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Fertility and Financial Incentives in France

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Résumé

On a souvent relié l'augmentation de la natalité en France depuis 1995 aux réformes des prestations familiales. Nous étudions dans cet article le lien entre fécondité et incitations financières en estimant et en simulant un modèle structurel de participation et de fécondité sur un échantillon de femmes françaises. Nos résultats suggèrent que les incitations financières jouent un rôle non négligeable dans les comportements de fécondité. De manière surprenante, ce rôle semble être plus important pour les naissances de rang bas.

Abstract

The increase in births in France since 1995 has often been linked by commentators to more generous family benefits. We study here empirically the link between fertility and financial incentives by estimating and simulating a joint structural model of participation and fertility on a sample of French women. Our results suggest that fertility responds to incentives in a non-negligible way. However, they also have some puzzling features: financial incentives appear to have much stronger effects on low-parity births.

Introduction

After the baby boom that followed the second world war, the birthrate decreased dramatically in France in the mid-60s. Births first stayed high as women born during the baby boom started having children; then they declined at the beginning of the 70's, as Figure 1 shows. However, the number of births has been increasing since 1995, a change that has drawn the attention of a number of commentators and of the media. This evolution has often been linked with various family policy measures which date from the same period, particularly with the extension of the "Allocation Parentale d'Éducation" (APE) to the second born in July 1994. The APE provides one of the parents of a newborn with a monthly benefit of around 500 euros during the three years following birth, provided the parent has held a job during two years in the past five years and stops working. It was aimed at families of three children or more before 1994, but was extended to two children families then.

In fact, the policies towards families implemented in France at the end of the 1930's were in part based on the belief that family benefits increase fertility. In a number of other countries, this belief is not shared (see Gauthier (1996)), and family benefits are mostly designed as a way to ensure a minimum standard of living to families and children. Even in France, a recent widely quoted administrative report by Thélot and Villac (1998) barely mentions fertility in its analysis of family policies.

However, it is natural for economists to presume the existence of a link between family transfers and fertility. The standard model of Becker (1991) implies that the demand for children depends on their cost, which in turn depends on family transfers (see for instance Cigno (1986) for a theoretical study of the impact of taxes on fertility). A number of empirical studies, for instance Butz and Ward (1979), Rosenzweig and Schultz (1985), Hotz and Miller (1988), Heckman and Walker (1990), typically confirm the theoretical prediction that fertility decreases with the potential wage of the women, and increases with the other income of the household. The estimated effects nevertheless are small (see the survey of Hotz, Klerman and Willis (1997)). These studies also rely on a very rough description of the family transfers.

The influence of family transfers on fertility does not seem to have been much studied on individual data. Gauthier and Hatzius (1997), for instance, use macroeconomic data on a panel of countries. Ekert-Jaffé (1986) and Blanchet and Ekert-Jaffé (1994) are based on the same type of information. These papers have lead to a consensus opinion that the family policies in France contribute to fertility of the order of 0.2 child per woman. But there are a number of methodological pitfalls, in particular on macro data, where

