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Abstract

The presented analysis discovers and explains typical patterns of work-family reconciliation for parents who had a child in the same period (2003) and in the same country (Luxembourg), thus facing the same macroeconomic and institutional conditions. Work-family trajectories are reconstructed as sequences of states using administrative records, so that working hours and use of leave provisions or other social security benefits are taken into account. Next, a clustering algorithm is applied to identify typical patterns. The analysis reveals that when the birth of a child is positioned as a pivotal point in the work-family trajectory, it appears to be a transition point for about a third of the female trajectories. For these women the event marks the beginning of a long-term reduction of labour participation manifested either in reducing the number of hours of work or in leaving the labour force. On the contrary, the career trajectories of working fathers are stable across time and for the majority of fathers there are no marked differences in work-force participation before and after the birth of a child. In the final stage of analysis available explanatory variables are linked to derived types of career profiles via a multinomial logit model. Work and family-related variables are used to test the hypothesis that women make a decision on reducing their labour market participation based on comparing the values of their time at home and the opportunity cost of not working. The results are in line with this reasoning for explaining the pattern of leaving the labour force after birth of a child. However, economic reasoning does not seem to explain the pattern of reducing the number of hours per week after the birth of a child.

1 Introduction

The goal of the present study is to explore and explain the diversity of working parents' work-family reconciliation strategies, which they use to accommodate the increased demand on their time upon the arrival of a new child in the family. For the analysis, I use a sample of parents who all work in the same country (Luxembourg) and who had a child born in their household in the same year (2003). Therefore, these working parents faced roughly the same broad economic situation and had the same set of policy provisions available for them to use. Yet, they made different decisions on how to accommodate the care needs of the new child in the family. Some parents decreased their work participation temporarily or in the long term, others used parental leave, yet, others continued working the same way as prior to the birth of the child without a significant interruption of change in their working trajectory.

This paper takes a closer look at this diversity of decisions and answers two main research questions. The first question is: what were the main strategies and how are they distributed? This research question is answered in the first part of the paper, where I identify the main types of work-family patterns and I discuss their relative frequency of occurrence. The second question shifts the analysis to an explanatory level and asks what are the factors that are related to choosing one strategy over another? The main focus on the analysis is on gender, as men and women are analysed separately. However, I also consider the individual opportunity costs for reducing labour force participation, as well as the role of situational factors, such as the type of employment, as well as the presence of partner and/or other children in the family.

While econometric analysis is typically concerned with explaining individual decision-making processes, this paper takes a more sociological approach and looks into the group patterns that emerge in society as a result of decisions taken by multiple individuals. The analysis reveals useful information in several ways. To begin with, rather than identifying "average" trends in parents' behaviour, this paper identifies groups of parents with similar work-family reconciliation trajectories. Such information is useful for governments for several reasons. To begin with, rather than searching for one-size-fit-all solutions, policy-makers receive information, which can enable them to search for solutions that emphasise flexibility and can be tailored to meet

the specific needs of parents. Second, through linking covariates to group patterns of behaviour, the analysis shifts the focus away from the individual decision-making and takes a perspective allowing for structural constraints or opportunities to be highlighted.

2   Approach

To explore the diversity of work-family reconciliation strategies of parents, this study makes use of the unique opportunity to work with administrative records. Administrative records provide accurate information on the hours of employment and salary-related income, as well as, social security payments received by individuals. In the case of work-family reconciliation administrative records provide information on the use of leave provisions because they are funded from the social security system. Therefore, it is possible to know if and when a parent used a leave policy. In addition, administrative records can provide insights into what else is happening in the life of a person. For example, unemployment benefits in an administrative record indicate that the individual is experiencing unemployment, sick leave payments indicate experiences of ill health and so forth.

For this study, I used the administrative records of over 10000 parents within an eight-year-long time frame. To make sense of this extremely complex set of information, I adopted a methodological strategy inspired by the sequence analysis literature. Sequence analysis methods allow that the full complexity of the work-family trajectories is taken into account. By working with trajectories it is possible to consider the variation of work-family status throughout the entire observation period, without a need to limit the analysis to a fixed number of points in time. With this analysis I follow the general steps outlined by Abbott (1990) who introduced sequence analysis to the social sciences. The analysis begins with computing a distance matrix composed of bivariate distances between all pairs of sequences in the data set. Then a clustering algorithm is applied to group similar sequences together. Finally, covariates are linked to cluster-membership via multinomial logistic regression.

The paper is split into three parts. First the work-family trajectories of working parents who had a child in 2003 in Luxembourg are reconstructed. This

part of the analysis replicates the analysis in Zhelyazkova (2013), however, instead of analysing the trajectories of parents transversally, a longitudinal perspective is applied. The second step is the application of a clustering algorithm to group similar trajectories together. This step is explained in detail in Section 5.

The analysis reveals nine distinct patterns of work-family reconciliation. The clusters reveal marked gender differences, as some are clearly female-dominated while others contain predominantly male trajectories. The main finding is that for about a third of the women in the sample the birth of a child represents a pivotal point in the work trajectory whereby many of them reduce their labour force engagement (for example by switching to part-time work) or leave permanently the labour force. In the male trajectories the birth of a child does not seem to present a pivotal point. For the majority of fathers trajectories continue before and after the birth in the same way. However, the clustering method identifies groups that are stable with reference to their overall work-family engagement across time. The majority of men remain in the same working hours over the observed period, although there are some exceptions. In addition, some small number of male trajectories were classified similarly to women's "family-oriented" trajectories with a very high probability of using parental leave and a work trajectory dominated by part-time working hours.

In the final part of the paper, a multinomial logit model is applied, through which available covariates are linked to the probability of being assigned to any of the nine clusters. The dependent variable is thus a categorical variable with nine levels: one for each cluster. As the paper is based on administrative records, there are only a limited number of family-related, demographic and work-related covariates, which could be included in the analysis. Nevertheless, the analysis has highlighted some interesting factors that explain cluster-membership. Most notably, opportunity cost as defined by forgone salary-related income does not seem to be a significant predictor for switching to part-time work after maternity leave.

Women's trajectories are of main interest for this analysis, however, the same algorithms are performed on the sample of male trajectories. The analysis of the male trajectories serves a twofold purpose. First, this is one of very few attempts in the literature to understand male patterns of work-family reconciliation, as there are presently only a few articles in the literature that examine the pattern of male parenting and work over time.

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The second purpose is that the analysis serves as a robustness check on the analysis of the female trajectories. With a dependent variable based on longitudinal work-family developments, it is difficult to separate covariates from the trajectories entirely. In this regard, comparing the outcomes for men and women is helpful in shedding additional light on gender-specific and other effects. This is especially evident in the group of parents who "leave" the data set after having a child, which implies that they do not have an administrative record. We see the same group pattern in both the female and male trajectories and they are more likely to be foreign nationals of countries not neighbouring Luxembourg. Therefore, it seems like women without an administrative record after having a child could also include a group leaving work as part of a general career mobility pattern and one cannot easily assume that all of them are leaving the labour force.

3 Review of related literature

This study is related to research found predominantly in the sociological and demographic literature. In recent years there have been several publications examining the relationships between gender, work and family. A number of scholars have pointed out the usefulness of the life-course theoretical framework presented in Elder and Giele (2009), for understanding how these three dimensions and the social and institutional contexts in which they are embedded interact with each other and with the individuals' decision making process to produce shared patterns of behaviour. Moen and Sweet (2004) provide an overview of how the life-course perspective can be useful in understanding gendered work/family dynamics and the problem of work-family reconciliation. The paper highlights the idea that there exists a mismatch between the gender and age composition of the workforce and the expectations and arrangement of work places, which remain somewhat outdated. In particular, the authors highlight the assumption that all workers have (or are married to) a full-time caretaker who makes it possible for them to dedicate most of their productive hours and attention to their paid work. The forty-hour work week, as well as the expectation that only full-time (or more) employment can lead to upward career mobility are examples of how modern careers are "locked" into such outdated expectations. As a result individuals who do not "fit" this model, such as partners in dual-career couples are forced to adapt their life-choices to fit the requirements of their

jobs, such as for example, by delaying or foregoing having children or by giving up their career aspirations and remaining in part-time jobs without opportunities for upward mobility.

Researchers using the life-course perspective often apply the use of sequence analysis methods. For a primer in sequence analysis readers can refer to some of the early works of Abbott (for example: Abbott and Hrycak, 1990; Abbott, 1990, 1992), who introduced sequence analysis methods in the social sciences. A review of developments and prospects from the first decade after its introduction is available in Abbott and Tsay (2000) and a more recent literature review has been published by Aisenbrey and Fasang (2010). From a more methodological standpoint, an article by Billari (2005) elaborates further the links between the life-course perspective as a theoretical framework and sequence analysis methods as an analytical tool, which maintains the individual life-course as the scope of analysis rather than focus on specific time points.

Although sequence analysis is not the only way to carry out empirical investigations from a life-course perspective, the focus of this review is on studies that apply this method of analysis. As the careers of women tend to be more varied, work-family histories have been primarily investigated with female samples. Some examples come from Sweden (for example: Huang and Sverke, 2007; Huang et al., 2007; Isaksson et al., 2006), the UK (for example: Aassve et al., 2007; Anyadike-Danes and McVicar, 2010) and Germany (for example Simonson et al., 2011). A common finding in the studies of women's work-family biographies is that there is a significant diversity in the work-career patterns. Typically studies find a cluster with continuous employment, continuous non-participation and several groups in between, which combine both in different ways. The proportions of women in the different groups, however, tend to vary across institutional contexts (e.g. East and West Germany) and across generations (see Simonson et al., 2011), which reflects the importance of the context within which female careers are realised for their development.

It is also found that women with continuous careers tend to have fewer children (Huang et al., 2007) or to delay child-bearing (Aassve et al., 2007) relative to women in other clusters, whereas women who have more children tend to belong to work-family combining clusters or to be predominantly outside the labour market. These relationships demonstrate the connection between women's working trajectories and their family life. The picture

becomes even more complete when the trajectories of partners are also introduced into the analysis. An example of a such a study is the work by Han and Moen (1999), which highlights a strong influence of the male career on the female career course, but not the other way around. In particular, the men whose biography followed the so-called "orderly career" (Han and Moen, 1999, p.107) were more likely to be married to a partner who never worked at all. In addition, men, in general seemed to work full-time regardless of the life-path of their partner.

