Job Security and Fertility Decision

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Abstract: This paper analyses the choices of fertility and labour supply of women along the life-cycle in a dual labour market. To study the interplay between job security and desired fertility, we build and estimate a dynamic life-cycle structural model which allows the hiring, promotion, and firing probabilities to differ conditionally on the type of job contract. Fixed-term contracts may exist for three years with a maximum of two renewals while permanent contracts have no expiring date but higher firing costs associated. This set-up allows us to study whether women delay the decision on fertility until they find a permanent job. We use the estimated model to simulate four different scenarios of job security and evaluate its impact on both labour supply and fertility decisions. Among the different alternatives, a single contract with a three-year probation period is able to provide a positive effect over fertility choices without decreasing the level of female labour force participation.

JEL classification: J13,J22,J28,J41,J63

Keywords: fertility, labour supply, temporary contracts, structural estimation

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1 Introduction

The decrease in fertility rates among developed countries has been a major concern during the last decades. As this indicator falls below the replacement fertility rate (2.1 kids per woman) for most of these countries, extensive research has been done to understand this phenomenon. Several structural models of discrete choice have been developed to understand what drives fertility decisions of women along the life-cycle.[1] Many of them include labour supply in the choice menu in order to account for the trade-off between additional household income and time allocated to child bearing (Becker, 1965).[2] However, none of them has yet played with different dual labour market set-up. This is a relevant gap, especially in countries like Portugal where more than 60% of working women with age between 15 and 24 years old have fixed-term contracts.

To promote flexibility in the labour market, many European countries have increased the use of fixed-term contracts over the past decades. These type of contracts are very attractive to firms since they work as screening devices with low firing costs.[3] However, as noted by Boeri et al. (2011), the conversion of temporary into permanent contracts never exceeds 50% in European countries and is particularly low in Portugal and France (12% and 13%, respectively). On top of this, there is evidence that women have a lower probability of being promoted into permanent contracts (Lazear and Rosen (1990) and Booth et al. (2002)). Therefore, while deciding upon fertility, women should have into consideration that under fixed-term contracts, the probability of being fired during child bearing is higher than when holding permanent contracts.

Several papers have looked to the interplay between job characteristics and fertility behaviour. Moffitt (1984) was the first to estimate a dynamic model of discrete choice where both fertility and wage profiles are endogenous over the life-cycle. Results revealed that shifts in the level of the lifetime wage profile are associated with both lifetime profiles of

[1] See Hotz et al. (1997)
[2] See Francesconi (2002) and Van der Klaauw (1996)
[3] See Portugal and Varejão (2009) and Portugal et al. (2010)

fertility rates and female employment rates. Building up on this outcome, Blackburn et al. (1993) introduces the investment in human capital to show that this is proportionally related with the age of first birth. Francesconi (2002) contributed to the literature by distinguishing between part-time and full-time employment. When comparing lifetime utilities between recent mothers in part-time jobs with those that interrupted their career, the author finds no substantial increase. Edwards (2014) explores the impact of flextime in the reduction of career interruptions related to fertility. Estimating the model with USA data, the author finds that flextime is more valuable to women with children and even more so to women with infant children. Adda et al. (2016) extend this work by incorporating occupation choices in the model and also by allowing skill atrophy to be occupation specific. Using German data, the authors conclude that women in abstract occupations deal with higher atrophy rates, thus higher opportunity costs of not working. Therefore women in these occupations tend to have children at a later stage than women with routine occupations.

Despite the increasing work in this literature, little is known about the impact of fixed-term contracts (FTC) on women's decisions on labour force participation and fertility. De la Rica and Iza (2005) and Auer and Danzer (2014) were the first, to our knowledge, to study this relationship but both agree there is potential presence of endogeneity in their analyses. More recently, Guner et al. (2017) have included different types of job contract in a structural model as well but most of the simulated counterfactuals are dedicated to child-care policies. We tackle this research question by estimating a dynamic discrete choice model in which women decide both on the participation in the labour market and on fertility, i.e., both decisions are endogenous in the model. In the theoretical model, women derive utility from consumption and children, and disutility from working. We then use this model as the basis of a structural estimation, which only considers women between 23 and 50 years old. This allows us to take schooling and retirement decisions as exogenous to the model in consideration.

To estimate this model we use the data from the Portuguese sample of the European Community Household Panel (ECHP) – a longitudinal harmonized survey coordinated by the

Eurostat. It provides information on a broad dimension of questions related to demographics, income, social life, housing condition, health, education, and employment. Even though this is the only dataset which simultaneously contains information on the type of job contract and family structure, we complement it with the Employment Survey (ES) of Portugal in order to improve the fit on the dynamics of the labour market. To incorporate both datasets we will estimate the model by the Method of Simulated Moments (MSM) in which the probabilities of firing, hiring and promotion will be estimated from the second dataset.

The estimates of the utility function presented in this version of the paper reflect the preferences of Portuguese women over kids and labour supply. In order to incorporate the degree of job security in the model we allow for different flow utilities according to the type of contract held by the mother. Using these preliminary estimates, four counterfactual experiments are conducted: 1. To extend the maximum duration of a fixed-term contract in a given firm for 6 years; 2. To eliminate the permanent contracts 3. To eliminate the fixed-term contracts 4. To create a single contract with a 3-year probation period. By analysing different scenarios of job security we conclude that a single contract with three-years of probation period is successful at decreasing the number of childless women without decreasing the high levels of female labour force participation in Portugal.

The remainder of the paper is organized as follows. Section 2 reviews the institutional background by providing an overview on the legislation and preeminence of fixed-term contracts in Portugal. Section 3 presents the data of both ECHP and ES. Section 4 provides some preliminary evidence on the relationship between fixed-term contracts and fertility with a survival analysis and a difference-in-differences approach using one policy change that affected the rules of fixed-term contracts. Section 5 describes the life-cycle dynamic discrete choice structural model. Section 6 is devoted to the estimation and identification issues. Section 7 presents the results which include both the fit of the model and the parameters estimates. In section 8 we conduct the different policy experiments. Finally, section 9 concludes.

2 Institutional Background

2.1 Fixed-term Contracts in Portugal - Evolution of Legislation

Even though the regulation of employment contracts in Portugal dates back to 1937, it was only in 1975 that fixed-term contracts (FTCs) became relevant in the Portuguese labour market. As explicit regulation on dismissals was implemented, this type of contract, with low firing costs, became an attractive screening device to the firms. Below we describe the major changes that affected FTC over the last decades, which are summarized in figure 1.

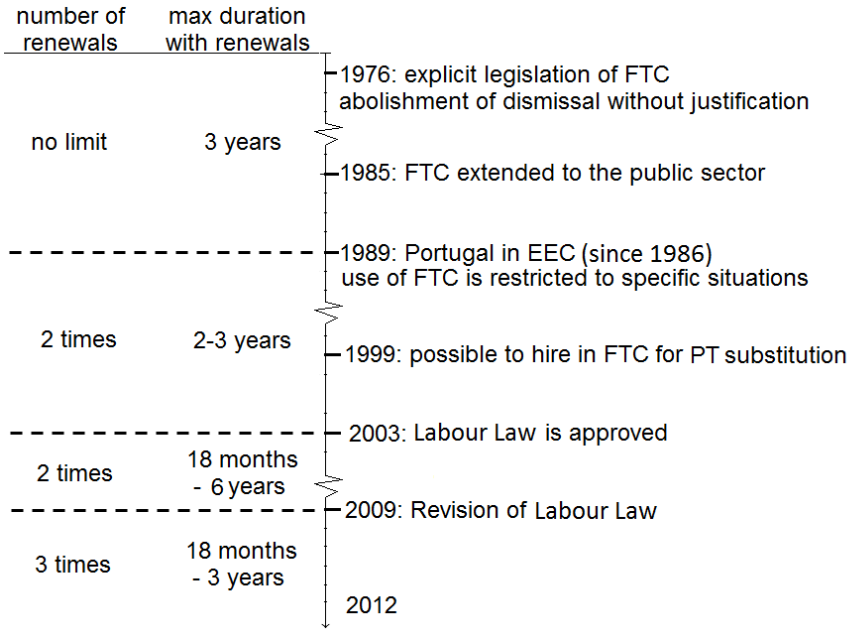
Back then, there was no minimum duration for the FTC. However, the period for which the worker could be employed for the same firm was limited to three years. As the number of renewals was unlimited, this probation period could either be a succession of short-term contracts or one single contract with three years of duration. Once the probation period was exhausted, the employer was obliged to convert the contract into a permanent contract (PC) in order to keep the worker in the same firm. Both renewals of FTC and conversions of FTC onto PC were automatic unless the employer explicitly communicated otherwise within a minimum of eight days before the end of the contract. In 1985, the Portuguese government has extended this type of contract to the Public Administration working force, as long as the contract was associated to casual or seasonal jobs.

In 1989, after the integration of Portugal in the Economic European Commission, the number of renewals of FTC was capped at two, without changing the maximum duration of three years in the same firm. However, in case of a new business, this duration was capped at two years. On the other hand a minimum duration was fixed at six months with the exception of short-term tasks defined by the firm when hiring experienced workers that were not classified as long-term unemployed. In the same year, the government introduced indemnities at termination, namely, two days for each month of FTC. The number of days for the communication of non-renewal was extended to 15 in cases of contracts with less than six months of duration, and to 30 in case of longer contracts.

Before 2001, the replacement of a worker in a FTC job position required three months of interval between the firing date of the former worker and the hiring date of the new one. After 2001 the waiting period increased to six months. Two other changes were applied to the FTC. The indemnities at termination have increased to three days for each month of the contract. The minimum number of days for the communication of non-renewal were decreased to five days only.

In 2003 the number of renewals was kept the same but the maximum duration of a FTC within the same firm was extended for up to six years, with the remark that the last renewal should be from one to three years. Long-term unemployed were restricted to a maximum of two years fixed-term contract, together with the workers in new businesses, as before. Workers looking for a first job could only get 18 months of duration. More recently in 2009 the number of renewals was increased to three times while the maximum duration with renewals has reversed to three years, like in pre-2003. The timeline of this subsection ends in 2012, when under the Memorandum of Understanding, numerous labour policy changes were approved.