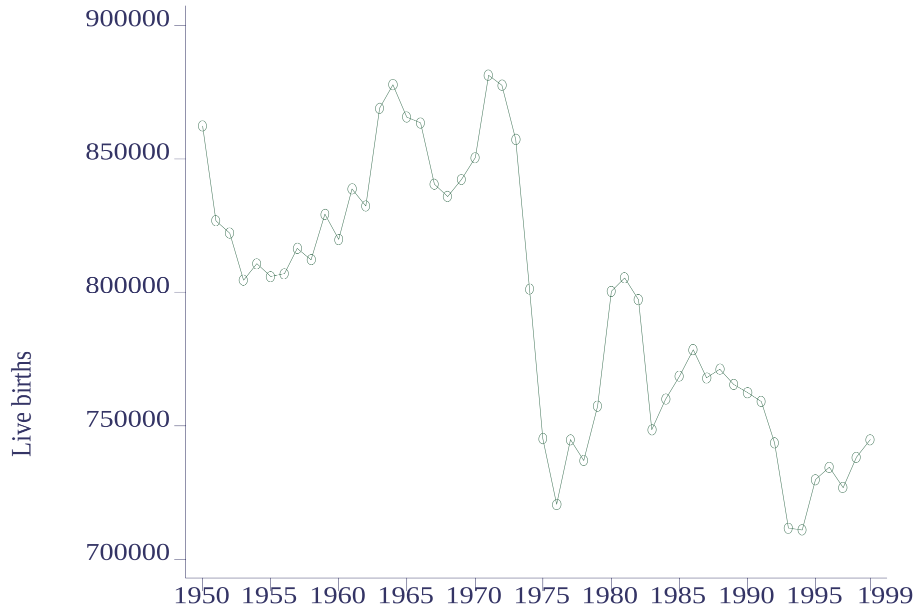

Figure 1: The annual number of births in France from 1950 to 1999

it is difficult to measure the incentive effects of transfers in a very heterogenous population. On Canadian individual data, Lefebvre, Brouillette and Felteau (1994) adjust a nested logit of fertility, number of children and participation and get a sizable impact of family benefits on fertility. Also, the recent study of Milligan (2002) on a newborn benefit in Québec between 1988 and 1997 finds a strong effect, using a natural experiment setup.

In order to measure the role of financial incentives on fertility at the individual level, one needs a careful and detailed model of the transfers accruing to the household. A number of transfers in France depend on the family composition: these include the family transfers themselves, but also housing benefits and the income tax. Moreover, the schedules are linked to the employment status of the parents. Such is the case for the APE, which goes to a parent (typically the mother) who reduces her work time. One should also note that unemployed women tend to delay their fertility decisions (Méron and Widmer (2002)). For all these reasons, it is important to describe in as much detail as possible the full transfer system and to simultaneously model the fertility and participation decisions. We shall rely on some of our previous work on women on the labor market (Laroque and Salanié (2002)). In our model, every woman is characterized by her productivity, her disutility for work and her net utility for a new child. If her productivity is smaller than the minimum wage, the woman cannot take a job but still may choose to have a child. Otherwise, she can take a job paid at her productivity if she wishes to do so. She then jointly decides on participation and fertility, depending on her individual characteristics.

In section 1, we start by taking a descriptive look at what our data may reveal about the fertility impact of the extension of the APE to the second-born in 1994. The paper then undertakes to estimate and simulate a structural model on individual data. The model is presented in section 2. Section 3 gives an order of magnitude of the financial incentives involved. The next section shows the estimation results, while section 5 simulates the impact on fertility and employment of a few representative policy measures. The paper ends with some cautionary concluding remarks.

The estimation of a structural model of the type which we are considering involves difficult choices. We have decided to give priority to the quality of the description of the transfer system, at the expense of the dynamic aspects of participation and fertility decisions. This goes against some of the recent advances in the literature (e.g. Francesconi (2002), Keane and Wolpin (2002a, 2002b)). In any case, a dynamic model would only make sense if we had a long enough panel, which is unavailable in France. For simplicity, we also ignore part-time work, in spite of the known links between giving birth and going part-time. Finally, we have not taken into account some of the child-care measures, (AGED and AFEAMA), which are closer to consumption subsidies than income transfers, in spite of the fact that they are important both in theory (Apps and Rees (2001)) and in practice (del Boca (2002) and Choné, Leblanc and Robert-Bobée (2002)).

1 A descriptive look at the data

The purpose of the Labor Force Survey is to study employment and wages, not fertility rates per se; we thus start by checking whether it can also be used for that purpose. We then study changes in fertility over the 1990s to see whether there is any evidence that the 1994 APE reform increased fertility.

1.1 Births in the Labor Force Survey

The Labor Force Surveys give the birth-year and birth-month of all children in households surveyed. They also indicate how the child is related to the reference person of the household. Figure 2 shows how the number of births changed over the 1990s according to Labor Force Surveys and according to the official registry (État Civil). For the Labor Force Survey of year I, we

