\_Finance[twentsix\_to\_thirtyfive, One\_Child, Medium\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[twentsix\_to\_thirtyfive, One\_Child, High\_Income] = (residual\_hours\_to\_SF[twentsix\_to\_thirtyfive, One\_Child, High\_Income]-Hours\_to\_Self\_Finance[twentsix\_to\_thirtyfive, One\_Child, High\_Income])/time\_to\_adj\_hours\_to\_SF  
 UNITS: Hours/Years

chnge\_in\_SF\_hours[twentsix\_to\_thirtyfive, Two\_Children, Low\_Income] = (residual\_hours\_to\_SF[twentsix\_to\_thirtyfive, Two\_Children, Low\_Income]-

Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Two\_Children,  
Low\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income] =  
(residual\_hours\_to\_SF[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income]-

Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Two\_Children,  
Medium\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[twenty-six\_to\_thirty-five, Two\_Children, High\_Income] =  
(residual\_hours\_to\_SF[twenty-six\_to\_thirty-five, Two\_Children, High\_Income]-

Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Two\_Children,  
High\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income] =  
(residual\_hours\_to\_SF[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income]-

Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Three\_Children,  
Low\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income] =  
(residual\_hours\_to\_SF[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income]-

Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Three\_Children,  
Medium\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[twenty-six\_to\_thirty-five, Three\_Children, High\_Income] =  
(residual\_hours\_to\_SF[twenty-six\_to\_thirty-five, Three\_Children, High\_Income]-

Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Three\_Children,  
High\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirty-six\_to\_forty-five, One\_Child, Low\_Income] =  
(residual\_hours\_to\_SF[thirty-six\_to\_forty-five, One\_Child, Low\_Income]-

Hours\_to\_Self\_Finance[thirty-six\_to\_forty-five, One\_Child,  
Low\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirty-six\_to\_forty-five, One\_Child, Medium\_Income] =  
(residual\_hours\_to\_SF[thirty-six\_to\_forty-five, One\_Child, Medium\_Income]-

Hours\_to\_Self\_Finance[thirty-six\_to\_forty-five, One\_Child,  
Medium\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirty-six\_to\_forty-five, One\_Child, High\_Income] =  
(residual\_hours\_to\_SF[thirty-six\_to\_forty-five, One\_Child, High\_Income]-

Hours\_to\_Self\_Finance[thirty-six\_to\_forty-five, One\_Child,  
High\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirty-six\_to\_forty-five, Two\_Children, Low\_Income] =  
(residual\_hours\_to\_SF[thirty-six\_to\_forty-five, Two\_Children, Low\_Income]-

Hours\_to\_Self\_Finance[thirty-six\_to\_forty-five, Two\_Children,  
Low\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirty-six\_to\_forty-five, Two\_Children, Medium\_Income] =  
(residual\_hours\_to\_SF[thirty-six\_to\_forty-five, Two\_Children, Medium\_Income]-

Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Two\_Children,  
Medium\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] =  
(residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income]-  
Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Two\_Children,  
High\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] =  
(residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income]-  
Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Three\_Children,  
Low\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] =  
(residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income]-  
Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Three\_Children,  
Medium\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

chg\_in\_SF\_hours[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] =  
(residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income]-  
Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Three\_Children,  
High\_Income])/time\_to\_adj\_hours\_to\_SF

UNITS: Hours/Years

UNITS: Hours/Years

actual\_subsidised\_hours = STEP(15, 2000)

UNITS: Hours

avg\_hourly\_income\_men[Low\_Income] = GRAPH(TIME)  
(1990,00, 2,550), (2015,00, 6,900)

UNITS: GBP/Hour

avg\_hourly\_income\_men[Medium\_Income] = GRAPH(TIME)  
(1990,00, 6,500), (2015,00, 13,000)

UNITS: GBP/Hour

avg\_hourly\_income\_men[High\_Income] = GRAPH(TIME)  
(1990,00, 20,00), (2015,00, 60,00)

UNITS: GBP/Hour

UNITS: GBP/Hour

avg\_hourly\_income\_mothers[Age\_Group, Number\_of\_Children\_under\_School\_age,  
Income\_Level] =

reference\_hourly\_income\_women[Income\_Level]\*effect\_of\_AWP\_on\_avg\_hourly\_income

UNITS: GBP/Hour

avg\_weekly\_income\_men[Low\_Income] =  
avg\_hourly\_income\_men[Low\_Income]\*standard\_work\_week