Figure 1: Summary of changes in fixed-term contracts legislation in Portugal

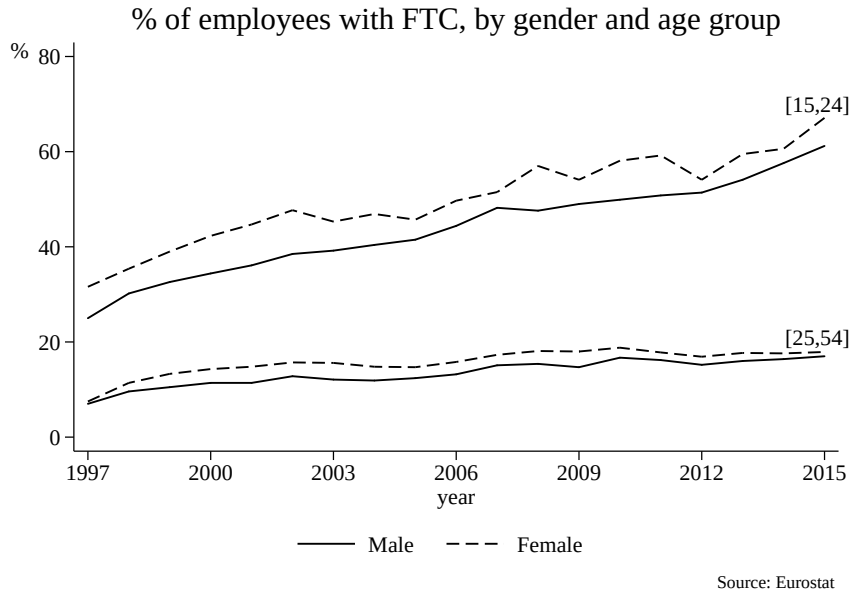


2.2 Persistence of fixed-term contracts over time, gender, and age

In the context of the Portuguese dual labour market, firms look at the fixed-term contracts as an attractive device to screen workers with low firing costs. For that reason, the share of employees with FTC has always been relatively large (18,7% in 2015), especially when compared to other European countries for which the average is 12% (in 2015). This disparity becomes even larger when we look at younger workers in the start of their careers. In 2015, two thirds of the young employees in Portugal had a fixed-term contract whereas the European average was only 40%.

Although the share of employees with FTC decreases sharply along age, the difference between males and females seems to be persistent throughout the life-cycle. Figure 2 illustrates these trends by gender and age group during the last two decades.

Figure 2: Percentage of employees with fixed-term contracts, by year, gender and age group



According to Weiss and Gronau (1981), during the early stage of their careers, women are still deciding between market and home production. Therefore, women are more likely to differ the investment in specific human capital. Under these conditions firms are "gender

blind" at the hiring stage but men are more likely to receive a promotion offer as their specific human capital grows faster (Lazear and Rosen, 1990). In other words, men with longer duration of temporary jobs are perceived to have lower ability than women in the same position (Booth et al., 2002).

3 Data

3.1 European Community Household Panel

The European Community Household Panel (ECHP) is a longitudinal harmonized survey, coordinated by the Eurostat. The panel includes 15 countries of the European Union during 8 waves, for most of the countries.[4] For the purpose of our research question, we will only use the panel for Portugal between 1994 and 1999.[5]

The choice of this database is related to the reasonable amount of information both at the individual and household level for such a long period. ECHP provides information on a broad dimension of questions related to demographics, income, social life, housing conditions, health, education, and employment. The Portuguese Employment Survey also includes both information on fixed-term contracts and fertility but only follows each household for a period of six quarters. The continuation of the ECHP, i.e., the European Union Survey on Income and Living Conditions (EU-SILC) has no explicit information on the duration of the fixed-term contracts. Therefore we have excluded it from our analysis for the moment.

Even though the information contained in ECHP is relatively broad to answer the question of this paper, we complement it with the data from the Employment Survey conducted in Portugal during the same period. This survey provides clearer information on the duration and renewals of fixed-term contracts and includes a larger sample of the individuals of interest. With this additional information, we expect to improve the modelling of labour market

[4]The 15 countries are: Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Spain, Sweden, Portugal, and the United Kingdom

[5]We have excluded the years of 2000 and 2001 as there was a change in definition on fixed-term contracts.

transitions of women along the life-cycle.

3.2 Employment Survey

The Employment Survey (ES) in Portugal (*"Inquérito ao Emprego"*) is a CPS-type household survey conducted by *Instituto Nacional de Estatística*. The survey is conducted on a quarterly basis and enquires around 40,000 individuals. Even though the survey includes all individuals in the household, only individuals aged 10 or above have to answer around 150 questions about their participation in the labour market. The survey is divided in six broad topics including main activity, secondary activity, training, past professional experience, job search and labour market status in the previous year. In all sections, the survey follows the definitions of *Eurostat* making the labour market indicators comparable among other European countries.

In each quarter, $\frac{1}{6}$ of the sample is rotated out. Therefore, we can only compute transitions between labour market states for $\frac{5}{6}$ of the workers in the sample. However, as mentioned in Blanchard and Portugal (2001) the measurement error is not a serious issue in this survey. The evidence for inconsistencies in the observed labour-market transitions is negligible due to the high reinterview rate and also to relatively low frequency of movements across labour market status.

To be consistent with the years selected in the ECHP data we have restricted the data in ES to the same period. However, due to changes in the survey we cannot follow transitions that occurred between the last quarter of 1997 and the first quarter of 1998.

3.3 Construction of Samples and Descriptive Statistics

In both datasets we focus our analysis on women between 23 and 50 years old. As both of them are constructed on a rotation basis, we have two unbalanced panels. In ECHP we have 2,283 individuals and in ES we have 34,998 individuals. Due to the restrictions we impose relative to the period and age, in both samples we have roughly above 50% of the

individuals being observed in all periods. For all individuals we collect information on age, marital status, household composition, education, employment status, employment history, type of contract, income.

Some definitions should be mentioned for clarity. For the purpose of this study, an individual is employed if she holds a job contract (either fixed or permanent) with a certain firm that pays a given wage. Hence, we exclude self-employment, family business and contracts with undetermined ending date. Education is classified into two categories only: non-university and university.

Table 1, in appendix A, presents the main variables from ECHP. This sample presents a relatively low percentage of women with university degree due to the period of time we are looking for. Slightly above 30% of the observations refer to non-workers and most of the employees hold a permanent contract. In terms of fixed-term contracts, most of them have one year of duration and zero renewals. This combination is reflected on the tenure for all types of contracts – 20% of the workers have one year (or less) of tenure. We do not have hourly wage in the data but we only use wages referred to full-time work. In 2000's euros the average wage is about 477, the minimum is 218.39 (minimum wage in 1994), and the maximum wage observed is about five times above the mean wage. More than 70% of the observations refer to women with a partner and 34% refer to non-mothers. Regarding the number of children, about half of the observations indicate the woman has two children.

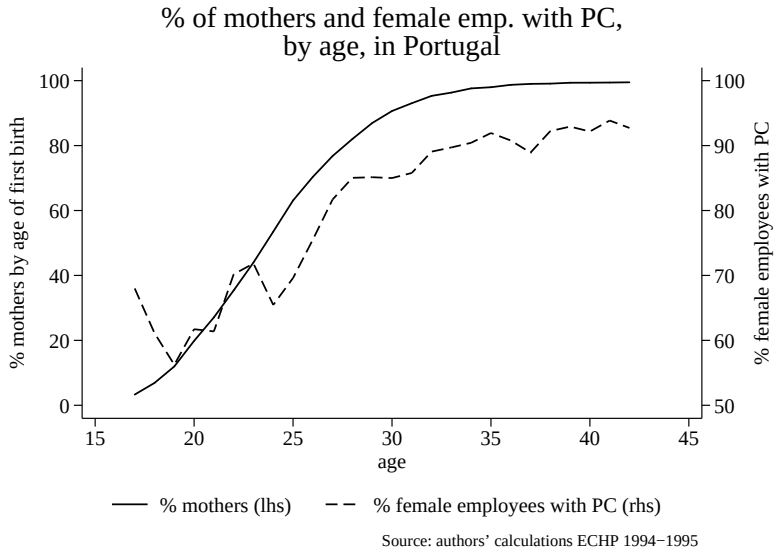
Table 2, in appendix A, presents the main indicators that describe the female labour market in both samples. The two samples are fairly similar when it comes to the percentage of women holding a university degree, the percentage of non-workers, the average unemployment duration, the percentage of fixed term contracts and average tenure. Larger differences are found in the classification of fixed-term contracts.Whereas the duration of the contract in ECHP is split into 4 classes: "less than 6 months", "6 months to 1 year", "1 year to under 2 years" and "2 years or more", that is defined in number of months in the ES database. Given this difference between the two datasets, we should also expect some differences in

the labour market flows, presented in table 3. Transitions to non-employment and short fixed-term contracts are fairly similar but major differences occur in transitions to longer fixed-term contracts and to permanent contracts. However, if we sum up these two categories the numbers in the two samples become much closer.

4 Preliminary Evidence

In this section we shed some light on the relationship between the job security (fixed-term vs permanent contracts) and fertility in Portugal, during the period in analysis. Looking at crude statistics along the life-cycle we observe a large correlation (95%) between the percentage of female employees with permanent contract and percentage of mothers giving birth at each age. That is, by looking at figure 3 we observe that more women give the first birth as the probability of being in a permanent contract goes up. In fact the only moment the two series do not walk together is before the age of 20 years old when some women are still investing in their education.