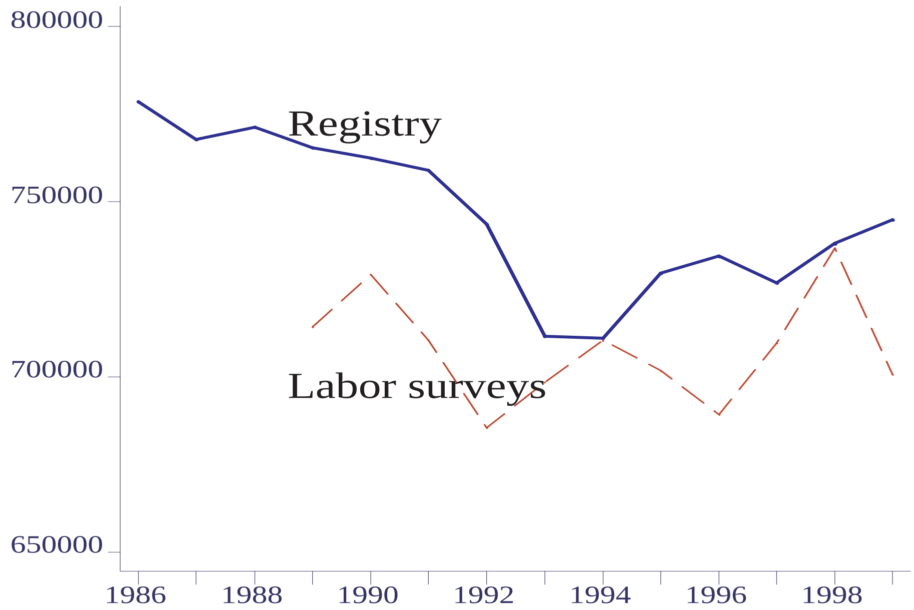

Figure 2: The number of births in France

count the children born over year $(I-1)$ and we give them the sampling weight of their household[1].

It appears from Figure 2 that the Labor Force Surveys substantially underestimate the number of births, by as many as 50,000 births from a total of about 700,000. Moreover, the measured fertility changes are rather far apart. These differences are larger than what a rough precision estimate would imply: about 80,000 households are surveyed every year and about 5% see a birth in that year, so that the standard error, $\sqrt{Np(1-p)} \approx \sqrt{0.05 \times 80,000}$, is about 65 observations, representing 20,000 births.

We should note here that there are many reasons why the figures from the Labor Force Surveys and those from the État Civil do not coincide.

1. Households may move abroad between the birth date and the survey date.

2. Some children die young (but there are few such deaths).

3. The scope of the surveys is "ordinary households", which for instance excludes hospitals.

[1] For a very few observations, the birth-year is that of the survey, while the birth-month is posterior to the date of the survey. We corrected these observations by relocating these births to year $(I-1)$.

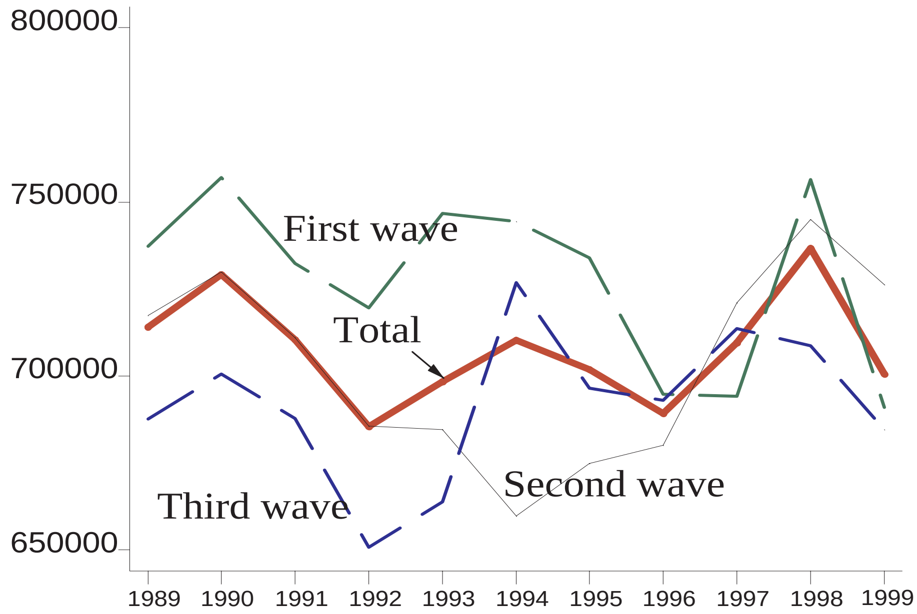

Figure 3: The number of births in France: the three waves of the LFS

4. The surveys are corrected for non-answering households using general variables from the Census. If, all other things equal, households that just had a child answer less frequently, then the correction for non-response biases their sampling weights downwards, which leads to an underestimate of the number of babies.

5. The surveys also are corrected for sampling fluctuations by adjusting the average of important variables by 5-year age classes, e.g. the 0-4 year old. This creates errors when behaviour varies within the age class[2].