UNITS: GBP

avg\_weekly\_income\_men[Medium\_Income] =  
avg\_hourly\_income\_men[Medium\_Income]\*standard\_work\_week

UNITS: GBP

avg\_weekly\_income\_men[High\_Income] =  
avg\_hourly\_income\_men[High\_Income]\*standard\_work\_week

UNITS: GBP

UNITS: GBP

avg\_weekly\_income\_mothers[Age\_Group, Number\_of\_Children\_under\_School\_age, Income\_Level] = Avg\_Work\_Participation\_Mothers\*avg\_hourly\_income\_mothers  
UNITS: GBP

childcare\_cost\_fraction[sixteen\_to\_twentyfive, One\_Child, Low\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, One\_Child, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, One\_Child, High\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, One\_Child, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, Two\_Children, High\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[sixteen\_to\_twentyfive, Three\_Children, High\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[sixteen\_to\_twentyfive, Three\_Children, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[twentysix\_to\_thirtyfive, One\_Child, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twentysix\_to\_thirtyfive, One\_Child, High\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[twentysix\_to\_thirtyfive, One\_Child, High\_Income]



UNITS: Dimensionless

childcare\_cost\_fraction[twenty-six\_to\_thirty-five, Two\_Children, Low\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[twenty-six\_to\_thirty-five, Two\_Children, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[twenty-six\_to\_thirty-five, Two\_Children, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twenty-six\_to\_thirty-five, Two\_Children, High\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[twenty-six\_to\_thirty-five, Two\_Children, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[twenty-six\_to\_thirty-five, Three\_Children, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[twenty-six\_to\_thirty-five, Three\_Children, High\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[twenty-six\_to\_thirty-five, Three\_Children, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirty-six\_to\_forty-five, One\_Child, Low\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[thirty-six\_to\_forty-five, One\_Child, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirty-six\_to\_forty-five, One\_Child, Medium\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[thirty-six\_to\_forty-five, One\_Child, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirty-six\_to\_forty-five, One\_Child, High\_Income] =  
childcare\_costs\_per\_child\_per\_hour/avg\_hourly\_income\_mothers[thirty-six\_to\_forty-five, One\_Child, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirty-six\_to\_forty-five, Two\_Children, Low\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[thirty-six\_to\_forty-five, Two\_Children, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirty-six\_to\_forty-five, Two\_Children, Medium\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[thirty-six\_to\_forty-five, Two\_Children, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirty-six\_to\_forty-five, Two\_Children, High\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*2)/avg\_hourly\_income\_mothers[thirty-six\_to\_forty-five, Two\_Children, High\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[thirtysix\_to\_fourtyfive  
, Three\_Children, Low\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[thirtysix\_to\_fourtyfive  
, Three\_Children, Medium\_Income]

UNITS: Dimensionless

childcare\_cost\_fraction[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] =  
(childcare\_costs\_per\_child\_per\_hour\*3)/avg\_hourly\_income\_mothers[thirtysix\_to\_fourtyfive  
, Three\_Children, High\_Income]

UNITS: Dimensionless

UNITS: Dimensionless

childcare\_costs\_per\_child\_per\_hour = GRAPH(TIME)

(1990,00, 1,600), (2002,50, 2,900), (2015,00, 5,000)

UNITS: GBP/Hour

desired\_cc\_hours\_to\_be\_Covered\_by\_grandmothers[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level] =  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers\*effect\_of\_PFI\_spent\_on\_CC\_on\_gran  
dmothers\_CC\_hours\_decisions

UNITS: Hours

effect\_of\_AWP\_on\_avg\_hourly\_income[Age\_Group,  
Number\_of\_Children\_under\_School\_age, Income\_Level] =  
GRAPH(Avg\_Work\_Participation\_Mothers/standard\_work\_week)  
(0,000, 0,099), (0,100, 0,099), (0,200, 0,165), (0,300, 0,351), (0,400, 0,574), (0,500, 0,739),  
(0,600, 0,839), (0,700, 0,900), (0,800, 0,945), (0,900, 0,986), (1,000, 1,000)

UNITS: Dimensionless

effect\_of\_CCCF\_on\_SFWHA[Age\_Group, Number\_of\_Children\_under\_School\_age,  
Income\_Level] = GRAPH(childcare\_cost\_fraction)  
(0,000, 1,000), (0,200, 1,000), (0,400, 0,951), (0,600, 0,821), (0,800, 0,587), (1,000, 0,300),  
(1,200, 0,147), (1,400, 0,079), (1,600, 0,017), (1,800, 0,000), (2,000, 0,000)