The relationship between occupational and family trajectories of men and women has also been shown in Widmer and Ritschard (2009). The authors compare the reconstructed trajectories of men and women from Switzerland born in three different cohorts (1910-1924, 1925-1945, 1946-1957). The results show that although there is not a large difference between the level of diversification of family trajectories between men and women across cohorts, women's family trajectories are related to their occupational trajectories in a way which seems to cause more diversity in their occupational trajectories. This diversity for the most part reflects multiple transitions between paid work and periods at home for women. In contrast, male trajectories in Switzerland have changed over time only in the period of life before age 30, reflecting increased transitions between paid work and education. In the authors' own words: "...uncertainty has become a permanent state in women's occupational trajectories, while it is only transitional in men's occupational trajectories."(Widmer and Ritschard, 2009, p.38)

It is important to note that due to the longitudinal nature of the research design in sequence analysis, one requires data on completed or at least partially completed biographies. In many cases, this translates into research on people born in the middle of the 20th century, whose experiences, as cohort comparisons demonstrate, may not necessarily remain relevant in the context of today. The present study is limited to the time-frame $2000 - 2008$. One the one hand this is an advantage as the findings are relatively current. On the other hand, the analysis is restricted to a limited scope covering about three years prior to having a child and about five years afterwards.

Having in mind the scope of the analysis, a related study appears to be the work of Hynes and Clarkberg (2005), where the trajectories of women around their first birth are grouped using a group-based trajectory method developed by (Jones, Nagin, Roeder, 2001 in Hynes and Clarkberg, 2005). The authors focus on the time interval of twelve months prior to the birth up

to the 24 months following it. They identify six groups of trajectories: "Continuously Employed", "Continuously Out", "Hiatus at Birth", 'Exit at Birth", "Declining Employment", and "Low Intermittent Employment" (Hynes and Clarkberg, 2005, p.229). The results highlight, once again, the importance of focusing on the diversity of women's trajectories rather than averages, as there is evidence of markedly different short- and long-term strategies.

This paper differs from previous research as it does not include all women in a single country (in this case Luxembourg). Rather it focuses only on working women who had a child while in the labour force and were eligible to use parental leave. With this sample selection, the analysis includes these working mothers who have full-time carrier patterns and who combine work and family. A group of women excluded from the analysis are the group who permanently remain outside the labour force and women who do not have children.

The present study builds on previously existing literature in several ways. To begin with, it focuses on the group, which is identified by most researchers as the most heterogeneous - the women combining work and family. Second, the study uses administrative records rather than self-reported data, which ensure the accuracy of the information, especially where income levels and specific use of maternity and parental leave are concerned[1]. In addition, due to the possibility to include information on leave policies the study makes it possible to understand the role of leave policies in the work-family trajectories of men and women. Finally, the study adds to the very limited literature available on male work-family trajectories.

4   Data and context of the study

Data for the analysis in this study are the same as the data presented in Zhelyazkova (2013). The analysis is based on the administrative records of 4481 women and 5827 men in Luxembourg provided by the *Inspection générale de la sécurité sociale (IGSS)*. The samples were selected based on the following criteria:

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[1]For a discussion on the problems with self-reported data on parental leave see Chan et al. (2012)

- Having a child born in the fiscal household in 2003

- Eligibility for parental leave at the time the child was born

- Employment in Luxembourg prior to the birth of the child

The administrative records were converted to person-period files, where for each person in the sample a single "state" was recorded for each month. The complete list of states and their numerical and colour codes are provided in Appendix A. All states were based on the administrative records, which means that the information is more accurate than in self-reported studies. However, there is an extent of exaggeration for some of the short-term states, such as sick leave or family leave, as if such states appeared in the record even only for a few days, the only way to retain them in the analysis was to code the whole month with this state.

In addition to the social security records, the IGSS were able to provide data on a number of covariates related to the employment characteristics of the persons involved, some details about their family situation and demographic characteristics such as nationality and age. Although limited, these covariates still allow for the construction of a more complete picture of the different types of parent work-family reconciliation strategies and to draw some inferences about relationships in the data.

With regards to work-family reconciliation parents in Luxembourg can use both parental leave and family leave. Since its introduction in 1999 working parents in Luxembourg have the right to take either a block of six months full-time parental leave or a block of twelve months part-time leave for the purposes of caring for a young child at home. The leave can be used up to the fifth birthday of the child and is an individual entitlement: both parents have to right of leave (if they meet the eligibility conditions), however, they cannot transfer it to each other. In addition, there is the requirement that the first leave in a two-parent family must be taken immediately after the maternity leave (the period immediately before and after birth, which in Luxembourg is equal to four or five months fully compensated from the health care fund). If a parental leave is not taken immediately after the maternity leave the right of the leave is forfeited, however, the second leave (in a case of family of two parents) can still be used until the child turns five. Parents who take parental leave are compensated on a flat-rate basis at 1778 €per month full-time in 2013 and half of the amount in case the leave

is taken part-time. The eligibility requirements for the leave are a minimum of one year employment with the same employer prior to the start of the leave and a reduction of at least 50 per cent of working hours in the case of taking the leave part-time.

In addition to parental leave working parents with young children have the option of taking a child-raising allowance(l'allocation d'éducation). In 2012, the monthly amounts were equal to 485.01 €full time and 242.51 €part-time. Every person in Luxembourg raising a child under two years is eligible for the allowance, however it cannot be combined with parental leave. The duration of the allowance is 22 months full time (and double for part time), which means that the total compensation received for the full duration is equal to the one for parental leave. The main difference between the two measures is that the child-rearing allowance does not entail any sort of job-guarantee or preservation of professional rights. The child-raising allowance has been in existence in Luxembourg before the introduction of parental leave. After the introduction of the leave both measures have been available to parents.

Family leave in Luxembourg can be taken for up to two days per year per child. It is to be used in cases of emergency or sickness of the child until the age of 15 years. More information on leave policies available in Luxembourg can be found in Zhelyazkova et al. (2013).

There are only a few sources of information on work family reconciliation in Luxembourg. They are outlined below, although the results from these studies are not directly comparable to the results obtained in this analysis. The main differences are in the nature of the analysed samples, the time frame and the use of self-reported information or reported expectations rather than actual behaviour.

A comprehensive review has been compiled by Plasman and Sissoko (2005) as part of the work of the European Commission's Expert Group on Gender, Social Inclusion and Employment(EGGSIE) funded by the European Commission. The report provides a summary of all relevant empirical studies on work family recollection in Luxembourg at the time of its completion. This makes the report very relevant for the empirical analysis presented here as it covers a similar time span - early 2000s. In terms of overall work-family reconciliation strategies Plasman and Sissoko (2005) discuss reduction of working hours and leaving the labour market, as strategies used by parents in addition to or instead of parental leave. Plasman and Sissoko (2005)

present evidence that parents in Luxembourg have a strong preference to care for their children themselves rather than use the services of a nanny or nursery. In addition, Plasman and Sissoko (2005) emphasise the role of the child care allowance (l'allocation d'éducation), which in 2003 was still more popular than parental leave as many more households were benefitting from it, rather than from parental leave. Another strategy for work-family reconciliation addressed by Plasman and Sissoko (2005) concerns the reduction of working hours. Although the total share of part-time workers in Luxembourg was less than the European average, the total share of women working part-time (26 per cent) in 2000 was closer to European average (33.7 per cent). Plasman and Sissoko (2005) note that both strategies: labour market inactivity or part-time work are more likely to be used by mothers in couples.

Use of parental leave and reduction of working hours are discussed in Valentova (2011). The analysis of Valentova (2011) uses information on the anticipated labour market strategies of working women who indicated that they plan to have a child in the near future. About two thirds of women said they were planning to use parental leave. However, less than half of the women who indicated that they would take parental leave (41 per cent) said they would like to continue working the same hours as before. More than half (51 per cent) expressed a preference to reduce their working hours, while the remaining 8 per cent said they were planning to leave the labour force after parental leave.

An analysis of labour market inactivity has been published by Valentova (2006). The results of the analysis suggest that the number of children in the household is positively related to an increased probability for women to be inactive on the labour market. Married women and less educated women were also less likely to participate on the labour market. The analysis of Valentova (2006) is not directly comparable to the analysis carried out in this paper, as Valentova (2006) uses a sample of all women residing in Luxembourg, while the present analysis is based on a sample of working women only and it includes cross-border workers.

Another source of information is the study of Lejealle (2005). Similarly to the analysis in this paper it is based on a sample of working women and on sequence analysis method and clustering. However, the study uses self-reported information on the professional activities and career interruptions of women from the Luxembourgish Socio-Economic Panel (PSELL) in 1998.

This means that an earlier historical period (prior to 1998) is covered in the analysis. Based on the self-reported information the career trajectories of women are reconstructed as sequences of annual states. The study takes as a starting point the first point of entry into the Luxembourg labour force and performs a cluster analysis on two samples of women: these for whom data are available for 15 years after start of the first employment and these for whom data are available for 30 years. Effectively, this also means comparing women from different generations (Lejealle, 2005).

The results of Lejealle (2005) suggest that in the sample of older women about one third had continuous career trajectories during the whole period of observation. About 13 per cent of women had career trajectories marked by prolonged periods of labour market inactivity and episodes of return to the labour force. The rest of the careers consisted of trajectories marked by episodes of continuous work in the beginning followed by permanent labour market inactivity. The results of the analysis of the younger cohort - women who could provide information on 15 years after their entry into the labour market, suggested an increase in the proportion of women with continuous careers - the fraction of trajectories without interruptions was already as high as 50 per cent.

There are very few sources of information on the work trajectories of fathers in Luxembourg. In a comparative report by Margherita et al. (2009), figures about the employment rates of men for the period of 2000 - 2006 show that employment rates of men in Luxembourg reported in remained above 90 per cent, regardless of whether the number or ages of children were taken into account. With reference to working hours Plasman and Sissoko (2005) observe that working hours for men in Luxembourg tended to increase when children were present.

5 Method: Identifying group patterns of behaviour by clustering

The first step in the analysis for this study is the reconstruction of trajectories based on the longitudinal information in the administrative records. For the reconstruction, the administrative records were re-structured, so that for each individual there was one state recorded for each of the time segments
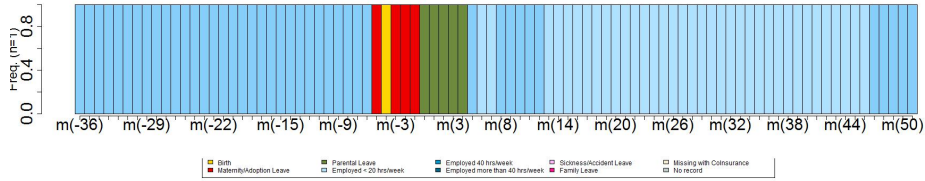
Figure 1: An example of a single reconstructed trajectory of a woman who had a child in 2003

(months) in the observation period (eight years). A detailed description of the data-preparation process and the reconstruction of trajectories is available in Zhelyazkova (2013). Figure 1 displays an example of a single reconstructed trajectory of a female working parent from the sample. Each segment of the trajectory corresponds to one month and each colour corresponds to a different "state", which is considered to describe the situation of the individual for that month. The colour codes for the states are provided in the legend of the figure and in addition more detailed descriptions are provided in Table 4 in Appendix A.