Figure 3: Relationship between age at first birth and percentage of permanent contracts



Using the same sample, we run a survival analysis, following the methodology of De la

Rica and Iza (2005) and Auer and Danzer (2014). In this analysis we start the fertile period at the age of 23 years old when most of the women already finished schooling. Figure 4 plots the survival function of giving first birth between the age of 23 and 45 years old, for fixed-term workers, permanent workers and non-workers. Survival curves were produced conditional on observable characteristics such as education, marital status, tenure, time dummies, cohort dummies and regional dummies. Two results stand out the most. The amount of women that decide not to give first birth until the end of the fertile period is substantially larger for women with fixed-term contracts when compared to their counterparts. According to our estimates, at age 40 around 75% of women with fixed-term contracts have not had their first child yet while that percentage is much smaller for permanent workers (53%) and for non-workers (49%).

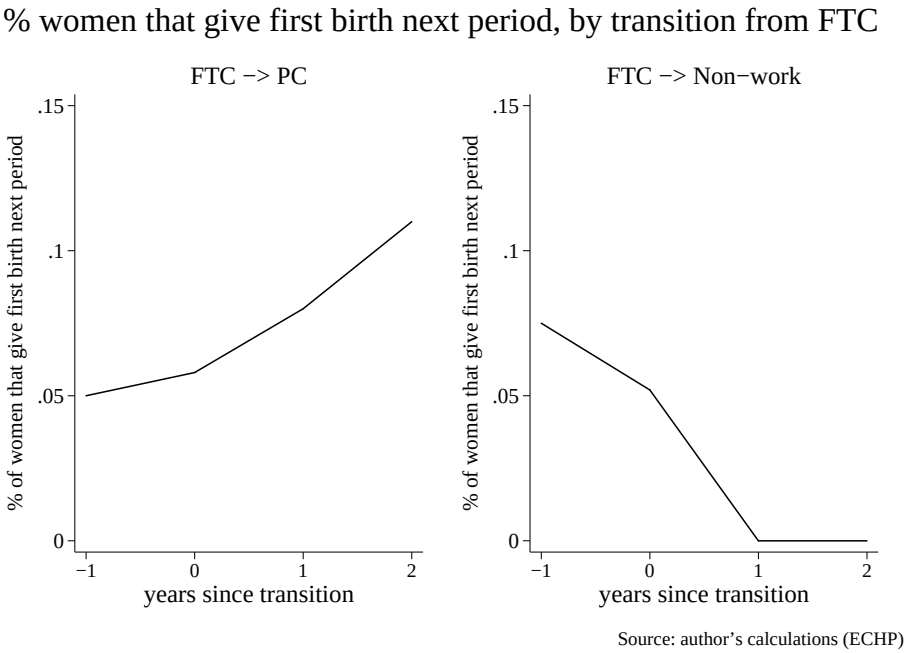
Figure 4: Survival function to **first** birth by labour market status and age

Source: author's estimates from loglogistic regression with ECHP data

According to the previous graph it seems that fixed-term contracts dissuade women from giving the first birth but it is not clear whether they are waiting for a permanent contract when they have a more stable career or for a period of non-work when they have more

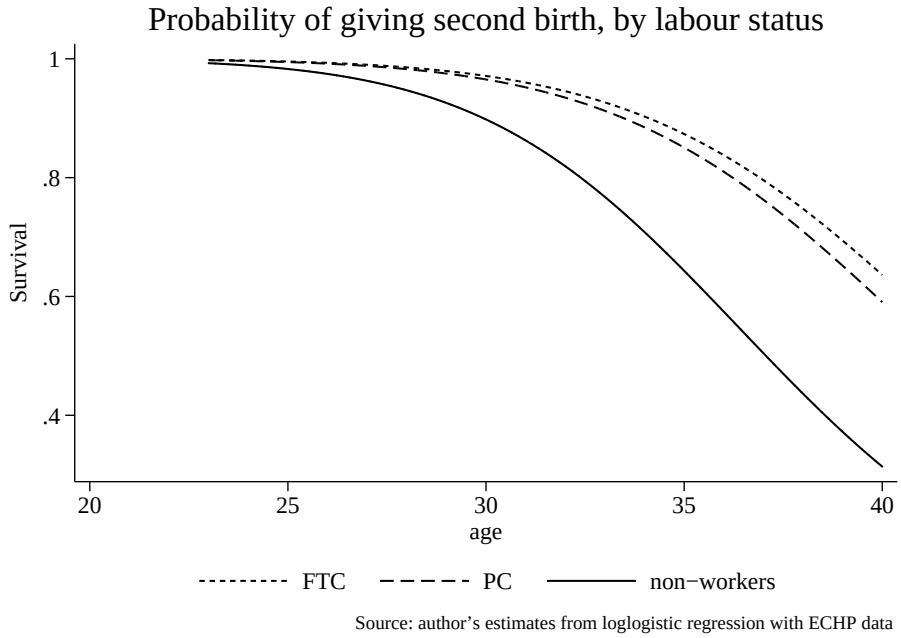
time to devote to child bearing. In order to understand which direction women want to go we plot the percentage of women that choose to give their first birth according to whether they have moved from a fixed-term contract to a permanent contract or from a fixed-term contract to non-work. Looking at the plots in figure 5 we can infer that the transition to a permanent contract seems to boost the fertility decision whether the loss of income in the second transition seems to overcome the increase in time for child-bearing.

Figure 5: % of Women who give **first** birth next period, by transition from FTC



Considering the evidence above one should expect that the percentage of women with fixed-term contracts and no children is substantially larger than that of their counterparts. However, in order to explain what drives low fertility rates, one should also look at women with more than one child. In figure 6 we plot the same survival function as before but regarding the second birth. Looking at the second birth survival probability it seems that job security is no longer important as the curve associated to permanent contracts is now much closer to fixed-term contracts.

Figure 6: Survival function to **second** birth by labour market status and age



Source: author's estimates from loglogistic regression with ECHP data

4.1 Do changes in FTC rules change fertility choices?

In order to motivate the construction of a structural model with labour supply and fertility choices conditioned on the rules of fixed-term contracts we study, in this subsection, how the policy reform, implemented in January 2004, affected the fertility choices of women in Portugal. As explained in section 2, in 2003, the Portuguese government approved a law which changed the maximum duration rule of fixed-term contracts.

Under the new scenario, a firm could keep an employee under a FTC for up to six years, while the rule of maximum of two renewals remained the same. Even though the enforcement of the new rule was up to the decision of each firm, the possibility of having a longer period of successive FTCs created has increased the job uncertainty (or insecurity) for the employees in Portugal. Therefore, keeping everything else constant, we should expect women to delay even more their decision of having kids, as their career takes longer to become stable, under the post-reform rules.

To study, what is considered to be an intention to treatment (ITT) effect, we resort to the ES database. As explained in section 3, this dataset is more accurate in terms of the job contracts' characteristics. Moreover, this dataset provides consistent definition of fixed-term contracts during the pre- (2000-2003) and post-reform (2004-2007) periods. Before any further regression we have compared descriptive statistics of mothers' characteristics before and after the reform.[6] In this comparison we have only considered married women employed with a FTC in their first year of the contract.

Table 1: Descriptive statistics of mother's characteristics before and after the reform

Variable	Pre	Post	Raw difference	Controlled DiD
	(1)	(2)	(3)	(4)
Age	31.063	32.15	1.087	-.326
			(1.283)	(1.33)
𝟙 University degree	.188	.15	-.038	-.065
			(.128)	(.128)
Years since 1st job	13.176	13.956	.779	-1.903
			(2.131)	(2.212)
Number of previous jobs	3.125	8.800	5.675	4.423
			(5.388)	(4.719)
Contract duration (months)	7.533	9.529	1.996 **	2.591
			(1.293)	(1.314)
𝟙 White collar	.5	.6	.1	.086
			(.171)	(.17)
Log(wage)	5.977	6.116	.139	-.022
			(.113)	(.114)
Log(husband wage)	6.518	6.403	-.115	-.223
			(.18)	(.18)

Notes: The table reports descriptive statistics of married women employed with a FTC in their first year of the contract. *Pre* includes women for which the contract started before the reform and *Post* includes women for which the contract started after the reform was implemented. Column (3) reports differences in means between both groups, and column (4) reports DiD estimates that control also for age of the woman. Robust standard errors are reported in parentheses. * Significant at 10%, ** Significant at 5%, *** Significant at 1%

In table 1 we observe that the only statistically significant difference between the two periods is the contract duration. Considering that FTC is a type of job contract with low firing cost, it was expected that firms would extend its duration once they were allowed

[6]For a similar analysis see Lalive et al. (2013)

to do it. However, as we can see in column (4), the longer average duration in the post-reform period did was not different between mothers and non-mothers. Now that we have guaranteed the conditions for a difference-in-difference approach, in the next table we present the results of the (ITT) effect of the reform on the probability that the woman gives birth in the following year.

Table 2: DiD regressions for the effect of the reform on birth likelihood

Dep Variable: Child born next year	(1)	(2)	(3)	(4)
𝟙 Contract after reform	-.462 *	-.681 *	-.648 *	-1.125 *
	(.251)	(.356)	(.367)	(.578)
Contract duration (months)				-.017
				(.036)
𝟙 Contract after reform × Contract duration (months)				.079 *
				(.045)
Age	.036	.058 **	.078 ***	.062 *
	(.022)	(.029)	(.03)	(.032)
𝟙 One child	-.165	-.073	-.136	-.172
	(.176)	(.224)	(.237)	(.269)
𝟙 University degree	.092	-.071	.102	.257
	(.235)	(.291)	(.274)	(.341)
Years since 1st job	-.005	-.016	-.03	-.036
	(.016)	(.022)	(.021)	(.026)
Number of previous jobs	.015 **	.015 **	.027 ***	.136 ***
	(.007)	(.007)	(.009)	(.04)
Log(husband wage)		.001	-.028	-.045
		(.207)	(.25)	(.271)
𝟙 White collar			-.178	-.339
			(.18)	(.22)
Log(wage)			-.09	-.356
			(.167)	(.234)
Year FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes
Log-likelihood	-142.031	-97.654	-93.027	-71.986
Observations	948	630	579	473

Notes: The table reports DiD estimates for the impact of a FTC that begun after the reform of 2004 on the likelihood of giving birth in the next period. The samples include all married women in the first year of a FTC between 2001 and 2007. Robust standard errors are reported in parentheses. * Significant at 10%, ** Significant at 5%, *** Significant at 1%

Summing up the results in table 2 we conclude that the fact that the job contract begun after the reform and could potentially lead to longer period of job insecurity has negatively

affected the probability of giving birth in the following year. This effect is counterbalanced when the women is older or when she has more experience. In the last column we have interacted the dummy of the new contract with the duration of the current contract. As the interaction yielded a positive statistically significant coefficient we conclude that a longer FTC in the post-reform actually attenuates the decrease in birth probability. That result might be explained by the fact that we have only included women in their first year of contract in the sample as these might then give birth and still be on time to come back to work and recover any career cost they might have had.