UNITS: Dimensionless

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive,  
One\_Child, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)  
(0,0, -1,000), (10,0, -0,688), (20,0, 0,455), (30,0, 0,960), (40,0, 1,361), (50,0, 1,658), (60,0,  
1,807), (70,0, 1,881), (80,0, 1,896), (90,0, 1,926), (100,0, 1,926)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive,  
One\_Child, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)  
(0,0, -1,000), (10,0, -0,688), (20,0, 0,455), (30,0, 0,960), (40,0, 1,361), (50,0, 1,658), (60,0,  
1,807), (70,0, 1,881), (80,0, 1,896), (90,0, 1,926), (100,0, 1,926)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive,  
One\_Child, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)  
(0,0, -1,000), (10,0, -0,688), (20,0, 0,455), (30,0, 0,960), (40,0, 1,361), (50,0, 1,658), (60,0,  
1,807), (70,0, 1,881), (80,0, 1,896), (90,0, 1,926), (100,0, 1,926)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive,  
Two\_Children, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -0,881), (30,0, -0,658), (40,0, -0,035), (50,0, 0,455), (60,0, 0,723), (70,0, 1,020), (80,0, 1,302), (90,0, 1,465), (100,0, 1,554)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,703), (20,0, 0,084), (30,0, 0,842), (40,0, 1,272), (50,0, 1,465), (60,0, 1,599), (70,0, 1,688), (80,0, 1,762), (90,0, 1,807), (100,0, 1,851)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -0,881), (30,0, -0,658), (40,0, -0,035), (50,0, 0,455), (60,0, 0,723), (70,0, 1,020), (80,0, 1,302), (90,0, 1,465), (100,0, 1,554)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -1,000), (30,0, -1,000), (40,0, -0,688), (50,0, -0,243), (60,0, 0,158), (70,0, 0,470), (80,0, 0,723), (90,0, 0,782), (100,0, 0,812)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,881), (20,0, -0,569), (30,0, -0,153), (40,0, 0,337), (50,0, 0,960), (60,0, 1,272), (70,0, 1,450), (80,0, 1,629), (90,0, 1,688), (100,0, 1,688)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -1,000), (30,0, -1,000), (40,0, -0,688), (50,0, -0,243), (60,0, 0,158), (70,0, 0,470), (80,0, 0,723), (90,0, 0,782), (100,0, 0,812)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,748), (20,0, 0,203), (30,0, 0,871), (40,0, 1,391), (50,0, 1,614), (60,0, 1,718), (70,0, 1,762), (80,0, 1,807), (90,0, 1,851), (100,0, 1,926)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,688), (20,0, 0,455), (30,0, 0,960), (40,0, 1,361), (50,0, 1,658), (60,0, 1,807), (70,0, 1,881), (80,0, 1,896), (90,0, 1,926), (100,0, 1,926)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, One\_Child, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,688), (20,0, 0,455), (30,0, 0,960), (40,0, 1,361), (50,0, 1,658), (60,0, 1,807), (70,0, 1,881), (80,0, 1,896), (90,0, 1,926), (100,0, 1,926)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -0,881), (30,0, -0,658), (40,0, -0,064), (50,0, 0,366), (60,0, 0,738), (70,0, 0,946), (80,0, 1,168), (90,0, 1,332), (100,0, 1,361)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,703), (20,0, 0,084), (30,0, 0,842), (40,0, 1,272), (50,0, 1,465), (60,0, 1,599), (70,0, 1,688), (80,0, 1,762), (90,0, 1,807), (100,0, 1,851)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, Two\_Children, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -0,881), (30,0, -0,658), (40,0, -0,035), (50,0, 0,455), (60,0, 0,723), (70,0, 1,020), (80,0, 1,302), (90,0, 1,465), (100,0, 1,554)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -1,000), (30,0, -1,000), (40,0, -0,688), (50,0, -0,243), (60,0, 0,158), (70,0, 0,470), (80,0, 0,574), (90,0, 0,604), (100,0, 0,589)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,881), (20,0, -0,569), (30,0, -0,153), (40,0, 0,337), (50,0, 0,782), (60,0, 1,168), (70,0, 1,450), (80,0, 1,614), (90,0, 1,688), (100,0, 1,688)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[twentysix\_to\_thirtyfive, Three\_Children, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -1,000), (30,0, -1,000), (40,0, -0,688), (50,0, -0,243), (60,0, 0,158), (70,0, 0,470), (80,0, 0,723), (90,0, 0,782), (100,0, 0,812)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,169), (20,0, 0,361), (30,0, 0,635), (40,0, 0,826), (50,0, 0,982), (60,0, 1,000), (70,0, 1,000), (80,0, 1,000), (90,0, 1,000), (100,0, 1,000)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,169), (20,0, 0,361), (30,0, 0,635), (40,0, 0,826), (50,0, 0,982), (60,0, 1,000), (70,0, 1,000), (80,0, 1,000), (90,0, 1,000), (100,0, 1,000)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,169), (20,0, 0,361), (30,0, 0,635), (40,0, 0,826), (50,0, 0,982), (60,0, 1,000), (70,0, 1,000), (80,0, 1,000), (90,0, 1,000), (100,0, 1,000)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -0,881), (30,0, -0,658), (40,0, -0,257), (50,0, 0,099), (60,0, 0,441), (70,0, 0,856), (80,0, 1,168), (90,0, 1,317), (100,0, 1,317)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,703), (20,0, 0,084), (30,0, 0,842), (40,0, 1,272), (50,0, 1,465), (60,0, 1,599), (70,0, 1,688), (80,0, 1,762), (90,0, 1,807), (100,0, 1,851)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -0,881), (30,0, -0,658), (40,0, -0,035), (50,0, 0,455), (60,0, 0,723), (70,0, 1,020), (80,0, 1,302), (90,0, 1,465), (100,0, 1,554)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -1,000), (30,0, -1,000), (40,0, -0,955), (50,0, -0,554), (60,0, -0,213), (70,0, 0,203), (80,0, 0,545), (90,0, 0,604), (100,0, 0,649)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -0,881), (20,0, -0,480), (30,0, -0,020), (40,0, 0,396), (50,0, 0,782), (60,0, 1,168), (70,0, 1,450), (80,0, 1,614), (90,0, 1,718), (100,0, 1,718)