What do we see in Figure 1? The start of the observation period is 36 months prior to the last month the woman was on maternity leave. We see that prior to the maternity period (marked in red), this female employee was working between twenty and thirty-nine hours per week. Her trajectory appears quite steady in this period, without any interruptions, such as sick leave, family leave or unemployment periods. After her maternity leave, the employees takes full-time parental leave[2]. After her parental leave, the employee returned to the same hours of employment in the initial period, however, later she switched to employment of less than twenty hours per week. At the end of the observation period, about fifty months after the end of her maternity leave, the employee resumes similar hours of employment as prior to her birth in 2003. However, as the data are cut off at this point, it is not possible to tell whether this change is permanent or not.

In Figure 2, we see a multitude of reconstructed trajectories "stacked" over each other. Individual lines are difficult to distinguish, as the total number

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[2]In Luxembourg full-time parental leave must be taken at a block of six months. In this case the parental leave appears to last only five months, possibly because it overlapped with maternity leave, and the month it began was coded as maternity leave.

of trajectories is quite large. There are 4481 women and 5827 men in the final sample of the analysis. However, what is interesting in Figure 2 are not individual trajectories, but the overall patterns. To make the graphs more readable the trajectories have been sorted according to their distance from the most frequent sequences in the sample of men and women.

Interested readers are referred to a related paper by Zhelyazkova (2013) where the cross-sectional state distribution of the trajectories is analysed in detail. In Zhelyazkova (2013) the work-family trajectories of the same parents are re-constructed and analysed. However, in Zhelyazkova (2013) the focus is on looking at trajectories transversally. A transversal analysis of trajectories means that the focus is on the vertical dimension(see Gabadinho et al., 2011b), i.e. on comparing the activities of parents at simultaneous time-points. One of the main findings from the analysis in Zhelyazkova (2013) is that the birth of a child is pivotal event in the work-family trajectories of women. A large percentage of women reduce their hours of work participation after the birth of a child and many of them transition to a state of labour market inactivity within the observation period of about five years after the birth. The present study extends these results by separating the trajectories that follow a continuous stable development throughout the observation period from these that exhibit a disruption around the time of birth.

The diversity within trajectories is visible already in Figure 2a. The trajectories are plotted at the bottom of Figure 2a seem to be relatively stable, as their hours of employment do not seem to differ in the period before and after their maternity leave. Readers are reminded that darker shades of blue in the colour index correspond to more hours per week worked. The trajectories of women right above them, up to about the top of the bottom half appear to be identical to the trajectories of the women at the bottom part of the graph, as they are predominantly made up of continuous states of employment at full-time or above full-time hours. For women in the upper part of the bottom half, however, return to work after the maternity leave is clearly marked by a reduction of hours (signified by a fading of the blue colour towards lighter shades).

In the trajectories of men, there is also some diversity. The trajectories at the top are of male parents who are continuously self-employed throughout the observation period. The rest of the trajectories in the upper half is made up of men in continuous full-time employment, while the bottom half rep-
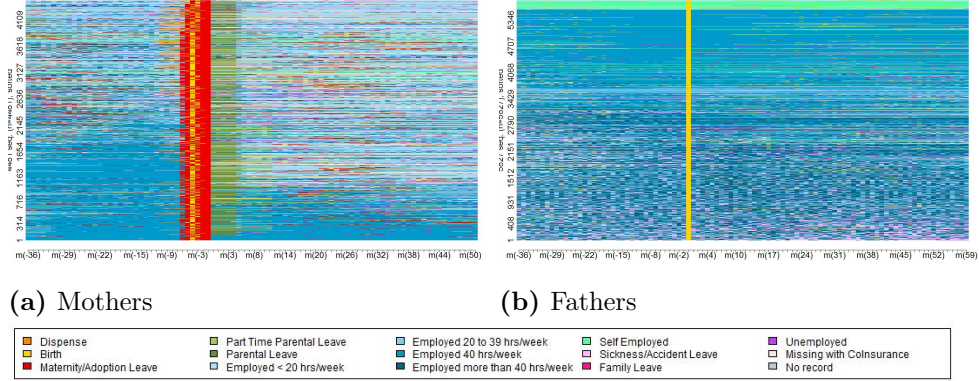
(a) Mothers   **(b)** Fathers

☐ Dispense	☐ Part Time Parental Leave	☐ Employed 20 to 39 hrs/week	☐ Self Employed	☐ Unemployed
☐ Birth	☐ Parental Leave	☐ Employed 40 hrs/week	☐ Sickness/Accident Leave	☐ Missing with CoInsurance
☐ Maternity/Adoption Leave	☐ Employed < 20 hrs/week	☐ Employed more than 40 hrs/week	☐ Family Leave	☐ No record

Figure 2: Longitudinal view of the sorted work family trajectories of parents in Luxembourg who had a child in 2003

resents the trajectories of primarily blue collar workers, marked by frequent periods of overtime work, as well as sick/accident leave periods. Again, as already stated in Zhelyazkova (2013), it appears that the differences between trajectories in the sample of male employees are not related to the arrival of a child in the family in 2003, while for many women this is very much the case.

To search for similar trajectories I use a clustering algorithm. Although there are different ways to identify shared patterns, the clustering approach has established itself as the dominating procedure in the sequence analysis literature (Abbott and Tsay, 2000). Some researchers have criticised the use of clustering algorithms on the basis of their explorative nature: it is not possible to test hypotheses about the number or type of clusters or the distribution of trajectories across clusters (Hynes and Clarkberg, 2005). In this paper, however, the method is chosen precisely due to its explorative nature. As there are only few studies on work-family reconciliation in Luxembourg or the utilization of leave policies along the life-course in general, formulating *apriori* hypotheses about types of work-family trajectories would be difficult.

The steps in cluster analysis are the computation of a distance matrix, clustering of the sequences, and finally the decision on the appropriate number of groups. In this study, I use the Longest Common Subsequence for com-

puting the distance matrix, which has been implemented in the TraMineR package (Gabadinho et al., 2011a), which runs under the free environment for statistical programming R (R Core Team, 2012). For the clustering of trajectories I use the Ward's method for agglomerative hierarchical clustering, which is implemented in the Cluster Package (Maechler et al., 2012). To determine the optimal number of clusters I use the cluster diagnostic tools suggested by Studer (2012a), which are implemented in the Weighted Cluster Package (Studer, 2013). A brief explanation of all these steps and tools is provided below.

The distance matrix is a matrix containing the "distances" between all sequences in the data set from one another. When we compare sequences, the distance is essentially a way to express numerically the level of the difference between them whereby 0 would mean that the distances are exactly the same and higher numbers would represent greater levels of difference. In this paper the distances between every pair of sequences are computed based on the Longest Common Subsequence (LCS). An explanation of this method can be found in the TraMineR manual (Gabadinho et al., 2011b) and in Elzinga (2007). In short, when comparing sequences with the LCS method, any elements from one of the sequences that appear in the same order in the other sequence would be considered a subsequence (even if there are other elements in between). For example in the sequence $ST-ST-ML-ML-B$, both $ST-ML$ and $ST-B$ would be considered subsequences, although the latter does not occur in the same way in the sequence. The pairwise distances between two sequences are symmetric (i.e. the distance between sequence a and b is the same as the distance between sequence b and a) and the distance between each sequence and itself is equal to 0. Therefore if we have n sequences the distance matrix will contain $\frac{n*(n-1)}{2}$ distances.

The choice of the LCS method over the most commonly used method Optimal Matching (OM)[3] is motivated mainly by the sequence complexity.

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[3]Optimal matching provides a numerical expression of the difference between a pair of sequences by assigning a value for each operation (insertion, deletion or substitution of elements) that would be necessary to transform one sequence into the other and then summing the total "cost" of the conversion process. Optimal matching is so commonly used in the social sciences, that it is sometimes used interchangeably with sequence analysis (Elzinga 2003 in Aisenbrey and Fasang (2010)).Despite the common use of optimal matching, it is important to note that there are a number of alternative ways to measure distances between sequences. For example Elzinga (2007) presents an overview of possible alternatives. Furthermore interested readers are invited to refer to Studer (2012a) who compares over thirty methods in a chapter of his doctoral thesis.

With as many as 17 distinct states in the female trajectories, defining a cost-matrix, which respects the triangle inequality and reflects a hierarchy of the states proved to be too challenging. In this case, LCS was considered a suitable measure, as it allows the identification of shared patterns in the long run. For the research problem at hand brief interruptions, such as sick leave or family leave are not as relevant as the long-run course of the trajectory. In addition, Elzinga (2007) notes that two measures are related, as LCS produces the same results as OM with a substitution costs equal to 2 and insertion/deletion costs equal to 1. Essentially, choosing LCS means assuming that differences between all the states are identical.

Once the distance matrix has been computed, similar patterns can be identified by a clustering algorithm. There are numerous choices of clustering algorithms and it is interesting why the somewhat subjective setting of costs in defining distances via OM tends to attract more discussion in the literature, as the results can be affected by both the method for computing the distance matrix *and* by the clustering algorithm (Holland, 2006). It is beyond the scope of this paper to discuss the different methods of clustering (interested readers can refer to Tan et al., 2006).

For the present analysis, an agglomerative hierarchical clustering procedure was chosen, which means that the process goes in a bottom-up direction. In the beginning each sequence is a separate cluster in itself and gradually similar[4] sequences are added together until all sequences are placed in one exhaustive final group. The "tree" analogy is often used when describing clustering algorithms. In this case, we can think of building the tree starting from individual leaves, then moving to smaller branches, then to the main branches and finally stopping at the trunk.

It is the job of the researcher to stop the clustering process at an appropriate point. Using the "tree" analogy again, the researcher must have some way to know how many "branches" should be cut from the tree, so what is left is a meaningful representation of the main sub-groups of patterns occurring in the data, assuming there are such patterns in the first place (see Hollister, 2009). In this paper, I applied the cluster diagnostic tools suggested by Studer (2012a) who discusses them at length in his doctoral thesis. He sug-

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[4]In the adding of sequences Ward's method was applied, which means that the sequences added to each a cluster would be the ones minimising the increase in the within-cluster variance.

gests using a number of diagnostic tools, based on previous research, which together can provide some indications as to where to stop the clustering.