The sample of dwellings of the surveys is renewed by a third every year: a given dwelling is surveyed for three consecutive years. Figure 3 emphasizes one of the reasons why births are underestimated in the surveys, at least in the first half of the 1990s. It shows the number of births in the surveys, multiplied by three, for each wave (that is, when the dwelling is surveyed

[2] Assume for illustrative purposes that all households move after experiencing a birth: then in the last two waves of the Surveys we lose all first births (except when by chance, a household with a newborn moves into one of the vacant surveyed addresses). Then sampling weights would only be given to households with children aged 1 to 4 years. This is not considered by INSEE to be a non-response, as the survey unit is a dwelling and not a household.

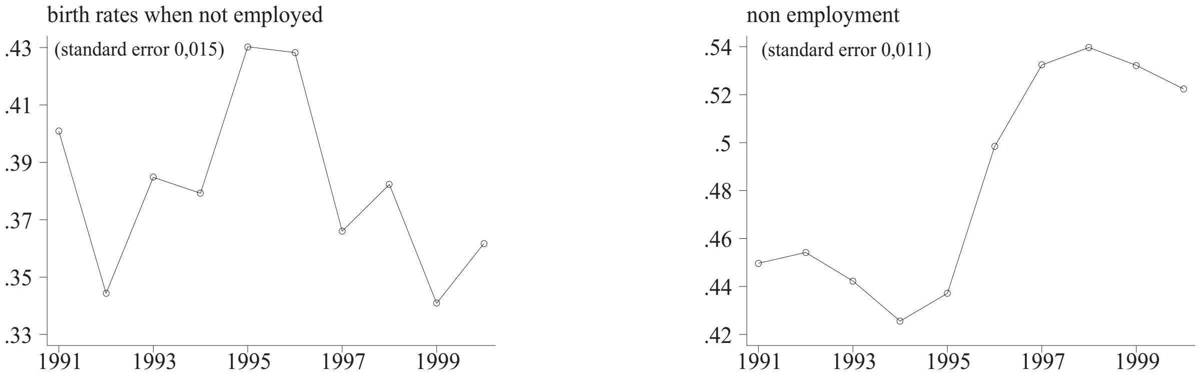

Figure 4: Non-employment and births in families with two children, including one aged less than 3

for the first, second or third time). It appears that the number of births for newly surveyed dwellings is consistent with the État Civil figures, but that, at the beginning of the 1990s, it is lower for the next waves of the surveys. The expectation of a birth may create an incentive for households to move, or the "family composition" part of the questionnaire may be filled less thoroughly in the last two waves.

A more detailed examination (not reported here) suggests that most of the underestimating error comes from the correction for non-responses by five-year age class. This mechanically introduces a lag of two and a half years with respect to global changes in birth rates. Moreover, changes in fertility over the three years for each subsample show no significant difference according to the survey wave. To conclude, it seems that the errors in the aggregate fertility measures computed from the Labor Force Surveys are largely due to the sampling weights assigned to individual observations. Thus they are not such as to undermine their usefulness for studying fertility changes at the individual level.

1.2 Changes in fertility in the 1990s

The extension in the summer of 1994 of the "Allocation Parentale d'Éducation" to two children families with one child aged less than 3 is the focal point of our analysis here. Figure 4, which refers to women aged 20 to 38 with two children of whom one is less than 3, reproduces on the right a much quoted figure used to show that this reform substantially reduced participation (see for instance Piketty (1998)): the percentage of non-employed women in this