UNITS: dmn1

effect\_of\_PFI\_spent\_on\_CC\_on\_grandmothers\_CC\_hours\_decisions[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] = GRAPH(pct\_of\_family\_income\_spent\_on\_childcare)

(0,0, -1,000), (10,0, -1,000), (20,0, -1,000), (30,0, -1,000), (40,0, -0,688), (50,0, -0,243), (60,0, 0,158), (70,0, 0,470), (80,0, 0,723), (90,0, 0,782), (100,0, 0,812)

UNITS: dmn1

UNITS: dmn1

family\_income[sixteen\_to\_twentyfive, One\_Child, Low\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, One\_Child, Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, One\_Child, High\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, One\_Child, High\_Income]+avg\_weekly\_income\_men[High\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income]+avg\_weekly\_income\_men[High\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[sixteen\_to\_twentyfive, Three\_Children, High\_Income] =  
avg\_weekly\_income\_mothers[sixteen\_to\_twentyfive, Three\_Children,  
High\_Income]+avg\_weekly\_income\_men[High\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, One\_Child,  
Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, One\_Child,  
Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, One\_Child, High\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, One\_Child,  
High\_Income]+avg\_weekly\_income\_men[High\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, Two\_Children,  
Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, Two\_Children,  
Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, Two\_Children, High\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, Two\_Children,  
High\_Income]+avg\_weekly\_income\_men[High\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, Three\_Children,  
Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, Three\_Children,  
Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[twentysix\_to\_thirtyfive, Three\_Children, High\_Income] =  
avg\_weekly\_income\_mothers[twentysix\_to\_thirtyfive, Two\_Children,  
High\_Income]+avg\_weekly\_income\_men[High\_Income]

UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] =  
avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, One\_Child,  
Low\_Income]+avg\_weekly\_income\_men[Low\_Income]

UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] =  
avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, One\_Child,  
Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]

UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, One\_Child,  
 High\_Income]+avg\_weekly\_income\_men[High\_Income]  
 UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, Two\_Children,  
 Low\_Income]+avg\_weekly\_income\_men[Low\_Income]  
 UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, Two\_Children,  
 Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]  
 UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, Two\_Children,  
 High\_Income]+avg\_weekly\_income\_men[High\_Income]  
 UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, Three\_Children,  
 Low\_Income]+avg\_weekly\_income\_men[Low\_Income]  
 UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, Three\_Children,  
 Medium\_Income]+avg\_weekly\_income\_men[Medium\_Income]  
 UNITS: GBP

family\_income[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] =  
 avg\_weekly\_income\_mothers[thirtysix\_to\_fourtyfive, Three\_Children,  
 High\_Income]+avg\_weekly\_income\_men[High\_Income]  
 UNITS: GBP  
 UNITS: GBP