In order to make the clustering results comparable for men and women, I performed the clustering on the merged sample including all 10308 trajectories. The clustering process was stopped at nine clusters based on the clustering diagnostics computed with the Weighted Cluster package (Studer, 2013). The diagnostics are presented in Appendix B. For an easier interpretation, cluster diagnostic results have been normalised and displayed graphically in Figure 3. Very roughly speaking, we are looking for a cluster number solution where all of the proposed measures are as high as possible, except the index Calinski-Harabasz (Calinski and Harabasz, 1974 in Studer, 2012a), which should be as low as possible.

6   Discussion of Clustering Results

This section provides an overview of the nine clusters obtained as described in Section 5. As the clustering algorithm has been preformed on the combined sample of male and female trajectories, the clusters are presented as obtained from this combined sample in Appendix C, Figure 4. The vertical bar marked as $m(0)$ on each of the nine clusters displayed in Figure 4 provides a quick, "eyeball" measure of the distribution of men and women in each cluster. In the female trajectories this month represents the last month of maternity leave and is therefore marked in red. In the male trajectories, the pivotal point of the analysis was set at the birth of the month of a child in the household. Therefore $m(0)$ for all male trajectories is marked in yellow. The relative proportions of red:yellow colours in $m(0)$ therefore provide an idea of the female:male ratio of trajectories.

To make the different distribution of male and female trajectories in the clusters apparent, counts and percentages for each gender per cluster have been presented in Table 1. Appendices D and E present the graphical displays of only the female and male trajectories in each cluster respectively. The clusters are described in detail below. Overall a major division was made between two general categories of cluster types: these representing continuous careers, without marked differences between the periods before and after the birth of the child in 2003 and these where the birth of the child

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seems to represent a pivotal point, after which the career takes a different turn.

Clusters representing continuous careers, included Types 1,2,3,4,7 and 8. The "typical" careers consisting of full-time work with few job-protected interruptions tended to be assigned to Type 3. Careers consisting of continuous part-time hours of employment were assigned to Types 1 and 7. Type 1 was dominated by employment in the range of 20 to 39 hours per week, which could be seen as part-time, but still more than half-time employment. Type 7, on the other hand, was characterised by employment in the range of 20 hours per week or less. Type 2 contains trajectories that can be characterised by predominant periods of self-employment (or part-time self-employment). Finally Types 4 and 8 appear to be characterised by somewhat irregular hours of employment where the parents work overtime in some months and part time in other months. This appears to be especially the case in Type 4. The careers in Type 8 seem to also have some irregularities, however, they are dominated by standard full-time hours of work.

Clusters 5, 6 and 9 appear to contain trajectories characterised by a disruption of the employment trajectory. Type 6 represent the most subtle kind of disruption, where the careers are characterised by a switch from full-time to part-time employment in the post-birth period. This switch appears to be permanent at least throughout the observation period. The sand colour dominating the after-birth period in trajectories assigned to Type 5 and the grey colour dominating the after-birth period in trajectories in Type 9 represent months without administrative records. In the first case (Type 5) labour market inactivity can be quite certainly assumed because insurance records for the corresponding periods showed that the person is insured as someone else's dependent for the corresponding period. It is somewhat more problematic to interpret the trajectories assigned to Type 9, where co-insurance records were not found. It is therefore possible that these persons are working in another country or in the European Union institutions in Luxembourg, which are outside the national social security system. The fact that a significant percentage of men (about 4 per cent) is in this cluster makes it possible to think that these careers represent part of normal job-related mobility, which could be expected in a highly international, cross-border labour market situation as in Luxembourg. On the other hand, however, the proportion of female trajectories assigned to this cluster is higher (9 per cent), which could also suggest that for a part of women from this cluster

	Women		Men	
	Count	Per Cent	Count	Per Cent
(1) Continuous part-time careers (20 - 39 hrs/week)				
	838	19%	185	3%
(2) Continuous self-employment				
	142	3%	302	5%
(3) Continuous full time careers				
	675	15%	1924	33%
(4) Continuous overtime hours intermittent with part-time hours				
	477	11%	2408	41%
(5)Transition to labour market inactivity after birth in 2003				
	523	12%	22	< 1%
(6)Reduction of working hours after birth in 2003				
	682	15%	39	1%
(7) Continuous part-time careers (<=20 hrs/week)				
	307	7%	63	1%
(8) Continuous full time careers with some irregular hours				
	439	10%	662	11%
(9) (Possibly) leaving Luxembourg after Birth in 2003				
	398	9%	222	4%
Total				
	4481	100%	5827	100%

Table 1: Distribution of clustering results for men and women

the career interruption is related to the event of birth.

There were some very clear differences in the gender distribution by cluster types. Women were over-represented in clusters characterised by continuous part-time employment (Type 7 and Type 1). In total, about 26 of the female trajectories were assigned to these clusters, compared to only 4 per cent of the male trajectories. Women were also more likely to be assigned to one of the cluster types (Type 5,6 and 9) characterised by a change of the trajectory after the birth of a child in 2003. About 36 per cent of women could be assigned to one of these three clusters. The change in the trajectory consisted either in an absence of administrative record (which could imply inactivity or moving to another country) or a reduction of working hours. In comparison, less than 5 per cent of the male trajectories were assigned to one of these three clusters.

The reconstructed careers of of men appeared to be concentrated in two very dominant groups: the continuous full-time careers (Type 3) and continuous full-time intermittent with part-time careers (Type 4). Almost three quarters (73 per cent) of the male careers were assigned to one of these two types of employment. The third most represented cluster (Type 8) contains about 11 per cent of the male trajectories. However, it should not be concluded that there are only three clusters in the male trajectories. In the course of analysis, the clustering algorithm was performed also on the separate sample of male trajectories, which resulted in seven distinct types. Again, the majority of trajectories could be contained within three main types, however, there appeared to be small and distinct sub-groups of men with somewhat more "feminised" trajectories, corresponding to Type 1 and Type 7 in this analysis. It is noteworthy that these somewhat atypical male trajectories appear to be stable across time. This means that the reduced levels of labour market participation are not a reaction to the life event of birth of a child in 2003, but they seem to represent a long-term life-style.

The reconstructed careers of women seemed to be spread across all cluster types. This is consistent with the results of other studies based on sequence analysis, which typically tend to find a greater diversity in female's career trajectories. Grouping the percentages of "continuous" career types, it appears that more than half of the working mothers in Luxembourg do not experience a disruption in their career path after having a child. However, a significant part of these careers represent continuous part-time careers.

7 Who is in each cluster: Multinomial logit analysis

The final step of the analysis is to incorporate all available information on covariates into a multinomial logit model. The model aims to provide an idea of how covariates are related to the probability of being in each cluster without any claim of establishing causality or disentangling problems of endogeneity, which are abundantly present given that the construction of the dependent variable incorporates information of the career trajectory over time and the predictor variables include information from a specific time period in the construction of the trajectory. The idea of performing a multi-variate analysis in this case is simply to examine the effects of the variables *controlling* for other variables, which is the maximum that could be achieved with the information which is available. As the distribution of trajectories across clusters for men and women came out so different from each other, separate multinomial logit models were fitted for the female and the male samples.

The covariates included in the analysis as predictors are described in Appendix F. Covariates were chosen based on availability in the administrative records and some were constructed based on the trajectories themselves. Generally, there are three types of covariates in the analysis: work-related (including earning information and workplace characteristics), family-related (including the presence of a spouse or other children) and control variables including age and nationality. The use of parental leave has also been incorporated in the analysis as a categorical variables. As the majority of women used their right to parental leave immediately, for women the values of leave use in the first month after maternity leave were used. For men, the use of parental leave was spread throughout the allowed period of five years. That is why the variable was created on the basis of leave use until 2008. The distribution of parental leave according to cluster types is presented graphically in Appendix G.

It is particularly interesting to use the results of the model to explain why some women reduce their work participation after having a child. Perhaps the most interesting comparison in this analysis is the comparison between Type 3 and Type 6 (women in who reduce their employment hours from full-time to part-time after the birth of their child). The trajectories of

the two clusters of women look almost identical in the pre-maternity leave period. However, after the birth of their child, women in Type 3 resume their previous full-time employment hours, while most of the women classified as Type 6 switch to working part-time after they have a child. It is also interesting to examine the differences between women in the reference group and the other two groups of women whose trajectories change after the birth of a child: Type 5 who seem to transition to long-term labour market inactivity and Type 9 who seem to leave the country.

The covariates available for the analysis allow that these differences are examined within a classical economic framework. A good overview of how economic reasoning could be conceptually applied to the decisions of women to work after child birth is provided in Joesch (1994). In this framework of analysis, women compare the benefits of working with the opportunity cost of working to make a decision about their labour market participation. The benefits of working reflect present and future earnings, while the opportunity costs refer to the value of the time of the woman spent at home. In Joesch (1994) the first part of the equation is termed the *Full Wage* and the latter part is termed the *Reservation Wage.*

Factors that are expected to increase the *Full Wage* include work experience and wages prior to the birth of the child. Work status during pregnancy is seen as an important factor as well, as it increases the *Full Wage* through the accumulation of additional human capital. It can also be seen as an indicator of women's preferences for paid work (Joesch, 1994). In this analysis, all women are pre-selected based on working throughout pregnancy up to the start of their maternity leave. However, two variables have been designed as proxies for labour market attachment: the complexity of the work trajectory and the number of months with uninterrupted employment in the pre-birth trajectory. The complexity of the work trajectory measures the longitudinal diversity of trajectories, whereby these trajectories with higher levels of complexity will include more transitions and to a higher number of states (such as sick leave, unemployment, etc.). The number of months in uninterrupted employment measures how many months a parent worked prior to the birth without any short or long-term interruption. The construction of these variables is described in more detail in Appendix F.

Factors that increase the *Reservation Wage* include the presence of a husband (thus a higher family income) and more children in the household, as well as the number, ages and spacing of the children (Joesch, 1994). In this

study, the marital status is included as a measure of the presence of partner. It must be noted that in the social security records made available for the analysis, persons who are co-habiting without a formal marriage are considered single. In addition, the number of children is made available based on artificially reconstructed fiscal households, which may not necessarily reflect the actual living situation.