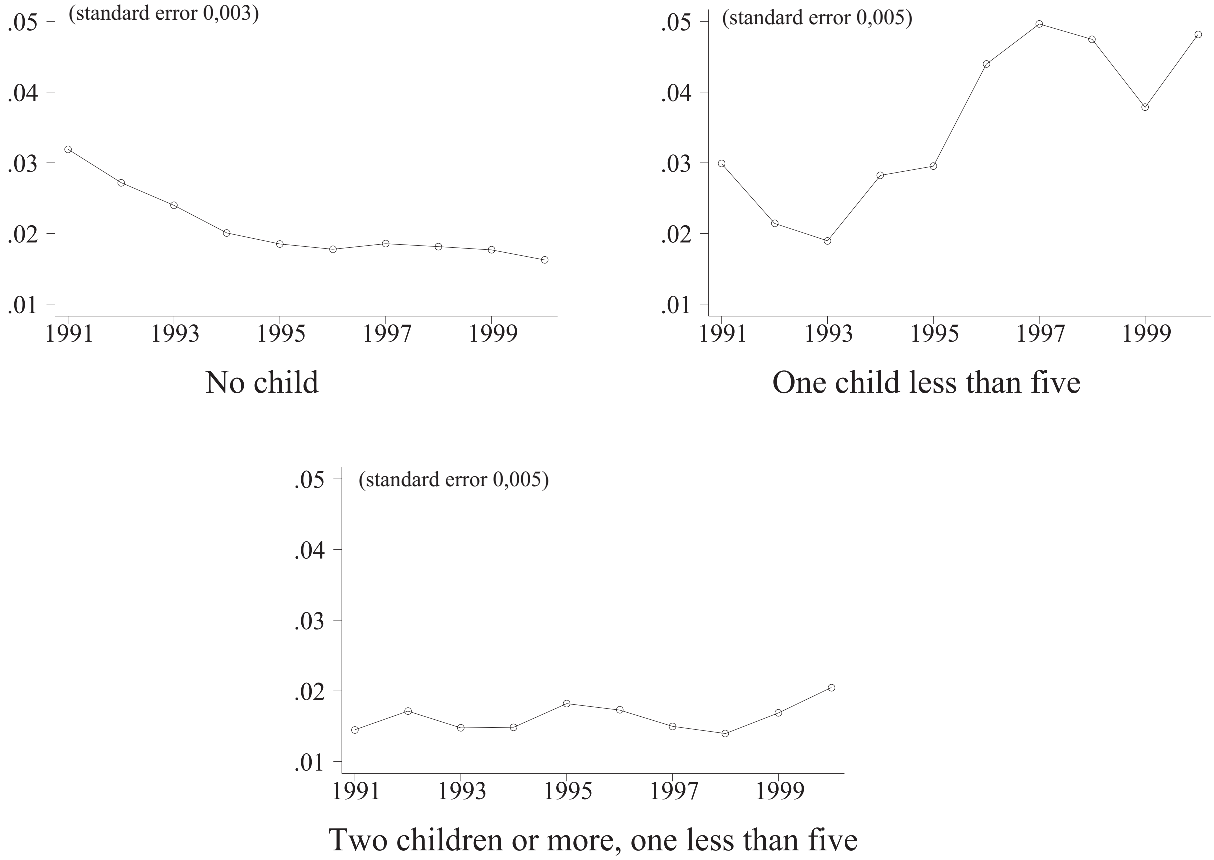

Figure 5: Frequency of transitions from employment to non-employment with a birth, by family composition

subsample increased a lot in 1996 and 1997, from 44% at the beginning of the 1990s to 53% at the end of the 1990s, while this percentage was stable or even decreased in households with one child or with three children. The left part of the figure, for the same subsample, shows how the percentage of births changed in non-employed women. Its interpretation is not as straightforward, since the selection criterion is directly linked to births: in a stationary regime for births and employment, we would expect a birth rate of 1/3 in families with a child aged less than 3. Indeed to a first degree of approximation, the rate x_y in year y is linked to births n_t in year t by:

$$x_y = \frac{n_y}{n_{y-2} + n_{y-1} + n_y},$$

if women who are non-employed when giving birth stay non-employed in the following two years. A first-order expansion around this stationary regime gives

$$dx_y \approx \frac{2}{9}\frac{dn_y}{n_y}.$$

Thus an increase of 10% in births in year y translates into an increase of about 2.2 points in the ratio x_y. If births then come back to their normal level, x_{y+1} and x_{y+2} both are 1.1 point below the reference level, and the rest of their trajectory is unchanged. If the 10% increase is permanent, then x increases by 2.2 points the first year, by 1.1 point the second year, then comes back to the reference level. Another cause of variation in x may be that women stop working the year when they give birth and go back to work the next year; then x would be constant and equal to 1. These remarks help in interpreting figure 4. The x_y rate is always larger than 1/3 between 1990 and 2000. It is about 0.38 in 1993 and 1994, before the APE reform. It suggests that a number of women stopped working only for giving birth and then went back to work. It could also indicate an increase in fertility, of course. The most spectacular change in x is the high level observed in 1995 and 1996, (about 0.43), when non-employment increases a lot. To illustrate the magnitude of this increase in x, it can be computed that if, all other things equal, the 9% of households in which the woman goes from employment to non-employment registered a new birth in 1996, this would increase x_{1996} by 6 points[3], which is close to the observed increase in 1995 and 1996. Thus the extension of APE in 1994 seems to have coincided with a large increase in births in eligible women. This change appears to be persistent, since the ratio only goes back to its reference value at the end of the 1990s and never went below it.