gender\_adj\_pct[Low\_Income] = 0.05  
 UNITS: Dimensionless

gender\_adj\_pct[Medium\_Income] = 0.1  
 UNITS: Dimensionless

gender\_adj\_pct[High\_Income] = 0.2  
 UNITS: Dimensionless  
 UNITS: Dimensionless

hours\_covered\_by\_subsidised\_childcare[Age\_Group,  
 Number\_of\_Children\_under\_School\_age, Income\_Level] =  
 actual\_subsidised\_hours+scenario  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, One\_Child,  
 Low\_Income] = 15  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, One\_Child,  
 Medium\_Income] = 3  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, One\_Child,  
 High\_Income] = 5  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] = 12  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = 8  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = 4  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = 10  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = 6  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = 3  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, One\_Child, Low\_Income] = 15  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, One\_Child, Medium\_Income] = 3  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, One\_Child, High\_Income] = 5  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, Two\_Children, Low\_Income] = 12  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, Two\_Children, Medium\_Income] = 8  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, Two\_Children, High\_Income] = 4  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, Three\_Children, Low\_Income] = 10  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, Three\_Children, Medium\_Income] = 6  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[twentsix\_to\_thirtyfive, Three\_Children, High\_Income] = 3  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] = 10  
 UNITS: Hours

INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = 3



UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = 5  
 UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = 8  
 UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = 6  
 UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = 3  
 UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = 6  
 UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] = 4  
 UNITS: Hours  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] = 2  
 UNITS: Hours  
 UNITS: Hours  
 INIT\_Average\_Work\_Participation\_Grandmothers[Age\_Group, Number\_of\_Children\_under\_School\_age, Income\_Level] = standard\_work\_week-  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Low\_Income, One\_Child] = 10  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Low\_Income, Two\_Children] = 9  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Low\_Income, Three\_Children] = 8  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Medium\_Income, One\_Child] = 36  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Medium\_Income, Two\_Children] = 7  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, Medium\_Income, Three\_Children] = 6  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, High\_Income, One\_Child] = 37  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, High\_Income, Two\_Children] = 37  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[sixteen\_to\_twentyfive, High\_Income, Three\_Children] = 3  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentsix\_to\_thirtyfive, Low\_Income, One\_Child] = 10  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentsix\_to\_thirtyfive, Low\_Income, Two\_Children] = 9  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentsix\_to\_thirtyfive, Low\_Income, Three\_Children] = 8

UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, Medium\_Income, One\_Child] = 36  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, Medium\_Income, Two\_Children] = 7  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, Medium\_Income, Three\_Children] = 6  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, High\_Income, One\_Child] = 37  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, High\_Income, Two\_Children] = 37  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[twentysix\_to\_thirtyfive, High\_Income, Three\_Children] = 2.5  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Low\_Income, One\_Child] = 8  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Low\_Income, Two\_Children] = 7  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Low\_Income, Three\_Children] = 5  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Medium\_Income, One\_Child] = 36  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Medium\_Income, Two\_Children] = 7  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, Medium\_Income, Three\_Children] = 6  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, High\_Income, One\_Child] = 37  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, High\_Income, Two\_Children] = 37  
 UNITS: Hours  
 INIT\_avg\_WP\_mothers[thirtysix\_to\_fourtyfive, High\_Income, Three\_Children] = 2  
 UNITS: Hours  
 UNITS: Hours  
 INIT\_Hours\_to\_Self\_Finance[Age\_Group, Number\_of\_Children\_under\_School\_age, Income\_Level] = (standard\_work\_week-  
 INIT\_Actual\_CC\_Hours\_Covered\_by\_Grandmothers)\*number\_of\_childrem  
 UNITS: Hours  
 number\_of\_childrem[sixteen\_to\_twentyfive, One\_Child, Low\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, One\_Child, High\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = 3  
 UNITS: Dimensionless

number\_of\_childrem[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, One\_Child, Low\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, One\_Child, Medium\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, One\_Child, High\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, Two\_Children, Low\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, Two\_Children, Medium\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, Two\_Children, High\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, Three\_Children, Low\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, Three\_Children, Medium\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[twentsix\_to\_thirtyfive, Three\_Children, High\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = 1  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = 2  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] = 3  
 UNITS: Dimensionless  
 number\_of\_childrem[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] = 3  
 UNITS: Dimensionless  
 UNITS: Dimensionless  
 pct = 100  
 UNITS: Dimensionless  
 pct\_of\_family\_income\_spent\_on\_childcare[sixteen\_to\_twentyfive, One\_Child, Low\_Income]  
 = MIN (((weekly\_childcare\_cost[sixteen\_to\_twentyfive, One\_Child,  
 Low\_Income]/family\_income[sixteen\_to\_twentyfive, One\_Child, Low\_Income])\*pct), pct)  
 UNITS: Dimensionless  
 pct\_of\_family\_income\_spent\_on\_childcare[sixteen\_to\_twentyfive, One\_Child,  
 Medium\_Income] = MIN (((weekly\_childcare\_cost[sixteen\_to\_twentyfive, One\_Child,