5 Model

We develop a structural model to describe the dynamic decisions of women on fertility and labour force participation over the life-cycle. Fertility choices are conditional on the existence of a partner (which includes both formal marriage and consensual union) which may change over the life-cycle. Labour supply decisions are conditional on job offers which arrive with a certain probability and depend on wages and contract duration (one year fixed-term, two year fixed-term, or permanent). Following Van der Klaauw (1996), Eckstein and Wolpin (1989), and Hotz and Miller (1988) we assume that women can only work full-time. The percentage of part-time workers is particularly small in comparison to other countries. According to André (1991) this phenomenon is due to the residential proximity of relatives which are essential to support employed women and to the sizeable contribution of women's labour income to household income in Portugal. Below, we describe the main components of our model.

5.1 Timing and Participation-fertility decision

Time is discrete, and a period lasts for a year in order to match the data frequency. The decision horizon for each woman starts at age 23, after school, and terminates at age 50,

when the number of old-age pensioners increases substantially in the data. Note however that fertility decisions can only be taken until the age of 40, the age at which, we assume ,a woman is no longer fecund.[7]

In every period, a woman has to decide both on fertility (n_{it}) and work (p_{it}). Fertility choices are only conditioned on the existence of a partner (h_{it}). That is, we assume complete and costless control over the ability to give birth at each age, like Wolpin (1984), Moffitt (1984), Happel et al. (1984), and Cigno and Ermisch (1989). However, we impose a restriction to a maximum of two children (k_{it}) who must be born in separate years as we exclude the possibility of twins in our model.[8] Working choices are conditional on having an offer or not being fired in case the woman is already working.

5.2 Job contracts and Wages

Jobs are characterized by monthly net wages and contract duration, which can be fixed or permanent. Fixed-term contracts can have one or two years of duration.[9] In Portugal, between 1989 and 2003, fixed-term contracts could be renewed twice as long as the maximum duration, with renewals, did not surpass that of three consecutive years. Thus, in our model, in case the firm wants to keep a worker after this period it has to convert the fixed-term contract into a permanent one, which has a higher firing cost associated.

In order to match these labour market dynamics we allow the following combination of contracts: one-year contracts can be renewed twice if replaced with similar contracts, or once if replaced with a two-year contract; two-year contracts can be renewed once if replaced with

[7]The starting age follows the same reasoning as Eckstein and Lifshitz (2011). Alternatively one could follow Van der Klaauw (1996) which starts the model in the first year of school leaving. We chose 23 as starting age because according to Portuguese data there is a big drop in school attendance after 22. Moreover, according to *Inquérito ao Emprego* only 5% of women in Portugal gave birth to the first child before 23 years old. Regarding the age which terminates the fertile period we follow Francesconi (2002). Also, according to *Inquérito ao Emprego* only 5% of the women in Portugal had the first child after 40 years old.

[8]According to *Instituto Nacional de Estatística* the number of households with more than two children was 6.5% and the less than 2% of births were twins.

[9]Legally, the fixed-term contracts are even allowed to have three years of duration but we have excluded them from the model as their existence is rather low in the market.

a one-year contract; in case the worker achieves the maximum number of renewals and keeps working in the following year, the fixed-term contract is replaced with a permanent one. Note however that a worker is always at risk of receiving a permanent job offer, thus it does not necessarily have to wait for the end of the maximum fixed-term duration.[10] We also allow for hirings with permanent contract.

As this is a partial-equilibrium model, we do not observe the wage rate associated to job offers for non-workers. Hence, we assume a specific expression for women's wages which is contract-specific (FTC, fixed-term contract, or PC, permanent contract):[11]

$$\ln(w_{it}^z) = \alpha_1^z + \alpha_2^z S_{i23} + \alpha_3^z t_i + \alpha_4^z D_{it} + \alpha_5^z X_{it} + \alpha_6^z R_{it} + \eta_{it}^z \quad z = FTC, PC \tag{1}$$

where S_{i23} is equal to 1 in case the woman had a university degree at 23 years old, zero otherwise; t_i stands for the period in the model which goes from 1 to 18; D_{it} is equal to 1, 2, or 3 in case the woman has a one-year fixed-term contract, two-year fixed-term contract, or permanent contract, respectively; X_{it} accounts for the number of years the individual holds the job contract, which can be equal to 1, 2 or 3, where 3 actually means 3 or more years of tenure; R_{it} is the number of renewals which can be 0, 1 or 2 in case of fixed-term contracts and is always set to zero in case of permanent contracts; finally, η_{it} is an i.i.d technology shock with zero mean and finite variance. Exponentiation of the r.h.s. or log of the l.h.s. ensures non-negative wages.

In the wage equation we set α_3^{FTC} to zero because the lack of variation in wages along age is not enough to pin down this parameter. Moreover note that, by definition, α_6^{PC} will also be zero as there is no renewals for permanent contracts. As for the other parameters we expect the average wage for temporary contracts to be higher to compensate for the absence of employment protection; schooling returns to be larger for permanent contracts as these in principle represent a better match between the worker skills and the firm needs; tenure

[10] According to Portugal et al. (2010), promotions to permanent positions are more likely to occur in the first two years of the fixed/term contract.

[11] See Francesconi (2002) for a similar approach.

returns to be negative for fixed term contracts in order to capture the lack of bargaining that these workers have within the same company; and positive for permanent contracts as a proxy for returns on experience; and renewals returns to be positive for fixed-term contracts as a sign of the quality of the match between the worker and the firm.[12]

5.3 Job offer and dismissal probabilities

Conditional on being unemployed, at most one job offer arrives each period with a certain probability. Even though we do not allow for search-on-the-job we do allow for job offer arrivals in the same period the woman is dismissed.[13] The job offer can either be a one-year contract, a two-year contract or a permanent contract. This probability not only reflects what is available on the market but also the age of the woman, her unemployment duration, and her previous contract duration in case she was fired in that period.

$$P(\text{offer}^1) = \frac{\exp\left\{\overbrace{\varsigma_0^1 + \varsigma_1^1 \mathbb{1}(D_{i,t-1}=1) + \varsigma_2^1 Ud_{i,t} + \varsigma_3^1 t_i + \varsigma_4^1 t_i^2}^{\text{Offer1}}\right\}}{1 + \exp\{\text{Offer1}\} + \exp\{\text{Offer2}\} + \exp\{\text{Offer3}\}} \tag{2}$$

$$P(\text{offer}^2) = \frac{\exp\left\{\overbrace{\varsigma_0^2 + \varsigma_1^2 \mathbb{1}(D_{i,t-1}=3) + \varsigma_2^2 Ud_{i,t} + \varsigma_3^2 t_i + \varsigma_4^2 t_i^2}^{\text{Offer2}}\right\}}{1 + \exp\{\text{Offer1}\} + \exp\{\text{Offer2}\} + \exp\{\text{Offer3}\}} \tag{3}$$

$$P(\text{offer}^3) = \frac{\exp\left\{\overbrace{\varsigma_0^3 + \varsigma_1^3 \mathbb{1}(D_{i,t-1}=3) + \varsigma_2^3 Ud_{i,t} + \varsigma_3^3 t_i + \varsigma_4^3 t_i^2}^{\text{Offer3}}\right\}}{1 + \exp\{\text{Offer1}\} + \exp\{\text{Offer2}\} + \exp\{\text{Offer3}\}} \tag{4}$$

[12] See Booth et al. (2002).

[13] Contrary to Miller and Llull (2016) and Edwards (2014) we do not allow individuals to receive job offers while employed but we do differentiate between whether they were dismissed in the same year or not.

Conditional on being employed, the worker is dismissed with a probability which depends on the schooling level, the number of renewals in case the elapsed duration of the fixed-term contract is equal to the predetermined one, and also on the type of contract. For simplicity, we assume that this probability is also the probability of non-renewal. Therefore, if at the end of a fixed-term contract the worker was not dismissed, this means that the firm did not offer her a renewal of the fixed-term contract nor a permanent contract.

$$P(\text{dismissal}) = \frac{\exp\left\{\varsigma_0^d + \varsigma_1^d S_{i,23} + \varsigma_2^d x_{i,t}(1+r_{i,t}) + \varsigma_3^d \mathbb{1}(d_{i,t}=2) + \varsigma_4^d \mathbb{1}(d_{i,t}=3)\right\}}{1+\exp\left\{\varsigma_0^d + \varsigma_1^d S_{i,23} + \varsigma_2^d x_{i,t}(1+r_{i,t}) + \varsigma_3^d \mathbb{1}(d_{i,t}=2) + \varsigma_4^d \mathbb{1}(d_{i,t}=3)\right\}} \quad (5)$$

5.4 Partner

In this model we do not differentiate between formal marriage and consensual unions, hence *marriage* in our model means getting a partner with whom the woman will potentially have children. [14] We define the probability of marriage as a function of the age of the woman as well as on the type of job contract she has. **Contrary to other models we find no significance on the schooling level towards marriage but the existence of a permanent contract, on top of women employment status, has revealed to be an important determinant of marriage.** This probability is thus expressed in the following way:

$$P(\text{marriage}) = \frac{\exp\left\{\theta_0^m + \theta_1^m t_i + \theta_2^m t_i^2 + \theta_3^m \mathbb{1}(d_{i,t}\in[1,2]) + \theta_4^m \mathbb{1}(d_{i,t}=3)\right\}}{1+\exp\left\{\theta_0^m + \theta_1^m t_i + \theta_2^m t_i^2 + \theta_3^m \mathbb{1}(d_{i,t}\in[1,2]) + \theta_4^m \mathbb{1}(d_{i,t}=3)\right\}} \quad (6)$$