This focus on two-children families with a non-employed woman is illustrative and brings us closer to the analysis of employment effects in Piketty (1998); but it is more convenient to examine women at risk of a birth with a selection criterion as exogenous as possible. This is done in figure 5, which uses data on women aged 20-38 to show the transition probabilities from employment in year y to non-employment and a birth in year $(y+1)$. We distinguish childless women, women with one child aged less than 5, and women with two children including one aged less than 5. The figure shows a marked increase in the mid-1990s for newly eligible women, at the time of the APE

[3]By assumption, $dn_{1996}/(n_{1994}+n_{1995}+n_{1996})$ equals 9%. The variation in x is

$$dx_{1996} = \frac{dn_{1996}}{n_{1994}+n_{1995}+n_{1996}} - \frac{n_{1996}dn_{1996}}{(n_{1994}+n_{1995}+n_{1996})^2}.$$

reform, while the probabilities are stable or even diminishing for non-eligible women. This also suggests that the reform of the APE may have led to an increase in fertility.

2 A model of labor supply and fertility

We work on a cross section. We aim to get an estimate of the effect of financial incentives on fertility through the large variability of situations in the data. Indeed, if financial incentives have a strong effect on fertility, we expect more numerous births in households which, all other things equal, receive more money from a birth.

We jointly model fertility and labor supply. These two decisions are indeed linked by the design of the benefits: the APE is conditional on reducing labor supply, and several other family benefits, the RMI (a minimum income guarantee) and housing benefits, jointly depend on the family composition and on income (therefore indirectly on employment status). We rely on a detailed representation of the transfers, and employment not only depends on labor supply but also on the level of the minimum wage as in Laroque and Salanié (2002).

2.1 The discrete choice model

A priori, we would like to derive the fertility and labor supply decisions as the outcome of a dynamic program over a long horizon, where the woman takes into account all future consequences of her decisions, in terms of employment, wages and further births. This would involve expectations on the state of the labor market, family events, and changes in the benefits and taxes. Postulating such expectations without having, as a safeguard, a long panel dataset is hazardous. We therefore limit the horizon to one year. We assume that the women make their fertility decisions in year t in a rather myopic way: they forecast their status in year $t+1$, in four possible contingencies, being employed or not, with a newborn baby or not. They decide on having a baby in year t when they find it worthwhile in this four-way comparison for year $t+1$. We also make the (somewhat unrealistic) assumption that the participation decision in year t does not influence the circumstances in date $t+1$, so that, as far as date t is concerned, the participation decision and the fertility decision can be considered separately.

Formally, let d be the labor disutility and v the net (of associated costs) benefit of a birth for a woman of the sample, forecasted for year $t+1$. We denote α_d, $\alpha_d > 0$, the sensitivity of labor supply to financial incentives and

α_v, $\alpha_v > 0$, the sensitivity of fertility to financial incentives. Let R_{ij} be the net disposable incomes of the household in the four possible contingencies:

- R_{00} : non employment in year $t+1$ and no birth in t
- R_{01} : non employment in $t+1$ and birth in t
- R_{10} : employment in $t+1$ and no birth in t
- R_{11} : employment in $t+1$ and birth in t.

These incomes are the disposable incomes of the household after taxes and transfers, which depend on the wages of the members of the household (when they work) and on family composition. The labor supply decision changes wage income and the fertility decision modifies family composition, and consequently disposable income.

We normalize the utilities associated with the four states by setting the coefficient of the income variable always equal to $\alpha_d\alpha_v$. Then the utilities to be compared are

$$\begin{cases} U_{00} &= \alpha_d\alpha_v R_{00} \\ U_{01} &= \alpha_d\alpha_v R_{01} + \alpha_d v \\ U_{10} &= \alpha_d\alpha_v R_{10} - \alpha_v d_0 \\ U_{11} &= \alpha_d\alpha_v R_{11} - \alpha_v d_1 + \alpha_d v \end{cases}$$

We assume that the labor disutility d is

$$d = Z\gamma + \rho\varepsilon + \eta_d$$

where Z gathers variables describing non wage income, family composition (age and number of children) and possibly the matrimonial status. The variable ε stands for an unobserved heterogeneity on wages, which may be correlated with labor disutility. The random term η_d is assumed to have a centered standard normal distribution. The net benefit v of a birth is specified as

$$v = V\delta + \eta_v$$

where V includes variables describing the family composition, matrimonial status and the age of the woman, and η_v again is centered standard normal. Z includes a variable that describes whether the woman has a new born baby or not, so that labor disutility differs when the woman just had a baby d_1 or not d_0.