Therefore based on economic reasoning, it would be expected that women would be more likely to belong to a cluster type marked by reduction in the labour participation if:

- The woman has lower earnings prior to the birth

- The pre-birth trajectory of the woman is more complex and includes more work interruptions

- The woman is married

- There are already other children in the household

The male trajectories were also analysed in the same way. However, explicit hypotheses were not formulated for them, as the main clusters did not seem to be affected by the event of birth of a child in the household. However, performing the analysis on the male sample can serve as a robustness check of the analysis (it would be alarming if the same variables are significant in both cases) and it can provide some more information on the gendered nature of the relationships between and work and family.

The results are presented in Tables 2 and 3. In the sample of fathers, clusters 5,6, and 7 were grouped together, as there were very few cases in each of these clusters and an estimation would have not been possible. For both models the reference category for the dependent variable was Type 3, which included trajectories dominated by standard full-time employment. The choice of reference category means that the effects of all variables can be interpreted with reference to the probability that a parent is in the cluster of continuous full-time employment compared to being in one of the other clusters in the analysis.

Several variables presented a problem for the analysis due to a large number of missing cases. For both men and women the largest number of missing

values was found in the variables measuring the number of children in the household as of 2003, the presence of a spouse and the size of the organization in 2003. These values were missing somewhat systematically due to a lack of administrative record of these individuals for 2003. To deal with this problem, missing values were substituted with values for the first available record after 2003. For about half of the observations this was as soon as 2004, however, some records were used from as late as 2007. For computing the number of children only these born before 2003 were counted. With this procedure the missing values of the records of 196/200 women and 378/380 men were imputed. Using these values means making the assumption that the situation of the person the first time a record appeared was the same as in 2003. To control for the potential bias introduced by these imputed records a dummy variable was entered in the analysis, which took the value of 1 if information on these three variables was based on a record later than 2003.

Another variable, which contained a large number of missing values was the variable indicating the growth of the salary in a six-month period prior to the maternity leave for women and the birth for men. The variable was calculated with a lag of six months to avoid capturing fluctuations in the level for salary growth due to the expectation of a child in a the near future. This means that information on the salary should be available for a record for as far back as 12 months before the start of the maternity leave or the birth so that the average growth rate could be computed. For some individuals there were no records, if they had started working in Luxembourg later than this period. Other reasons why some values could be missing were gaps in the salary information. Overall these were very few records. To deal with the problem a dummy variable indicating a missing value was introduced in the model.

The model for women converged after 7 iterations, while the model for men converged after 8 iterations. The results of the Likelihood Ratio Chi-Square test for both models, suggested that the hypothesis that all predictors' coefficients in the model are equal to zero can be rejected($\chi^2_{women} = 3602.4, p < 0.001$, $\chi^2_{men} = 5685.4, p < 0.001$). However, the results of the Hausman-McFadden on the Independence of Irrelevant Alternatives assumption suggest that the results should be interpreted with caution in the case of the male sample, as it seems that the assumption does not seem to hold ($\chi^2_{men} = 483.9604, df = 116, p < 0.001$).Some researchers have raised some concerns about the accuracy of this test (see Vijverberg, 2011). However,

the test was still applied in this case, as it remains one of the most commonly used tests in the literature and other alternatives have not yet clearly been established.

The results on the sample of women are displayed in Table 2. For an easier interpretation of the results coefficients have been exponentiated, which means that values can be interpreted as odds ratios. Odds ratio higher than one indicate a positive relationship, while odds ratios lower than one indicate a negative relationship.

To compare the odds associated with being in Type 3 relative to Type 6 for women according to the covariates used for the analysis, one needs to look at the column titled Type 6 in Table 2. Work-related variables show surprisingly few differences between women in the two types. Based on economic reasoning it would be expected that women with higher opportunity cost (i.e. higher earners) and women with more job-specific human capital (with more experience) will be less likely to reduce their work participation as they have a higher opportunity cost of doing so. However, the results are somewhat contrary. Earners in the category 3000 - 3500 euro per month (higher than the reference group) are in fact more likely to be in Type 6 than in Type 3, as are women who started working in Luxembourg earlier (i.e. and have presumably more experience). Turning to family-related variables again we find only mixed-level support for a traditional economic explanation. Economic reasoning would suggest that women would be likely to reduce work participation as the value of their time at home increases - i.e. if they have more children. Interestingly, however, it appears that the choice of reducing working hours from full-time to part time is made when the first child is born, as women who have no other children are more likely than women with one other child to be in Type 6. Women who are married are almost twice more likely than women who are not married to reduce their working hours. This is in line with the expectations, as women with partners can reduce working hours and the income of their spouse would still contribute to the family's income. While there is no information on the working status of the spouse, it can be assumed that male spouses are working. For example, figures presented in Margherita et al. (2009) suggest that about 95 per cent of fathers of children aged 0 to 11 were employed in Luxembourg, regardless of the age of their child. In the countries where the majority of cross-border workers come from (France, Belgium and Germany), the same report presents employment rates for fathers above 90 per cent (see Margherita et al., 2009, p.34).

Comparisons with Types 5 and 9 also indicate interesting results. Women in these clusters tend to have a prolonged period without and administrative record after the birth of a child. For women in Type 5 it can be almost certainly assumed that they transition to labour market inactivity as their records are matched with a record of co-insurance. Women in Type 9 are a more mysterious group as the absence of administrative record could indicate that they work in another country. Either way, however, both of these trajectories are marked by an interruption in the pre-birth employment, which is what work-family reconciliation policy aims to reduce. Therefore these two types deserve a special attention. Workplace related variables seem to play a larger role here, as almost all coefficients are significant. The pre-birth salary related income dummies suggest a non-linear relationship between salary level and the odds of being into one of these two types relative to the reference group (Type 5). Women earning lower than the reference group or higher both have higher chances of being assigned to Clusters 5 or 9 relative to 3. Complexity of the pre-birth trajectory also seems to play a role, as women with more complex trajectories have higher probabilities of being in Clusters 5 or 9. Family-related variables add more to the story. Women who have a partner have about 8 times higher odds of being in Cluster 5 than in Cluster 3 (the reference group). Women who already have at least two other children also have almost double odds of transitioning to labour market inactivity (Type 9). However, the presence of partner and children does not seem to be related to the probability of being in Type 9. Interestingly, however, the birth of twins or triplets in 2003 does seem to more than double the odds of interrupting one's career, although the variable is significant only at the 10 per cent level for Type 5.

Overall women with one or two children were more likely than women with no other children prior to 2003 to be in clusters of Type 1 and Type 7, relative to Type 3 (the reference group). Clusters 1 and 7 were marked by predominantly part-time work. It is interesting to think that perhaps the beginning of the trajectories of women in these clusters is identical to the end of the trajectories of women in Cluster 6 (mothers who have remained in the labour force but who have reduced their working hours after having their first child). The presence of husband was positively associated to higher odds of being in Types 1, 5, 6, 7, relative to Type 3. What is common in the first four trajectory types is that they are either marked by a reduction in the labour force participation after birth or contain primarily trajectories of part-time employment (especially Types 1 and 7). These findings are consistent with economic reasoning where it has been suggested that more

children in the household increase the values of mothers' time at home and thus increase the cost of labour participation of women. The findings on the presence of husband are also consistent with the idea that the potential earnings of the husband (in Luxembourg and the neighbouring countries over 90 per cent of fathers were employed as of 2006 (see Margherita et al., 2009, p.34)) serve to reduce the economic cost on the family of the reduced earnings of the mother.

The results of the same analysis on the male sample are displayed in Table 3. These results are interesting to consider next to the results for women, as they provide further insight into the gendered nature of the relationship between employment and family. One of the most striking findings is that family-related variables, such as the presence of spouse, number of children already in the household and multiple births are not significant for any of the models. The only exception is that married men are more likely to be in Type 2, where trajectories are dominated by self-employment. Salary-related variables seem to follow similar patterns to the results for the female sample, as the lowest level earners (below 2000 per month) were less likely to be in Type 3 than in any of the non-reference groups for the dependent variable. In the male sample Type 4 is the only exception. Looking at the coefficients for the higher earning groups, it appears that the highest earners are more likely to be in Type 3 in the female sample. The results are different in the male sample. The coefficients of the dummy variables for the higher income categories are not significant in most places, which suggests that men earning higher than the reference group (2500 - 3000 per month) do not have different probability of being in Type 3 or another type (except Types 4 and 9). In fact, higher earners are more likely to be in Type 1 than in Type 3. These results suggest that for women attaining median and higher income is for the most part possible by maintaining continuous full-time employment hours. For men it seems like it is not so much the number of hours, but the type of employment that matters. The significant coefficient for the higher earning dummies in the comparison between Type 1 and Type 3, further suggests that some men seem to be able to maintain a high monthly income based on fewer working hours.

	Type 1	Type 2	Type 4	Type 5	Type 6	Type 7	Type 8	Type 9
Intercept	*** 0.13	*** 0	*** 0.01	*** 0.1	*** 0.67	0.01	*** 0.64	*** 0.07
Salary: <2000	2.81	*** 3.62	*** 2.36	*** 6.02	*** 1.1	3.32	*** 1.63	*** 4.02
Salary: 2000-2500	1.45	0.61	1.63	. 1.71	0.92	1.41	1.55	. 1.6
Salary: 3000-3500	1.15	0.64	1.22	0.94	1.43	0.78	1.08	1.16
Salary: 3500-4000	1.52	. 0.68	1.39	0.61	1.64	0.86	1.19	. 0.5
Salary: 4000+	0.62	* 0.79	0.9	0.4	*** 1.16	* 0.15	*** 0.8	*** 0.36
Salary growth: Positive	0.65	*** 0.21	*** 0.73	* 0.67	*** 0.87	0.87	0.87	*** 0.56
Uninterrupted employment: 11+ months	0.38	*** 0.81	1.56	* 0.55	*** 0.83	0.51	*** 0.73	*** 0.55
Complexity: Above median	3.79	*** 0.91	39.59	*** 3.52	*** 1.19	3.02	*** 3.27	. 3.14
Years participation in LU	1.02	0.91	*** 1.04	1.05	* 1.07	*** 1.07	* 0.99	*** 0.92
Category: Blue collar	0.97	0.12	*** 3.57	*** 0.86	1.08	0.59	. 1.3	1.53
Married	1.52	*** 0.82	1.17	6.95	*** 1.84	*** 3.1	*** 1.21	0.84
Other children in HH:(1)	1.74	*** 1.29	0.85	1.02	0.7	3.46	*** 0.79	1.26
Other children in HH:(2+)	3	*** 2.15	* 0.95	1.85	* 1.03	* 6.55	*** 1.31	1.67
Male child born in 2003	0.96	0.77	0.94	0.99	0.93	0.95	1.01	1
Twins or triplets in 2003	0.97	2.06	1.16	2.41	. 1.63	1.1	2.45	. 2.88
Age in 2003	1.07	*** 1.19	*** 1.04	* 1.03	1	1.09	*** 1	*** 1.09
Nationality: France	0.73	. 0.27	*** 1.79	* 0.11	*** 0.63	*** 0.22	*** 1.24	* 1.62
Nationality: Portugal	0.58	* 0.83	1.47	0.13	*** 0.37	*** 0.14	*** 0.75	*** 0.28
Nationality: Belgium	1.02	0.27	*** 2.08	*** 0.26	*** 0.92	0.45	*** 1.26	. 1.61
Nationality: Germany	2.2	* 1.13	1.53	1.77	3.11	*** 3.56	*** 1.99	*** 7.37
Nationality: Other	0.64	. 0.47	* 1.63	. 0.47	*** 0.72	0.32	*** 1.54	1.32
No parental leave	0.5	*** 4.15	*** 0.61	*** 0.97	0.4	*** 0.38	*** 0.5	*** 0.53
Part time parental leave	0.82	8.56	*** 0.85	0.09	*** 1.52	*** 0.46	*** 0.37	*** 0.24
Missing: Salary growth	0.56	2.77	0.45	1.99	1.48	3.01	1.52	0.85
Missing: Record 2003	1.09	0.46	0.84	0.49	1.23	1.19	1.11	. 0.56