The probability of *divorce* (losing a partner) is defined as a function of the number of children only and it is assumed to be zero in the year of birth (when the youngest kid reaches one year old). As for the couples without children this probability is constant to reflect the lack of evidence we found for positive correlation between divorce and age of the woman. This

[14] We analyse both married and unmarried women because, according to INE data, half of the births in Portugal are currently conceived out of marriage.

probability is thus expressed in the following way:

$$P(\text{divorce}) = \begin{cases} 0 \quad \text{,if } ak = 1 \\ \dfrac{\exp\left\{\theta_0^d + \theta_1^d k_{i,t}\right\}}{1 + \exp\left\{\theta_0^d + \theta_1^d k_{i,t}\right\}} \quad \text{,if } ak \neq 1 \end{cases}$$

5.4.1 Permanent unobserved heterogeneity

In terms of unobserved permanent heterogeneity we include ζ_i^p and ζ_i^k as taste shifters towards the working and fertility choices. This approach is similar to that of Heckman and Singer (1984), where it is assumed a multinomial distribution with 4 types: The type for

Table 3: Unobserved permanent heterogeneity

	work	non-work
high fertility	HW	HU
low fertility	LW	LU

each individual is drawn at the beginning of the life-cycle, conditioning on the initial values of tenure, presence of a partner and the number of children.

5.5 Utility Function

As the decision to work is conditional on the type of contract duration we simplify notation hereafter by denoting $p_{i,t} \times \mathbb{1}(d_{i,t} = j)$ by $dj_{i,t}$ where j assumes the value 1, 2, or 3 in case the woman is working in a one-year fixed-term, two-year fixed-term or in a permanent contract, respectively. The utility of individual i at period t takes the following form:

$$\begin{aligned} U_{it} = {} & c_{it} + \gamma_1 p_{i,t} \times c_{it} + \gamma_2 k_{i,t} \times c_{it} + (\gamma_3 + \zeta_i^p) p_{i,t} + (\gamma_4 + \zeta_i^n) k_{it} + \gamma_5 k_{it}^2 \\ & + \gamma_6 (d1_{i,t} + d2_{it}) \times k_{it} + \gamma_7 d3_{i,t} \times k_{it} \\ & + \gamma_8 (d1_{i,t} + d2_{it}) \times \mathbb{1}(ak_{i,t} = 1) + \gamma_9 d3_{i,t} \times \mathbb{1}(ak_{i,t} = 1) \\ & + \gamma_{10} \mathbb{1}(k_{i,t} = 2) \times \mathbb{1}(ak_{i,t} = 1) + \sum_{j=1}^{4} q_{it}^j \epsilon_{it}^j \end{aligned} \tag{7}$$

Consumption is denoted by c_{it} which represents the level of a composite good for which the price was normalized to 1. Following Eckstein and Lifshitz (2011), consumption enters linearly in the utility function and there are no assets, thus no borrowing nor saving are allowed in the current version of the model. Following Edwards (2014), we allow for income effects through the interaction of consumption with the choice of labour supply (γ_1) and with the number of children (γ_2). The disutility from work does not depend on the type of contract but differs with taste (ζ_i^p). Note that we do not specify the utility level associated with not working since we assume this as the baseline in our model. We also introduce heterogeneity (ζ_i^n) in the utility derived by the number of children (γ_4). ($\gamma_1 0$) is restricted to be negative in order to capture the fact that women prefer one child instead of two.

In the second row, we allow for utility from children to vary with the type of job contract. In a fixed-term contract, we expect the woman to derive a lower utility from children, as she is unsure about whether she will be working in the near future to bear the costs with children. In the third row we allow interactions between each type of job contract and the fact that the woman has a one-year old child (infant) which may require greater investments both in terms of time and money. We also allow the utility from children to vary with this in order to control for the birth spacing that is observed in the data. Finally, $q_{it}^j \epsilon_{it}^j$ are choice-specific random preference shocks, which follow a type I extreme value distribution: $F(\epsilon_{it}^j) = \exp\left\{-\exp\left\{-\epsilon_{it}^j/\tau\right\}\right\}$ with mean $\tau\gamma$ and variance $\tau^2\pi^2/6$.

5.6 Budget constraint

The household budget constraint takes the following expression:

$$c_{i,t}^H = MGI(hi, t, p_t, ki, t) + y_{it}^h h_{it} + w_{it} p_t + ub_{it}(1-p_t) \times \mathbb{1}(x_{i,t} = 1) - CC(w_{i,t}, h_{i,t}, k_{i,t}, ak_{i,t}) \quad (8)$$

Household consumption is defined as $c_{i,t}^H = c_{i,t} \times (1 + 0.5 \times h_{i,t} + 0.3 \times k_{i,t})$. That is, the woman's consumption ($c_{i,t}$) scaled by the "OECD modified scale", where the "number of

adult equivalent" is equal to 1 plus 0.5 for a second adult and 0.3 for each child (Hagenaars et al., 1994).[15] As we have no assets in the current version of the model the income of the household depends solely on husband's income, woman's wage, unemployment benefits and children care costs. In order to ensure non-negative consumption and to illustrate the large dependence of low income families, we also include the minimum guaranteed income which depends on the presence of a partner, the labour supply choice and on the number of children. Note that instead of considering husband's labour earnings we consider husband's personal income since in our data 99% of married couples reported positive husband personal income even though only 73% of them are working. However, to avoid increasing the state space we also express husband's income in terms of the woman's observables, namely on her schooling level and age.[16]

$$y_{it}^h = \alpha_1^h + \alpha_2^h s_{i,23} + \alpha_3^h t_i \tag{9}$$

Besides husband's income, and women's wage, defined previously, the household income is also composed by the unemployment benefits in case the woman was fired in the previous year. Note that in case the woman decided not to work conditional on having received a job offer she is not entitled to unemployment benefits. In terms of duration of the unemployment benefits we do not allow the woman to receive them for more than a year which is not a strong assumption considering the rules in Portugal during the period in analysis – the maximum potential duration for individuals between 23 and 30 years old was 12 months and for individuals between 30 and 40 years old was 18 months, regardless of previous working experience. For older individuals the potential duration of unemployment benefits could go up to 2 years and a half but because they have to comply with the obligations to find a job, most of the beneficiaries did not take more than one year of unemployment benefits.

Finally we introduce a cost for children care which depends on the wage of the mother, the

[15] Contrary to Adda et al. (2016) we will not estimate the weights of the OECD modified scale. Also, according to Burniaux et al. (1998), sensitivity analyses suggest that while the composition of income poverty is affected by the use of different equivalence scales, trends over time are much less affected.

[16] See Van der Klaauw (1996), Sheran (2007), or Adda et al. (2016) for similar specifications.

presence of the father in the household, the number of children, and the age of the youngest child. In case the mother is not working we assume there are no child care costs as she has time to look after the child. In case the mother is working the costs are a percentage of her wage. This percentage is larger when the youngest child is younger and when the husband is not present in the household.

5.7 Dynamic Decision Problem

Each year the woman makes her decisions conditional on the following state space:

$$\Omega_{i,t} = \left(p_{i,t-1}, n_{i,t-1}, k_{i,t}, h_{i,t}, ak_{i,t}, s_{i,23}, d_{i,t}, x_{i,t}; \epsilon_{i,t}, \eta^z_{i,t}, \zeta^p_i, \zeta^n_i\right) \tag{10}$$

The value function for individual i in period t is given by:

$$V^j_t(\Omega_{it}) = \max_{j \in J} U_i t^j(\Omega_{it}) + \beta E_t(V_{t+1}(\Omega_{t+1})|j \in J, \Omega_t) \tag{11}$$

where β is a discount factor, and E_t is the expectation operator conditional on information in period t.[17] Note that J, the set of possible choices, may not be equal in every period as it depends on the arrival of job offers, on the existence of a partner, on the number of children (as we limit the maximum to 2 children), and on the age of the woman (as she is assumed to be no longer fertile from age 40 onwards). In the next section we present all the possible conditional value functions.

5.8 Conditional Value Functions

According to the model presented above, the number of choice possibilities in each period depends on the existence of a partner and on the arrival of job offers/renewals and not necessarily on the choice that was made in the previous period.[18] Hence, for simplicity in

[17] In the current version of the paper, β is set to 0.98, following Attanasio et al. (2008).

[18] Note that since each period is one year and the maternity leave in Portugal is no more than 4 months then we can allow for the woman to give birth and work in the same period.

this section, the conditional value functions related to fertility choices will not incorporate the labour supply decision and vice-versa.[19]

In what follows $V_{i,t}^{N_k}$ denotes the value function associated to the decision of choosing to giving the k$^{\text{th}}$ birth in the next period. Not choosing to have a new child is denoted by $\bar{N}$. In case the woman gives birth, the state space will be denoted as $\Omega_{i,t}^{k}$.