pct\_of\_family\_income\_spent\_on\_childcare[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] = MIN (((weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income]/family\_income[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income] = MIN (((weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income]/family\_income[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[twentysix\_to\_thirtyfive, Two\_Children, High\_Income] = MIN (((weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Two\_Children, High\_Income]/family\_income[twentysix\_to\_thirtyfive, Two\_Children, High\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income] = MIN (((weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income]/family\_income[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income] = MIN (((weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income]/family\_income[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[twentysix\_to\_thirtyfive, Three\_Children, High\_Income] = MIN (((weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Three\_Children, High\_Income]/family\_income[twentysix\_to\_thirtyfive, Three\_Children, High\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income]/family\_income[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income]/family\_income[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, One\_Child, High\_Income]/family\_income[thirtysix\_to\_fourtyfive, One\_Child, High\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income]/family\_income[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income]/family\_income[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income])\*pct), pct)

Medium\_Income]/family\_income[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income]/family\_income[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income]/family\_income[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income]/family\_income[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income])\*pct), pct)

UNITS: Dimensionless

pct\_of\_family\_income\_spent\_on\_childcare[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] = MIN (((weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income]/family\_income[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income])\*pct), pct)

UNITS: Dimensionless

UNITS: Dimensionless

reference\_hourly\_income\_women[Low\_Income] = avg\_hourly\_income\_men[Low\_Income]-avg\_hourly\_income\_men[Low\_Income]\*gender\_adj\_pct[Low\_Income]

UNITS: GBP/Hour

reference\_hourly\_income\_women[Medium\_Income] = avg\_hourly\_income\_men[Medium\_Income]-avg\_hourly\_income\_men[Medium\_Income]\*gender\_adj\_pct[Medium\_Income]

UNITS: GBP/Hour

reference\_hourly\_income\_women[High\_Income] = avg\_hourly\_income\_men[High\_Income]-avg\_hourly\_income\_men[High\_Income]\*gender\_adj\_pct[High\_Income]

UNITS: GBP/Hour

UNITS: GBP/Hour

residual\_hours\_to\_SF[sixteen\_to\_twentyfive, One\_Child, Low\_Income] = MAX ((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, One\_Child, Low\_Income]-Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, One\_Child, Low\_Income]), 0)

UNITS: Hours

residual\_hours\_to\_SF[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] = MAX ((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]-Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]), 0)

UNITS: Hours

residual\_hours\_to\_SF[sixteen\_to\_twentyfive, One\_Child, High\_Income] = MAX ((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, One\_Child, High\_Income]-

Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, One\_Child, High\_Income]), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] = MAX  
 (((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]\*2)-  
 (Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]\*2)), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = MAX  
 (((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]\*2)-  
 (Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]\*2)), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = MAX  
 (((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, Two\_Children, High\_Income]\*2)-  
 (Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Two\_Children, High\_Income]\*2)), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = MAX  
 (((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]\*3)-  
 (Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]\*3)), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = MAX  
 (((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]\*3)-  
 (Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]\*3)), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = MAX  
 (((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[sixteen\_to\_twentyfive, Three\_Children, High\_Income]\*3)-  
 (Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[sixteen\_to\_twentyfive, Three\_Children, High\_Income]\*3)), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] = MAX  
 ((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive, One\_Child, Low\_Income]-  
 Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive, One\_Child, Low\_Income]), 0)  
 UNITS: Hours  
 residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] = MAX  
 ((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income]-  
 Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income]), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, One\_Child, High\_Income] = MAX  
(((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
One\_Child, High\_Income]-  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive, One\_Child,  
High\_Income]), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] = MAX  
(((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
Two\_Children, Low\_Income]\*2)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive,  
Two\_Children, Low\_Income]\*2)), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income] = MAX  
(((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
Two\_Children, Medium\_Income]\*2)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive,  
Two\_Children, Medium\_Income]\*2)), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, Two\_Children, High\_Income] = MAX  
(((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
Two\_Children, High\_Income]\*2)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive,  
Two\_Children, High\_Income]\*2)), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income] = MAX  
(((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
Three\_Children, Low\_Income]\*3)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive,  
Three\_Children, Low\_Income]\*3)), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income] = MAX  
(((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
Three\_Children, Medium\_Income]\*3)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive,  
Three\_Children, Medium\_Income]\*3)), 0)