Table 2: Multinomial logit results for women Reference categories: Salary: 2500-3000, Salary growth: Negative, Uninterrupted employment: <11 months, Complexity: Below median, Category: White collar, Married: No, Other children in HH:(0), Sex of child born in 2003: Female, Single Birth, Nationality: Luxembourg, Parental leave: Full timecodes: *** 0.001, ** 0.01, * 0.05, . 0.1

	Types 567	Type 1	Type 2	Type 4	Type 8	Type 9
Intercept	0.01 ***	0.02 ***	0 ***	0.04 ***	0.08 ***	0.01 ***
Salary < 2000	3.42 *	7.81 ***	8.77 ***	0.82	1.14	2.42 *
Salary: 2000-2500	1.84	4.45 ***	0.96	1.04	1.05	1.83 .
Salary: 3000-3500	0.87	4.23 ***	0.67	0.59 *	0.77	0.47 .
Salary: 3500-4000	0.71	3.26 *	0.53 .	0.48 ***	0.63 *	0.98
Salary: 4000-4500	0.85	1.65	0.31 ***	0.48 ***	0.51 ***	1.03
Salary: 4500-5000	0.41	3.04 *	0.43 *	0.59 *	0.64 .	0.44
Salary: 5000-5500	0.98	2.92 *	0.41 *	0.56 *	0.38 ***	0.51
Salary: 5500+	1.46	0.93	0.85	0.44 ***	0.4 ***	0.82
Salary growth: Positive	0.72	0.6 ***	0.18 ***	0.49 ***	0.58 ***	0.56 ***
Uninterrupted employment: 11+ months	2.34 *	1.12	1.67	2.29 ***	1.86 ***	0.45 ***
Complexity: Above median	2.79 ***	4.9 ***	2.06 ***	40.82 ***	16.7 ***	7.22 ***
Years participation in LU	0.98	1.02	1.04 .	1.02	0.99	0.92 ***
Category: Blue collar	21.29 ***	2.95 ***	0.22 ***	17.08 ***	1.92 ***	1.97 *
Married	3.2 .	0.93	2.02 *	1.05	1.18	1.49 .
Other children in HH:(1)	1.21	0.88	1.21	1.26 *	1.12	1.38
Other children in HH:(2+)	1.47	1.32	1.55 *	1.16	1.13	1.1 .
Sex of child born in 2003: Male	1.2	0.96	0.95	0.97	1.02	0.86
Twins or triplets	0.75	1.84	0.67	1.01	0.76	0.98
Age in 2003	1.01	1.02	1.06 ***	1.01	1.02	1.04 *
Nationality: France	0.12 ***	1.21	0.41 ***	1.7 ***	1.58 ***	3.24 ***
Nationality: Portugal	0.07 *	0.9	2.96 ***	5.62 ***	2.67 ***	8.64 ***
Nationality: Belgium	0.49 .	1.48	0.95	2.05 ***	1.62 ***	3.42 ***
Nationality: Germany	1	0.82	0.6	1.47 .	1.59 *	1.19
Nationality: Other	0.63	0.99	2.21 ***	2.47 ***	2.11 ***	6.03 ***
No parental leave (5 years)	0.26 ***	0.56 *	4.12 *	0.96	0.78	1.58
Part time parental leave (5 years)	1.87	0.97	10.58 ***	0.74	0.39 *	0.17
Missing: Salary growth	0.92	0.6	1.86	0.42 .	0.6	1.13
Missing: Record 2003	0.37	0.93	1.5	1.34	0.96	1.54 .

Table 3: Multinomial logist results for men Reference categories: Salary: 2500-3000, Salary growth: Negative, Uninterrupted employment: <11 months, Complexity: Below median, Category: White collar, Married: No, Other children in HH:(0), Sex of child born in 2003: Female, Single Birth, Nationality: Luxembourg, Parental leave: Full time Significance codes: *** 0.001, ** 0.01, * 0.05, . 0.1

8 Discussion

The main goal of this paper was to identify and describe the main patterns of work-family reconciliation for working mothers and fathers in Luxembourg. The main finding is the event of a birth of a child in the household in about a third of the female career types, where some of them tend to reduce their working hours or withdraw form the labour force for prolonged periods. About a third of women employed in Luxembourg maintain a profile of continuous full time (and even overtime) employment, while the other third have predominantly part time careers. About 85 per cent of the male trajectories fall in one of three major types: continuous full time employment, and continuous overtime employment intermittent with either full time or part time work.

This paper has also made an attempt to link the probability of being in any the major career profiles with certain covariates that have been made available in the administrative data. Overall the results on the analysis of the sample of mothers lend partial evidence to an economic justification of women's career decisions. Lower opportunity cost (in terms of foregone salary earnings) does seem to be associated with higher probability to leave the workforce. More children and the presence of a spouse in the household also make it more likely that a woman will leave her pre-birth employment than maintain a continuous full-time career track. However, these variables do not seem to explain why some women reduce employment hours from full time to part time after having a child.

The main contribution of the paper to previous knowledge on work-family reconciliation is in its holistic approach. Each trajectory includes all decisions made by parents as they unfold over time and only the final, resulting pattern is analysed. In addition, a few words must be mentioned about using very administrative data for the reconstruction of career trajectories. This is in contrast with similar studies using sequence analysis methods, where sequences are based on self-reported data. The opportunity to use administrative records presents a unique chance to obtain a greater level of detail and accuracy than what individuals can recall themselves, for example in terms of their use of sick leave or other career-related interruptions.

However the present study has a number of limitations. To begin with, the results are based on the analysis of a specific, restricted sample: parents

employed in Luxembourg, who were eligible to take parental leave at the time of birth. By definition, this analysis excludes marginalised workers who work less than twenty hours per week for the same employer, non-parents and parents who do not participate in the labour force. Therefore the results must be interpreted with caution and in particular comparisons of other similar papers based on samples drawn from the whole population must be made with care.

Combining state sequence analysis and clustering, means taking two steps: construction of the distance matrix and the clustering algorithm. Critics of the method have pointed out that usually these steps are made in the absence of a clear theoretical foundation (as is the case in this study). In addition, other scholars have pointed out that results based on sequence analysis can be sensitive to *both* the distance metric and the clustering criteria (Holland, 2006). It is worth mentioning that there already exist methods where links between covariates and trajectories can be established directly, without an intermediate step of clustering. Interested readers are referred to Studer et al. (2011, 2010), where discrepancy analysis and regression trees are discussed. Unfortunately they are beyond the scope of this paper.

A possible further direction for research building on the results on this study would be the use of a clustering algorithm based on theoretically developed career profiles. Rather than letting the clusters emerge from the data in an explorative manner, the researcher could pre-define clusters that are expected to be in the data based on theory or previous knowledge and the clustering can subsequently be done based on how far each trajectory is from each of the "ideal" clusters (Abbott and Hrycak, 1990, see). It would also be interesting to have a more precise analysis of men and women at the time points at which they make decisions about using parental leave.

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A   State Definitions

| Color	Code	Definition	Notes
	D	Dispense	
	B	Birth	Denotes the month when a child was born; Births after 2007 are not recorded
	ML	Maternity/Adoption Leave	In the case of civil servants includes also assumed ML
	PL	Parental Leave Part Time	
	PP	Parental Leave Full Time	
	E<20	Employed less than 20 hours/week	Includes also 0 hours
	E<39	Employed between 20 and 39 hours per week	
	E40	Standard Full Time Contract	
	E40+	More than 40 hoours	
	SE	Self-Employed	Includes also part-time self-employed
	S/A	Sickness or Accident Leave	
	F	Family Leave	
	U	Unemployment	Includes also part-time unemployment
	X	No Record	
	COA	No Record with CoInsurance	Possibly out of the country, economically inactive or employed at EU Institutions

Table 4: State definitions

B Cluster Diagnostics
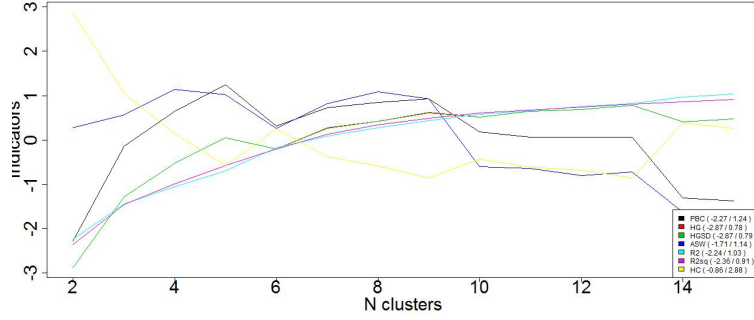
Figure 3: Values of the cluster diagnostic statistics (y-axis) by number of clusters (x-axis)

	PBC	HG	HGSD	ASW	CH	R2	CHsq	R2sq	HC
2	0.48	0.55	0.54	0.28	2243.10	0.18	4039.44	0.28	0.20
3	0.61	0.71	0.70	0.29	1772.56	0.26	3433.59	0.40	0.14
4	0.66	0.78	0.78	0.32	1428.26	0.29	2955.74	0.46	0.11
5	0.70	0.84	0.84	0.31	1261.62	0.33	2748.08	0.52	0.09
6	0.64	0.81	0.81	0.28	1255.22	0.38	2684.28	0.57	0.11
7	0.66	0.86	0.86	0.30	1165.16	0.40	2664.10	0.61	0.09
8	0.67	0.88	0.87	0.31	1074.77	0.42	2575.04	0.64	0.08
9	0.68	0.90	0.89	0.31	1004.37	0.44	2465.03	0.66	0.08
10	0.63	0.89	0.88	0.25	942.92	0.45	2335.34	0.67	0.09
11	0.62	0.90	0.90	0.25	878.13	0.46	2194.90	0.68	0.08
12	0.62	0.90	0.90	0.24	825.10	0.47	2083.65	0.69	0.08
13	0.62	0.91	0.91	0.24	779.02	0.48	1989.26	0.70	0.08
14	0.54	0.87	0.87	0.21	758.26	0.49	1899.09	0.71	0.12
15	0.53	0.88	0.88	0.21	722.80	0.50	1816.76	0.71	0.11

Table 5: Values of the cluster diagnostic statistics by number of clusters

The diagnostic statistics displayed in this appendix have been computed with the WeghtedCluster Package(Studer, 2012b), which runs under the free statistical and programming environment R (R Core Team, 2012). Detailed descriptions of each statistic are available in (Studer, 2012a).