In case the woman is not married, she will get a partner with probability μ, which depends on the age of the woman and on the duration of the job contract the woman holds in that period. In case she is married she will lose the partner with probability ρ, which solely depends on the number of children.[20]

Value of being single

$$V_{i,t}^{\bar{m}}(\Omega_{it}) = \; U_{it}^{\bar{m}}(\Omega_{it}) + \beta\Big\{\mu\,\mathbb{E}\max\Big[V_{t+1}^{N}(\Omega_{t+1}), V_{t+1}^{\bar{N}}(\Omega_{t+1})\Big] + (1-\mu)\,\mathbb{E}\Big[V_{t+1}^{\bar{N}}(\Omega_{t+1})\Big]\Big\}$$

Value of having a partner

$$V_{i,t}^{m}(\Omega_{it}) = \; U_{it}^{m}(\Omega_{it}) + \beta\Big\{\rho\,\mathbb{E}\max\Big[V_{t+1}^{\bar{N}}(\Omega_{t+1})\Big] + (1-\rho)\,\mathbb{E}\Big[V_{t+1}^{N}(\Omega_{t+1}), V_{t+1}^{\bar{N}}(\Omega_{t+1})\Big]\Big\}$$

Value of choosing to have the first child

$$V_{i,t}^{N_1}(\Omega_{it}) = \; U_{it}(\Omega_{it}) + \beta\Big\{\,\mathbb{E}\max\Big[V_{t+1}^{N_2}(\Omega_{t+1}^{k}), V_{t+1}^{\bar{N}}(\Omega_{t+1}^{k})\Big]\Big\}$$

Value of choosing to have the second child

$$V_{i,t}^{N_2}(\Omega_{it}) = \; U_{it}(\Omega_{it}) + \beta\Big\{\,\mathbb{E}\Big[V_{t+1}^{\bar{N}}(\Omega_{t+1}^{k})\Big]\Big\}$$

In terms of labour supply conditional values functions we denote $V_{i,t}^{P_{d,r}}$ denotes the value function associated to the decision of working with a contract of duration d and renewals r. Not working is denoted by $\bar{P}$. In case the woman is receiving unemployment benefits, the

[19] Note that conditional value functions related with fertility decisions are assumed to be zero once the woman has two children and/or is older than 40 years old.

[20] We have tried different reduced form specifications for the probability of divorce and the years of marriage turned out to be non-significant in all cases.

state space will be denoted as $\Omega_{i,t}^{ub}$.

In case the woman decides to work she is fired with a probability δ, which depends on the duration of the current contract, the tenure of the current contract and the number of renewals. In every period, regardless of her employment status, each woman receives at most one offer with duration D with probability λ^D, which depends on the duration of the last contract in case she was just fired (if not this duration is set to zero), the tenure of the current contract in case she was just fired or the number of years in unemployment in case she was fired in a previous period, and her age.

Value of working with a fixed-term contract with $d = 1, r = 0$

$$V_{i,t}^{P_{1,0}}(\Omega_{it}) = U_{it}^{P_{1,0}}(\Omega_{it}) + \beta \Bigg\{ \left(1 - \sum_{D=1}^{3} \lambda_D\right) \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub})\right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda^D \, \mathbb{E} \max\left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right]\right)$$

$$+(1-\delta) \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max\left[V_{t+1}^{P_{D,1^*}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right]\right) \Bigg\}$$

* Note that when the renewal is to two-years the firm cannot renew more at the end of that contract **Value of working with a fixed-term contract with** $d = 1, r = 1$

$$V_{i,t}^{P_{1,1}}(\Omega_{it}) = U_{it}^{P_{1,1}}(\Omega_{it}) + \beta \Bigg\{ \left[\left(1 - \sum_{D=1}^{3} \lambda_D\right) + (1-\delta)\lambda_2\right] \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub})\right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max\left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right]\right)$$

$$+(1-\delta) \left(\lambda_1 \, \mathbb{E} \max\left[V_{t+1}^{P_{1,2}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right] + \lambda_3 \, \mathbb{E} \max\left[V_{t+1}^{P_{3,1}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right]\right) \Bigg\}$$

Value of working with a fixed-term contract with $d = 1, r = 2$

$$V_{i,t}^{P_{1,0}}(\Omega_{it}) = U_{it}^{P_{1,0}}(\Omega_{it}) + \beta \Bigg\{ \left[\left(1 - \sum_{D=1}^{3} \lambda_D \right) + (1-\delta)(\lambda_1 + \lambda_2) \right] \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub}) \right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max \left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] \right)$$

$$+(1-\delta)\lambda_3 \, \mathbb{E} \max \left[V_{t+1}^{P_{3,2}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] \Bigg\}$$

Value of working with a fixed-term contract with $d = 2, r = 0, x = 1$

$$V_{i,t}^{P_{2,0}}(\Omega_{it}) = U_{it}^{P_{2,0}}(\Omega_{it}) + \beta \Bigg\{ \left[\left(1 - \sum_{D=1}^{3} \lambda_D \right) + (1-\delta)\lambda_1 \right] \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub}) \right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max \left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] \right)$$

$$+(1-\delta) \left(\lambda_2 \, \mathbb{E} \max \left[V_{t+1}^{P_{2,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] + \lambda_3 \, \mathbb{E} \max \left[V_{t+1}^{P_{3,1}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] \right) \Bigg\}$$

Value of working with a fixed-term contract with $d = 2, r = 0, x = 2$

$$V_{i,t}^{P_{2,0}}(\Omega_{it}) = U_{it}^{P_{2,0}}(\Omega_{it}) + \beta \Bigg\{ \left[\left(1 - \sum_{D=1}^{3} \lambda_D \right) + (1-\delta)\lambda_2 \right] \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub}) \right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max \left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] \right)$$

$$+(1-\delta) \left(\lambda_1 \, \mathbb{E} \max \left[V_{t+1}^{P_{1,2}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] + \lambda_3 \, \mathbb{E} \max \left[V_{t+1}^{P_{3,1}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1}) \right] \right) \Bigg\}$$

Value of working with a fixed-term contract with $d = 2, r = 1$

$$V_{i,t}^{P_{2,0}}(\Omega_{it}) = U_{it}^{P_{1,0}}(\Omega_{it}) + \beta\Bigg\{ \left[\left(1 - \sum_{D=1}^{3} \lambda_D\right) + (1-\delta)(\lambda_1 + \lambda_2)\right] \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub})\right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max\left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right]\right)$$

$$+(1-\delta)\lambda_3 \, \mathbb{E} \max\left[V_{t+1}^{P_{3,2}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right] \Bigg\}$$

Value of working with a permanent job contract ($d = 3$)

$$V_{i,t}^{P_3}(\Omega_{it}) = U_{it}^{P_3}(\Omega_{it}) + \beta\Bigg\{ \delta \left(1 - \sum_{D=1}^{3} \lambda_D\right) \mathbb{E}\left[V_{t+1}^{\bar{P}}(\Omega_{t+1}^{ub})\right]$$

$$+\delta \sum_{D=1}^{3} \left(\lambda_D \, \mathbb{E} \max\left[V_{t+1}^{P_{D,0}}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right]\right)$$

$$+(1-\delta) \, \mathbb{E} \max\left[V_{t+1}^{P_3}(\Omega_{it+1}), V_{t+1}^{\bar{P}}(\Omega_{it+1})\right] \Bigg\}$$

5.8.1 Terminal condition

By the age of 40, women make their last fertility decision in the model. However, as noted by (Adda et al., 2016) children have costs in the life-cycle career of the woman. Therefore, we include 10 additional years of labour supply decisions in the model in order to capture these costs before women start to retire. At the age of 50 we assume that the future value function is the average old-age pension benefits estimated from the ECHP conditional on the type of the last job contract and on the number of children.

6 Estimation

6.1 Procedure

The parameters of the model are recovered in two steps. First, we estimate the equations of the exogenous elements in the model. In this version, these exogenous elements include the dynamics of marriage, divorce, lay-off, job offers, and women and husband earnings. The discount factor and the cost of childcare are externally set. Second, the remaining parameters related to the utility function are estimated in the current version of the paper. All the values for both the parameters and exogenous elements in the model can be found in appendix A.

We estimate the parameters in the utility function by the Method of Simulated Moments (MSM).[21] Firstly we solve the model backwards (starting at the age of 50) by assuming a initial set of parameters in order to calculate all the possible conditional value functions. Secondly we simulate the choices of 2985 women (5 times the number of women we have aged 23 years old), over the life-cycle and save them in a panel data format. Initial conditions are assumed to be equal to the observations we have for women who are 23 years old. From here we draw the types of permanent unobserved heterogeneity and also the outcomes in terms of lay-off, job offers and marriage/divorce. Decisions are made at the end of the each period conditional on both observables and outcomes from random draws which are known at the beginning of each period.

Using both datasets (real and simulated) we compute the moments that are described in the next subsection. Finally, recurring to the method of Bound Optimization by Quadratic Approximation (Powell, 2009), the parameters are re-set in order to solve the following problem:

$$\min_{\theta}(M(\theta) - M_R)' W_R^{-1} (M(\theta) - M_R) \tag{12}$$

where θ is the vector of parameters to be estimated; $M(\theta)$ is the vector of moments computed

[21] See Pakes and Pollard (1989) and Duffie and Singleton (1993)

from the simulated data; M_R is the vector of moments computed from the real data; W is the weighting matrix which contains sample variances of M_R in the diagonal and hence the moments with greater variance will be less important. The sample variances were bootstrapped with 10000 iterations.[22]

6.2 Moments

In the current version of the paper we estimate the parameters of the utility function, thus leaving all the probabilities related marriage/divorce and job transitions, as well as wages, to be estimated outside the model - see estimates' results in tables 4, 5, 6 and 7.

To identify the parameters in the utility function we match 57 data moments which are listed in table 4.

Table 4: Moments

Description	#
Proportion of women with one year child in each contract	4
Transitions between each labour market status	16
Proportion of non-mothers by age group	3
Proportion of mothers of one child by age group	3
Proportion of mothers of two children by age group	3
Proportion of non-workers by age group	5
Proportion of workers in fixed-term contracts by age group	5
Proportion of workers in permanent contracts by age group	5
Proportion of married women by age group	5
Coefficients of OLS regression of children (0/1) on age, $\mathbb{1}$(husband), and type of contract	4
Coefficients of OLS regression of children (1/2) on age, $\mathbb{1}$(husband), and type of contract	4

Note: the age groups are [23,30],]30,35],]35,40],]40,45],]45,50]. When calculating the proportion of mothers we do not consider the age groups outside the fertile age. Both OLS regressions also account for year fixed effects.