UNITS: Hours

residual\_hours\_to\_SF[twentysix\_to\_thirtyfive, Three\_Children, High\_Income] = MAX  
(((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[twentysix\_to\_thirtyfive,  
Three\_Children, High\_Income]\*3)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[twentysix\_to\_thirtyfive,  
Three\_Children, High\_Income]\*3)), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] = MAX  
((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
One\_Child, Low\_Income]-  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, One\_Child,  
Low\_Income]), 0)

UNITS: Hours



residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = MAX  
((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
One\_Child, Medium\_Income]-  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, One\_Child,  
Medium\_Income]), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = MAX  
((standard\_work\_week-hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
One\_Child, High\_Income]-  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive, One\_Child,  
High\_Income]), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = MAX  
(((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
Two\_Children, Low\_Income]\*2)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive,  
Two\_Children, Low\_Income]\*2)), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = MAX  
(((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
Two\_Children, Medium\_Income]\*2)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive,  
Two\_Children, Medium\_Income]\*2)), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = MAX  
(((standard\_work\_week\*2)-(hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
Two\_Children, High\_Income]\*2)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive,  
Two\_Children, High\_Income]\*2)), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = MAX  
(((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
Three\_Children, Low\_Income]\*3)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive,  
Three\_Children, Low\_Income]\*3)), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] = MAX  
(((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
Three\_Children, Medium\_Income]\*3)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive,  
Three\_Children, Medium\_Income]\*3)), 0)

UNITS: Hours

residual\_hours\_to\_SF[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] = MAX  
(((standard\_work\_week\*3)-(hours\_covered\_by\_subsidised\_childcare[thirtysix\_to\_fourtyfive,  
Three\_Children, High\_Income]\*3)-  
(Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers[thirtysix\_to\_fourtyfive,  
Three\_Children, High\_Income]\*3)), 0)

UNITS: Hours

UNITS: Hours

scenario = STEP(scenario\_step, 2017)

UNITS: Hours

scenario\_step = -15

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, One\_Child, Low\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child,  
Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, One\_Child,  
Low\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child,  
Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, One\_Child,  
Medium\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, One\_Child, High\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child,  
High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, One\_Child,  
High\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children,  
Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, Two\_Children,  
Low\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, Two\_Children,  
Medium\_Income] = Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children,  
Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, Two\_Children,  
Medium\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, Two\_Children, High\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children,  
High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, Two\_Children,  
High\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children,  
Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, Three\_Children,  
Low\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, Three\_Children,  
Medium\_Income] = Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children,  
Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, Three\_Children,  
Medium\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[sixteen\_to\_twentyfive, Three\_Children, High\_Income] =  
Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children,  
High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[sixteen\_to\_twentyfive, Three\_Children,  
High\_Income]

UNITS: Hours

self\_financed\_work\_hours\_available[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] =  
Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child,

Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, One\_Child,  
 Low\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, One\_Child, Medium\_Income]  
 = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, One\_Child,  
 Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, One\_Child,  
 Medium\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, One\_Child, High\_Income] =  
 Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, One\_Child,  
 High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, One\_Child,  
 High\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, Two\_Children, Low\_Income]  
 = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Two\_Children,  
 Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, Two\_Children,  
 Low\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, Two\_Children,  
 Medium\_Income] = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Two\_Children,  
 Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, Two\_Children,  
 Medium\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, Two\_Children, High\_Income]  
 = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Two\_Children,  
 High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, Two\_Children,  
 High\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, Three\_Children, Low\_Income]  
 = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Three\_Children,  
 Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, Three\_Children,  
 Low\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, Three\_Children,  
 Medium\_Income] = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Three\_Children,  
 Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, Three\_Children,  
 Medium\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[twenty-six\_to\_thirty-five, Three\_Children, High\_Income]  
 = Hours\_to\_Self\_Finance[twenty-six\_to\_thirty-five, Three\_Children,  
 High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[twenty-six\_to\_thirty-five, Three\_Children,  
 High\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirty-six\_to\_forty-five, One\_Child, Low\_Income] =  
 Hours\_to\_Self\_Finance[thirty-six\_to\_forty-five, One\_Child,  
 Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirty-six\_to\_forty-five, One\_Child,  
 Low\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirty-six\_to\_forty-five, One\_Child, Medium\_Income] =  
 Hours\_to\_Self\_Finance[thirty-six\_to\_forty-five, One\_Child,

Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, One\_Child,  
 Medium\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] =  
 Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, One\_Child,  
 High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, One\_Child,  
 High\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] =  
 Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Two\_Children,  
 Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, Two\_Children,  
 Low\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, Two\_Children,  
 Medium\_Income] = Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Two\_Children,  
 Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, Two\_Children,  
 Medium\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] =  
 Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Two\_Children,  
 High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, Two\_Children,  
 High\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income]  
 = Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Three\_Children,  
 Low\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, Three\_Children,  
 Low\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, Three\_Children,  
 Medium\_Income] = Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Three\_Children,  
 Medium\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, Three\_Children,  
 Medium\_Income]  
 UNITS: Hours  
 self\_financed\_work\_hours\_available[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income]  
 = Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive, Three\_Children,  
 High\_Income]\*effect\_of\_CCCF\_on\_SFWHA[thirtysix\_to\_fourtyfive, Three\_Children,  
 High\_Income]  
 UNITS: Hours  
 UNITS: Hours  
 standard\_work\_week = 40  
 UNITS: Hours  
 time\_to\_adj\_CC\_hours\_covered\_by\_grandmothers = 1.5  
 UNITS: Years  
 time\_to\_adj\_hours\_to\_SF = 1  
 UNITS: Years  
 time\_to\_adj\_work\_participation = 1  
 UNITS: Years  
 time\_to\_adj\_work\_participation\_grandmothers = 2  
 UNITS: Years

total\_work\_hours\_available[Age\_Group, Number\_of\_Children\_under\_School\_age, Income\_Level] =  
hours\_covered\_by\_subsidised\_childcare+Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers+self\_financed\_work\_hours\_available

UNITS: Hours

weekly\_childcare\_cost[sixteen\_to\_twentyfive, One\_Child, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, One\_Child, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, One\_Child, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, One\_Child, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, Two\_Children, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, Two\_Children, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Two\_Children, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, Three\_Children, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[sixteen\_to\_twentyfive, Three\_Children, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[sixteen\_to\_twentyfive, Three\_Children, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, One\_Child, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive, One\_Child, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, One\_Child, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
One\_Child, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Two\_Children, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
Two\_Children, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Two\_Children, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
Two\_Children, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Two\_Children, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
Two\_Children, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Three\_Children, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
Three\_Children, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Three\_Children, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
Three\_Children, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[twentysix\_to\_thirtyfive, Three\_Children, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[twentysix\_to\_thirtyfive,  
Three\_Children, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, One\_Child, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
One\_Child, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, One\_Child, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
One\_Child, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, One\_Child, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
One\_Child, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Two\_Children, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
Two\_Children, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Two\_Children, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
Two\_Children, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Two\_Children, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
Two\_Children, High\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Three\_Children, Low\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
Three\_Children, Low\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Three\_Children, Medium\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
Three\_Children, Medium\_Income]), 0)

UNITS: GBP

weekly\_childcare\_cost[thirtysix\_to\_fourtyfive, Three\_Children, High\_Income] = MAX  
((childcare\_costs\_per\_child\_per\_hour\*Hours\_to\_Self\_Finance[thirtysix\_to\_fourtyfive,  
Three\_Children, High\_Income]), 0)

UNITS: GBP

UNITS: GBP

work\_participation[Age\_Group, Number\_of\_Children\_under\_School\_age, Income\_Level] =  
GRAPH(SMTH1 (total\_work\_hours\_available, 2))

(0,00, 0,00), (4,00, 3,99), (8,00, 7,08), (12,00, 9,00), (16,00, 10,99), (20,00, 14,57), (24,00,  
19,46), (28,00, 26,75), (32,00, 30,69), (36,00, 35,22), (40,00, 38,28)UNITS: Hours

work\_participation\_grandmothers[Age\_Group, Number\_of\_Children\_under\_School\_age,  
Income\_Level] = GRAPH(standard\_work\_week-  
Actual\_Childcare\_Hours\_Covered\_by\_Grandmothers)

(0,00, 0,00), (4,00, 3,99), (8,00, 7,08), (12,00, 9,00), (16,00, 10,99), (20,00, 14,57), (24,00,  
19,46), (28,00, 26,75), (32,00, 30,69), (36,00, 35,22), (40,00, 38,28)

UNITS: Hours