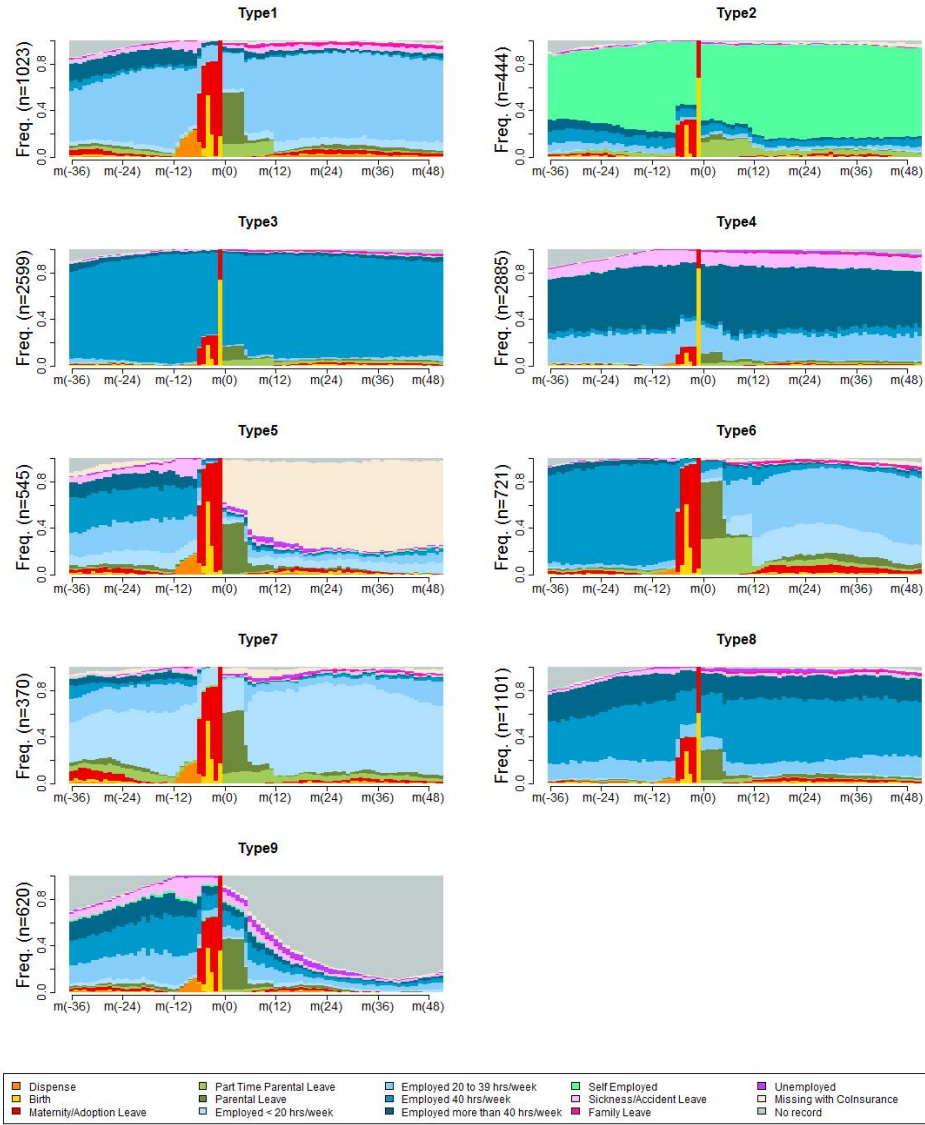# C Work-family trajectories of the entire sample of parents by cluster types

Figure 4: Cross-sectional state distribution of trajectories of working mothers in Luxembourg grouped in eight clusters

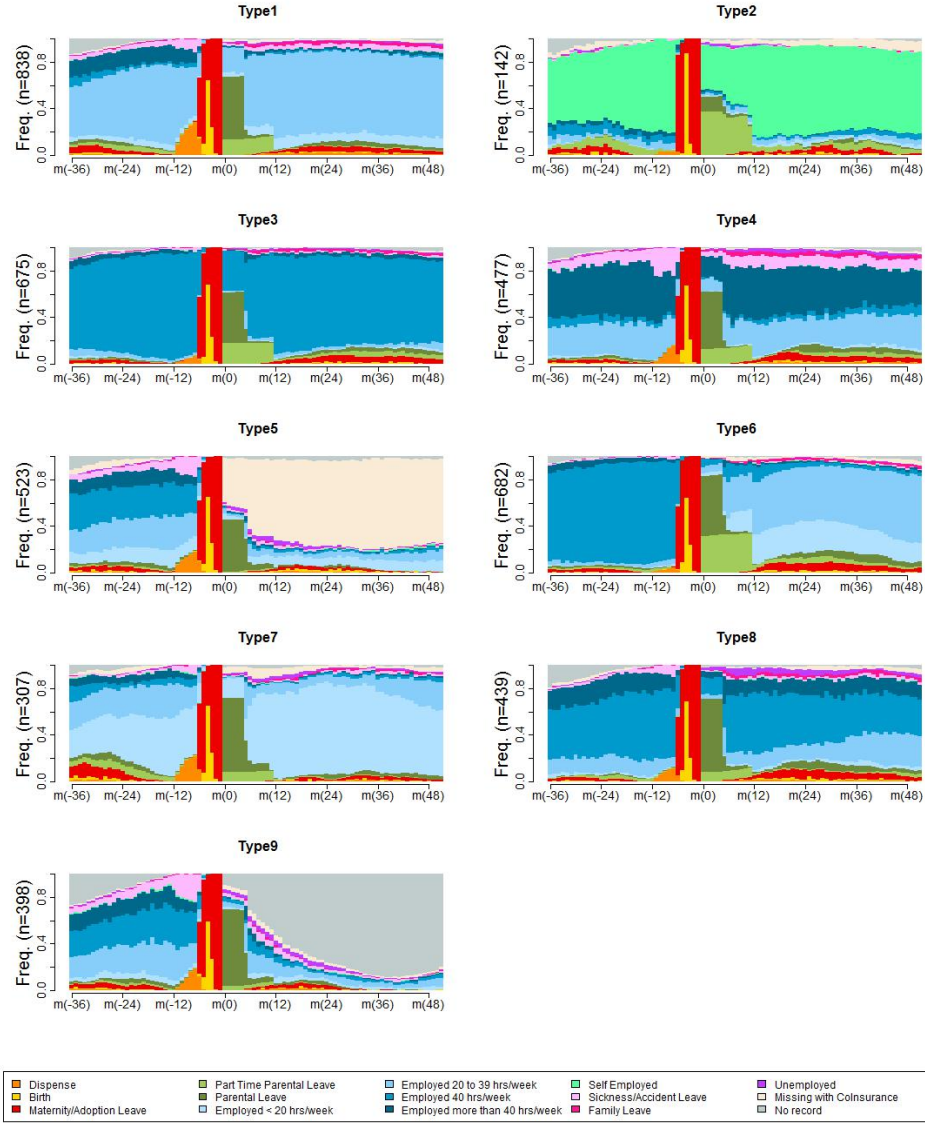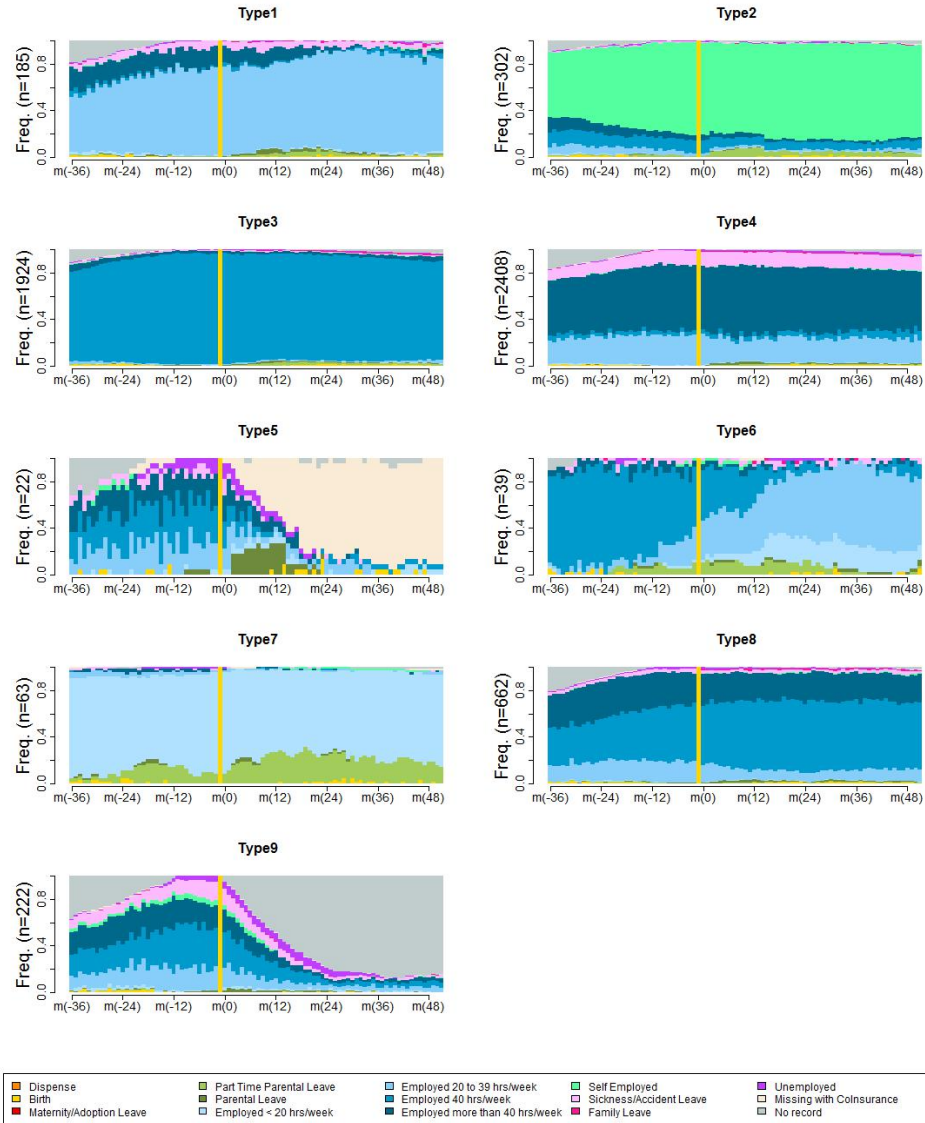# D   Work-family trajectories of mothers by cluster types