The moments we match are the proportions of non-workers, workers with one-year fixed-term contract, workers with two-year fixed-term contract and workers with permanent contract, conditional on the number of children (zero, one, or two); the proportion of recent mothers, by their labour market status; the average age when giving birth, by labour market

[22] Under the regulatory conditions stated in Pakes and Pollard (1989) and Duffie and Singleton (1993), the estimator $\hat{\theta}$ is consistent and asymptotically normally distributed.

status; and the transitions between labour market status. In order to test if the parameters of the utility function are identified by the moments chosen, we check whether the objective function changes with respect to changes in a given parameter.

7 Results

7.1 Parameter estimates

Preliminary parameter estimates for the utility function and respective standard errors are shown in table 5. Despite the fact that we assume a utility function that is linear in consumption, there is evidence for complementarity between that and labour and the number of children, as both parameters (γ_1 and γ_2) report a negative value.

Table 5: Utility function parameters:

Parameter	**Value**	**Standard Error**
γ_1	-0.45	(0.03)
γ_2	-0.01	(0.01)
γ_3	-0.52	(0.06)
γ_4	2.63	(0.83)
γ_5	-0.21	(0.13)
γ_6	-0.50	(0.19)
γ_7	0.42	(0.05)
γ_8	-1.03	(0.21)
γ_9	-0.61	(0.18)
γ_{10}	-2.05	(0.87)
Unob.Heterogeneity		
ζ^p	0.18	(0.00)
ζ^n	0.10	(0.04)
Proportions (%)		
HW	18.40	
HU	20.17	
LW	35.59	
LU	25.84	

In a previous version of the model the disutility of labour (γ_3) depended on the type of the job contract. However, as we estimated the model, that difference turned out to be

irrelevant as what drives the employment profiles in the different types of contract are mainly the probabilities estimated with the ES dataset.

The contribution of children to the utility function assumes a quadratic shape (γ_4 and γ_5) which sheds light on the larger proportion of single-child mothers relative to two-child ones. Illustrating the usual spacing between the first and second births, γ_{10} presents a relatively large negative value.

The interplay between labour supply and fertility decisions is reflected in γ_6, γ_7, γ_8, and γ_9. The first two parameters have opposite signs to reflect the stronger preference for children when the woman is permanently employed. As the job security is lower in a fixed-term contract the woman is likely to face an income shock which might have (negative) implications in terms of children (monetary) investment, therefore, the coefficient associated with children during the period of fixed-term employment (γ_6) is negative. Note however that the magnitude (in absolute terms) of the parameter associated to children while the woman is permanently employed (γ_7) is smaller than that for fixed-term employment to highlight the fact that, while employed, the mothers will have less time to spend with their children.

When we look at these interactions in the presence of an infant (i.e., the youngest child has 1 year old), the coefficient associated to permanent employment (γ_9) is no longer positive in order to highlight the importance of time investment in children in the first year of life. However, to compensate for the lack of time while employed, the mothers might choose alternative childcare. Such costs become relatively more expensive if the mother becomes unemployed in the following years as the income necessary to keep such monetary investment might decrease (with a larger probability) in case she holds a fixed-term contract (γ_8).

Finally, in terms of unobserved heterogeneity, the types that have relatively stronger preference towards working have less disutility from labour force participation (ζ^p) and the types which are more prone to have children enjoy it more (ζ^n) over the life-cycle. The proportions for each type are presented at the end of the table. From these we observe that the groups with relatively more taste for children (HW and HU) are less than 40% of the

sample and the groups with relatively more taste for work (HW and LW) represent more than half of it. As expected the most representative group is the one with lower taste for children and higher taste for work (LW, with 35.59%).

7.2 Fit of the model

In table 6 we list the proportions of women according to different characteristics, both in actual and simulated data.

Table 6: Comparison of means between actual and simulated data

	Actual	**Simulated**
p=1	0.6600	0.6718
p=1, d=1	0.0544	0.0425
p=1, d=2	0.0170	0.0151
p=1, d=3	0.5964	0.6141
p=0	0.3323	0.3282
n=1	0.0370	0.0354
k=0	0.3470	0.2940
k=1	0.3127	0.3825
k=2	0.3404	0.3235
ak=0	0.3814	0.2940
ak=1	0.3127	0.3825
ak=2	0.3404	0.3235
h=1	0.7197	0.6918

In this version of the model we attain a reasonably good fit in terms of the labour market indicators. However, in figure 7 we observe that the model predicts a relatively faster decay of the share of fixed-term contract holders when compared with the actual data.

In terms of fertility choices the model predicts reasonably well the number of births but not its profile along the life-cycle. The largest disparity is between 23 and 25 years old when a quite larger proportion of women in our simulations give birth when compared to the actual mothers. Such difference could be controlled by including the value for quality of the children as women in actual data may delay birth until they have enough income security to invest and raise children with more quality.[23] Given this disparity, the proportion of women according to

[23]See Becker and Tomes (1976); Chiswick (1986); Del Boca et al. (2014); Carneiro and Ginja (2016) for

the number of children and to the age of the youngest child also present significant differences in this version of the model. Despite these discrepancies, figure 8 shows that we do capture quite well the general pattern of fertility from age 25 until the end of the fertile period. Also, on average, we do quite well in terms of simulating the number of mothers with two children.

Figure 7: Goodness of fit of contracts and non-working

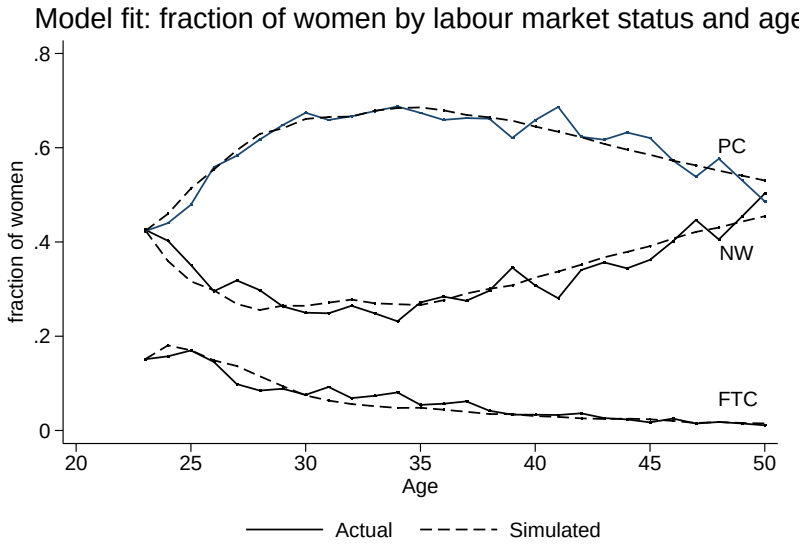
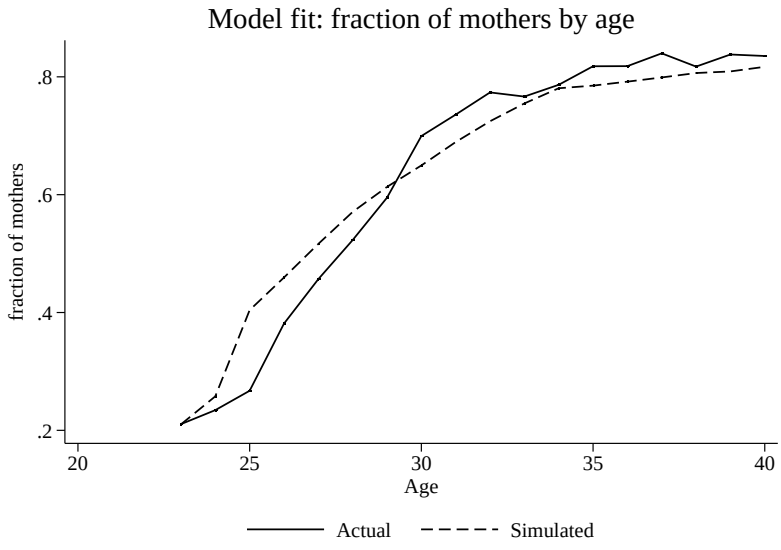


Figure 8: Goodnes of fit of fertility choices



valuable discussions over the relation between labour supply and children investment. Note however that we cannot follow this approach as there is lack of data (to our knowledge) relating the early child investment with child performance for Portugal.

8 Policy experiments

In this section we use the structural parameter estimates to predict the impact of four counterfactuals on both labour supply and fertility decisions: (1) To extend the maximum duration of successive FTC in the same company to 6 years, like it happened in the reform of 2003; (2) To eliminate the permanent contracts; (3) To eliminate the fixed-term contracts; (4) To create a single contract with a 3-year probation period. Note that all policy experiments contain no prior announcement as they are implemented permanently from time t = 1 on.

In the first experiment we basically allow for two-year fixed-term contracts to be renewed two times rather than none.[24] As we change the structure of the labour market but only model the labour supply we should also adapt the probabilities for each transition in the labour market. To achieve this, we re-estimate the same functional forms of the probabilities using ES data between 2004 and 2008 in order to capture the legislation in place at the time, which was precisely the one set in this experiment. We could use data up until 2009, when legislation changed again, but we decided not to do so in order to avoid the contamination of the crisis in Portugal at that time, even though we control for general trends by including dummies for both cohorts and years in all the regressions.

As for the second experiment we do not change the parameters in the transition probabilities, relative to the baseline model, but we assume that all the women with permanent contracts as initial conditions have a 2-years fixed-term contract instead. To be consistent, we also join the probability of receiving a permanent contract offer to that of receiving a two-year fixed-term contract offer. As we do not adjust the rest of the labour market characteristics (restrictions on the number of renewals, lay-off probabilities and wages) one should expect the unemployment rate to increase with the higher prevalence of fixed-term contracts. With this experiment we aim to test how much fertility is affected when the job insecurity is extremely large.

To complement the previous counterfactual we eliminate all the fixed-term contracts in

[24] We also allow for other combinations of renewals between one-year and two-year fixed-term contracts.

the third experiment by converting them into permanent ones since the period t=1. Once again, we do not adjust the rest of the labour market characteristics as these are assumed to be exogenous in the model. Therefore, in a situation with extremely low job insecurity one should expect the employment rate to go up. Under this scenario we want to test how much fertility would increase in case there were no fixed-term contracts in the labour market.

Finally, we aim at decreasing the firing costs of permanent contracts by introducing a single contract with a probation period of three years. During this period, we assume employers have the right to terminate the contract as if it was a fixed-term contract but following the probation period, employers are required to employ the workers permanently. Such design is in line with what was adopted in Italy in 2012.[25] Under these conditions we expect job security to decrease in the first years of a permanent contract but also a higher conversion of fixed-term contracts into permanent ones. Given the two counteracting forces we are not clear about the direction of the fertility change under this scenario.

The main results are summarized in table 7, which exhibits the effects (in percentage point deviations) of the counterfactuals on eight main statistics. As expected, and in line with Güell and Rodríguez Mora (2016), we observe a larger unemployment rate when the prevalence of fixed-term contracts is higher. As the authors suggest, the rest of the labour market conditions (such as the minimum wage) should adjust in order to accommodate this scenario. In terms of the effects in fertility decisions we observe that increasing the job security leads to less childless women (at age 41) but the effect in the average number of children is only relevant once we restrict the entire labour market to permanent contracts. The impact on the average age at first kid (for the women who conceived the first child after 23 years old) is not as straightforward as when we look at the other statistics for each counterfactual. If on the one hand the average age follows the opposite direction of the change in job security in counterfactuals (1) and (3) that does not happen in the other two experiments. The negative change in counterfactual (2) relative to the baseline might be

[25] See Lepage-Saucier et al. (2013) for a discussion of other alternatives.

explained by the large decrease in employment in this scenario. As children have strong positive contribution to the utility function, along the life-cycle they are used as substitutes to work under an environment with high levels of unemployment rate. However, the number of childless women is the highest in this experiment in order to reflect the lack of income needed to bear a child.

Table 7: Policy experiments: average baseline and deviations from baseline

	Baseline	**(1)**	**(2)**	**(3)**	**(4)**
Employment (%)	67.18	-6.37	-45.33	23.40	5.94
Permanent contracts (%)	91.42	-9.28	-91.42	8.58	3.18
FTC converted into PC (%)	9.33	-6.51	-9.33	-9.33	19.25
Average number of kids at age 41	1.23	-0.06	-0.39	0.15	0.05
Childless women at age 41 (%)	17.05	2.14	7.98	-2.65	-1.87
Average age at first kid (after 23)	27.58	-0.14	-0.27	-0.07	0.08
Kids conceived during FTC (%)	5.55	0.93	23.69	-5.55	-0.48
Kids conceived during unemp. (%)	31.86	2.28	38.90	-0.87	-4.84

Summing up, the option of a single contract seems to be the most (reasonable and) effective in terms of decreasing the percentage of childless women and increasing the average number of children without decreasing (and actually, increasing) the high levels of female employment that are characteristic in the Portuguese labour market. Note that without a change in the firing costs policy currently in place in Portugal, the third policy would not be optimal in a global welfare perspective as to increase fertility per women would result in large costs to the firms that would employ them.

9 Conclusion

In this paper, we develop a dynamic structural model in which women decide both on the participation in the labour market and on fertility, conditionally on the type of job contract they hold, if any. With this approach we are able to analyse the interplay between the type of contract (fixed-term or permanent), or absence of job, and fertility decisions along the life-cycle. In this preliminary version of the paper we only estimate the parameters of the utility function by the method of simulated moments, thus leaving all the probabilities related to marriage/divorce and job transitions, as well as wages, to be estimated outside the model.

Using these estimations, we simulate the choices of 2985 women and evaluate the fit of the model to the data by comparing simulated and actual choices, along the life-cycle. In terms of labour market choices we observe that the model predicts reasonably well the path of choices but the fit for fertility choices need some improvement even though we do capture the general trend for women age 27 and above.

Once we get the estimates of the model we conduct four counterfactuals: 1. To extend the number of renewals such that the maximum duration of a fixed-term contract in a given firm is 6 years; 2. To eliminate the permanent contracts 3. To eliminate the fixed-term contracts 4. To create a single contract with a 3-year probation period. By analysing different scenarios of job security we conclude that a single contract with three-years of probation period is successful at decreasing the number of childless women without decreasing (and actually, increasing) the high levels of female labour force participation in Portugal.

For future research we intend to extend the model in several dimensions. Firstly, we want to take advantage of the existence of other countries in the ECHP data in order to understand how the above counterfactuals would impact on the fertility rates in countries with different levels of labour market duality. Secondly, we aim to transform the model into a general equilibrium one in order to endogeneize the hiring and firing decisions by firms to better accommodate the impact of the counterfactuals in study in the labour market structure.

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Appendices

Appendix A

Table 1: Descriptive statistics of ECHP

Variable	**Mean**	**Std Dev**	**Min**	**Max**
Age	35.479	8.174	23	50
University degree	0.105	0.307	0	1
Not working	0.325	0.469	0	1
Working				
FTC (1 year)	0.081	0.274	0	1
FTC (2 years)	0.025	0.155	0	1
0 FTC Renewals	0.872	0.334	0	1
1 FTC Renewals	0.059	0.236	0	1
2 FTC Renewals	0.069	0.253	0	1
PC	0.894	0.308	0	1
Contract tenure 1 year	0.200	0.400	0	1
Contract tenure 2 years	0.064	0.245	0	1
Contract tenure 3+ years	0.735	0.441	0	1
Full-time Monthly Wage in 2000's euros	476.745	269.561	218.3894	2543.869
With partner	0.723	0.447	0	1
No children	0.338	0.473	0	1
Mothers				
1 child	0.473	0.499	0	1
2 children	0.527	0.499	0	1
Years in sample	4.502	1.559	2	6
N. individuals	2283			
N. panel observations	10277			

Table 2: Comparisson between ECHP and ES - Labour Market Indicators

	ECHP		ES	
Variable	**Mean**	**Std Dev**	**Mean**	**Std Dev**
University degree	0.105	0.307	0.106	0.308
Not working	0.325	0.469	0.343	0.475
Unemployment Duration	1.907	0.946	1.857	0.856
FTC (1 year)	0.081	0.274	0.073	0.261
FTC (2 years)	0.025	0.155	0.046	0.210
0 FTC Renewals	0.872	0.334	0.866	0.341
1 FTC Renewals	0.059	0.236	0.099	0.299
2 FTC Renewals	0.069	0.253	0.035	0.184
PC	0.894	0.308	0.880	0.325
Contract tenure 1 year	0.200	0.400	0.215	0.411
Contract tenure 2 years	0.064	0.245	0.075	0.263
Contract tenure 3+ years	0.735	0.441	0.710	0.454
N. individuals	2283		34988	
N. panel observations	10277		125484	

Note: read section 3.3 for explanation of main differences

Table 3: Comparisson between ECHP and ES - Labour Market Flows

From/To	Non-employment	FTC (1 year)	FTC (2 years)	PC
ECHP				
Non-employment	0.858	0.040	0.007	0.095
FTC (1 year)	0.145	0.501	0.063	0.290
FTC (2 years)	0.051	0.095	0.416	0.438
PC	0.049	0.015	0.005	0.932
ES				
Non-employment	0.876	0.053	0.017	0.053
FTC (1 year)	0.171	0.551	0.119	0.159
FTC (2 years)	0.071	0.050	0.656	0.223
PC	0.032	0.010	0.005	0.954

Note: read section 3.3 for explanation of main differences

Appendix B

Externally set parameters: We set the discount factor β to 0.98 (see Blundell et al. (2016) and Attanasio et al. (2008)). We set the mean of the extreme value distribution to 0 and the scale to 0.2. We also set the children's cost to 0.55.

Table 4: Partner probabilities estimates:

	P(Marriage)	P(Divorce)
Age	0.041	
	(0.069)	
Age^2	-0.008*	
	(0.005)	
PC	0.694***	
	(0.185)	
FTC	0.498*	
	(0.261)	
N. Kids		-0.776***
		(0.164)
Constant	-2.450***	-3.373***
	(0.219)	(0.198)
Observations	1799	4338

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Lay-off probability estimates:

	P(Laid-off)
Univ. Degree	-1.806***
	(0.273)
Tenure	-0.660***
	(0.048)
FTC (2 years)	-0.423***
	(0.162)
PC	-1.320***
	(0.104)
Constant	-0.670***
	(0.096)
Observations	23826

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Labour market transitions probabilities estimates:

	P(Offer FTC (1 year))	P(Offer FTC (2 years))	P(Offer PC)
From FTC (1 year)	2.104***	2.067***	1.533***
	(0.158)	(0.267)	(0.169)
From FTC (2 years)	0.586**	4.179***	2.353***
	(0.243)	(0.281)	(0.206)
From PC	-0.714***	0.247	4.634***
	(0.171)	(0.279)	(0.149)
Age	-0.015	-0.011	0.026***
	(0.014)	(0.019)	(0.009)
Age^2	-0.001	-0.001*	-0.001***
	(0.000)	(0.001)	(0.000)
Unemp Duration	-0.554***	-0.371***	-0.410***
	(0.077)	(0.131)	(0.076)
Constant	-0.768***	-2.206***	-1.439***
	(0.159)	(0.265)	(0.157)
N	26102.000		

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7: Wages estimates:

	FTC Wage
	b/se
Age	-0.005*
	(0.003)
FTC (2 years)	0.058*
	(0.034)
Univ. Degree	0.584***
	(0.038)
Constant	1.159***
	(0.026)
N	716.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	PC Wage
	b/se
Age	0.009***
	(0.001)
Tenure	0.071***
	(0.010)
Univ. Degree	0.834***
	(0.019)
Constant	0.916***
	(0.027)
N	4830.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

	Husband's Wage
	b/se
Age	0.015***
	(0.001)
Univ. Degree	0.568***
	(0.019)
Constant	6.010***
	(0.016)
N	3131.000

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$