Figure 5: Cross-sectional state distribution of trajectories of working mothers in Luxembourg grouped in eight clusters

E Work-family trajectories of fathers by cluster types

Figure 6: Cross-sectional state distribution of trajectories of working fathers in Luxembourg grouped in eight clusters

F Description and Construction of Covariates

Table 6: Description and construction of covariates

Variable	Notes
Work related covariates	
Monthly salary prior to the birth in 2003	
Categorical variable with 6 levels for women and 9 levels for men.	This variable was constructed by taking the average of the monthly salary-related income received 12 months prior to the start of the maternity leave for mothers in 2003 and 12 months prior to the birth of the child in 2003 for fathers. Salary-related income was converted to 2005 EUR values using the monthly *Harmonized Consumer Price Indices (HCIP)* provided by Eurostat[5] for Luxembourg. The variable was categorised so that non-linear effects could be captured and the effects of extreme observations can be eliminated. There were different groupings for men and women, as the underlying income distributions differed from each other.
Salary growth prior to the birth in 2003	
• Positive (>1.00) • Negative ($=<1.00$)	This variable was constructed based on the deflated values of salary-related income for the period of 12 months prior to maternity leave (mothers) or the birth in 2003 (fathers). The average salary growth was computed using the following formula: Average monthly growth from period t to period s = $\left(\frac{wage_t}{wage_s}\right)^{\frac{1}{t-s}}$
11/12 Uninterrupted employment months	
• Yes (11 or 12 months of uninterrupted employment in the pre-birth trajectory) • No (Less than 11 uninterrupted months in the pre-birth trajectory)	This variable counts the months in which the parent had a status of "employed" without any interruptions, such as sick leave, family leave, unemployment, etc. The variable counts the months with uninterrupted employment for the period of 12 months prior to the maternity leave (mothers) or the birth in 2003 (fathers). The majority of parents had at least 11 months of uninterrupted employment, therefore the variable was entered in the regression analysis as a categorical covariate with two levels: less than 11 months of uninterrupted employment and 11 or 12 months of uninterrupted employment.
Complexity of the pre-birth career trajectory	

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[5]http://epp.eurostat.ec.europa.eu/

Variable	Notes

• Continuous variable ranging from 0 to 1
• For the analysis categorized in the following way:
    – Below median
    – Above median
	The complexity index is a longitudinal measure of sequence diversity in (Gabadinho et al., 2011a) and available in the TraMineR package. It uses both the number of transitions and the longitudinal entropy of a sequence in the computation. The formula for the complexity is: $C(x) = \sqrt{\frac{l_d(x)}{l(x)} \frac{h(x)}{h_{max}}}$. In this formula $h(x)$ is the entropy of the sequence and h_{max} is the theoretical maximum value of the entropy if all states *in the alphabet* are visited. The term $\frac{l_d(x)}{l(x)}$ stands for the number of transitions in the sequence($l_d(x)$), divided by the maximum possible number of transitions ($length\,of\,the\,sequence - 1$). By incorporating the maximum possible entropy therefore the complexity index takes into account also if some states are not visited (see Gabadinho et al., 2011a, p.23). Therefore the complexity index carries valuable information for this analysis, as trajectories that incorporate only transitions from Employment to Employment with longer hours or to only one kind of a short-term job-protected break (such as Family or Sick Leave) will be ranked as less complex than trajectories with the same number of transitions, however, involving more states. The complexity index is defined in a way, which makes it easy to interpret, with a clearly defined minimum of 0 (which can be reached if a sequence remains the whole time in the same state, meaning that the number of transitions is equal to 0), and a maximum of 1, which can be reached when a sequence incorporates all possible states and spends an equal number of time in them and makes the maximum number of transitions($l(x) - 1$) (Gabadinho et al., 2011a)

Years since entry in Luxembourg labour force

• Recorded in years	This variable was constructed as a proxy for working experience. The variable was constructed by subtracting the year when the parent had an administrative record in Luxembourg for the first time from 2003. The variable is only a partial indicator of working experience, because it does not account for working interruptions since the first point of entry into the Luxembourgish labour force or for experience acquired in other countries.

Workplace

Type of employment

Variable	Notes
• White collar (including civil servants) • Blue collar	Variable constructed based on the 12 months prior to the start of the maternity leave for women and 12 months prior to the birth in the household for men. In cases of multiple employers with different categories, the category reflecting longest hours worked was chosen.

Family related characteristics

Married

• Yes (Married) • No (Single)	Luxembourg provides a legal alternative to marriage, known as a *Partenariat (PACS)*, which provides the same tax, civil and social security rights as marriage. However, in the administrative data co-habiting couples are coded as "not married" and it is not possible to find the difference between single and cohabiting parents. In addition, Luxembourg does not recognise registered partnerships in other countries. Therefore co-habiting couples from other countries are also considered as single persons.

Other children in the household as of 2003

• No • Yes	This variable describes whether in 2003 there were already any other children below 18 years of age living in the same household as the parent. The count excludes the baby born in 2003. The records do not distinguish between biological children or other children (e.g. step-children, siblings, etc.) living in the household.

Child sex

• Female • Male	For this variable, information from the annualised IGSS records was used. In the case of twins or triplets the sex of the child was chosen randomly.

Multiple births

• No (single birth) • Yes (twins or triplets)	For this variable, information from the annualised IGSS records was used. The majority of births were single births. twins and triplets were grouped in the multiple births category.

Use of parental leave

Parental leave

Variable	Notes
• No parental leave used • Full-time parental leave • Part-time parental leave	This variable was constructed differently for women and men. For women, the variable described whether they took parental leave immediately following maternity leave for the birth in 2003. Therefore the leave can be assumed to be for the new-born baby, although there is no information in the records for which child the leave is taken. Only 6 per cent of the women who did not use leave in the first month after maternity leave used leave later on, however, then it could be following the birth of other children. For men, a different approach was taken as only 2 per cent of the fathers used parental leave within three months of the birth of the baby in 2003. Therefore, their leave-taking behaviour was traced over the entire five-year period, disregarding the possibility that the leave is taken up for other children.

Socio-demographic controls

Nationality

• Luxembourg • France • Portugal • Belgium • Germany • Other	This variable was constructed based on the annualised IGSS files. There were no instances of changes in nationality during the observation period. Values of 2003 were used.

Age

• Recorded in years	Age was measured in 2003. This variable was constructed using the information on year of birth for each parent.

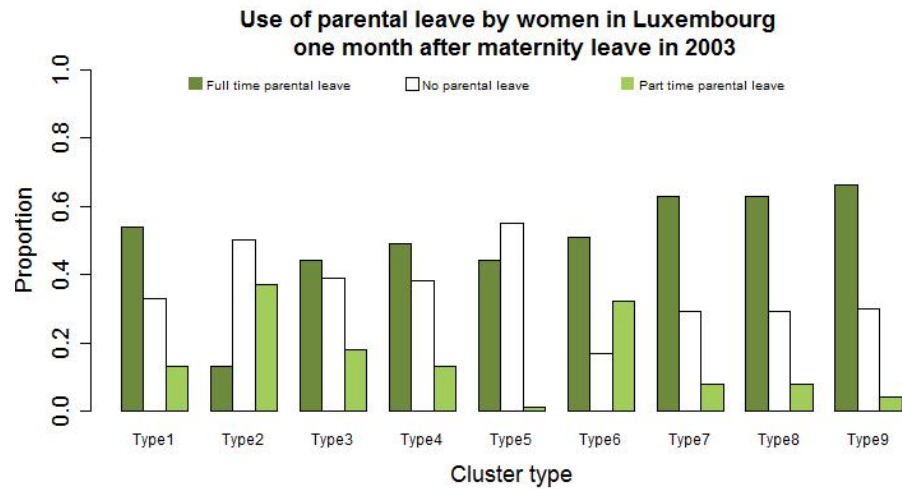# G   Use of parental leave across clusters

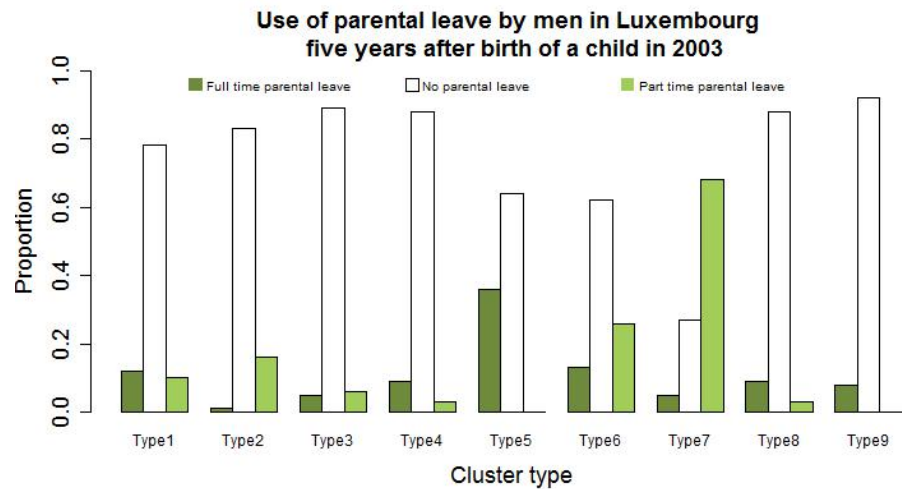**Figure 7:** Use of parental leave by cluster type within the female trajectories

Figure 8: Use of parental leave by cluster type within the male trajectories

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