The assumption of a unit variance of η_d and η_v is a normalization of utilities. At this stage, we have not allowed for a correlation between η_d and η_v, nor between ε and η_v.

A woman in the population knows her characteristics, both observable (V, Z) and unobservable (ε, η_d and η_v) to the econometrician. Barring any obstacle to employment, she chooses to have a baby when either U_{01} or U_{11} is the largest of the four numbers U_{00}, U_{01}, U_{10} and U_{11}, and not to have a baby otherwise.

Participation in date t is consistent with the forecast made earlier in date $t-1$. Given the family composition, in particular the possible presence of a new born in the household, the woman participates when the benefits from work exceed the cost, evaluated with the same parameters d, v, α_d and α_v as above.

Remark: From the point of view of the econometrician, who does not know the value of the idiosyncratic shocks but assumes a normal distribution, note that if Φ is the c.d.f. of the standard centered normal distribution, then conditionally on the decision of being unemployed, the probability of a birth is

$$\Phi\left(V\delta + \alpha_v(R_{01} - R_{10})\right)$$

which justifies the interpretation of α_v as a measure of the sensitivity of fertility to financial incentives. Similarly, the probability of working in 2000 given a birth is

$$\Phi\left(\alpha_d(R_{11} - R_{01}) - Z\gamma - \rho\varepsilon\right)$$

and α_d does measure the sensitivity of labor supply to financial incentives.

2.2 Empirical implementation

We work on a sample of women, interviewed at the Enquête Emploi (Labor Force Survey) in January 1999, from which we get the exogenous variables of the model. The endogenous variables are the employment status at the time of the survey, the wage in case of employment[4], and the occurrence of a birth during the year 1999. We restrict our attention to the two thirds of the sample that are reinterviewed in 2000, and obtain the fertility decision from the 2000 Survey[5].

[4] We only consider two possible situations on the labor market: non employment or full-time employment.

[5] The requirement that the same women be present at the two successive surveys is not innocuous. According to the 2000 survey, 700,000 children were born during the year 1999. The survey operates by interviewing all members of a household, as defined by its address. A bit more than 10% of the 2000 survey households that ought to be present in 1999 are missing (nobody resided in the dwelling, or there was no answer), but they correspond to more than 15% of the births. Moreover, even when the same address did yield an answer in 1999, more than 10% had different occupants in both years. All told, our study is restricted to 480,000 births out of the total 700,000.

The model starts with a wage equation, which describes the labor cost for a full time 39 hour work week:.

$$\log C = X\beta + \sigma\varepsilon$$

where ε has a standard centered normal distribution and X contains the usual variables: number of school years and its square, experience and its square, diploma.

We have programmed the tax and transfer schedule in 1999, through a function R which associates to the detailed characteristics of the household, labor costs of man and woman, number and age of the children, etc., its disposable income. To keep notation simple, we only make explicit two arguments so that $R(C, F)$ denotes the disposable income of the household under the 1999 legislation, when the labor cost of the woman is C (equal to 0 when she does not work) and the family composition of her household is F.

According to the previous description, the model then operates as follows. In January 1999, the woman decides on her labor supply by comparing $\alpha_d R(C, F_{99})$ and $(\alpha_d R(0, F_{99}) + d)$, where F_{99} stands for the family composition of her household at that date. A woman who has decided to participate finds a job if her labor cost C exceeds the cost of the minimum wage $\underline{C}$. At the same time, the woman plans on possibly giving birth during 1999, by anticipating her situation in March 2000, comparing the utilities of the four possible states discussed above. A couple more remarks are in order:

- the less skilled women, for whom $C < \underline{C}$, in fact only compare the two situations of non employment, since the minimum wage excludes them from the labor force.

- we assume a myopic expectation of the legislation, so that the same function R is used in 2000 as in 1999. The incomes R_{ij} take into account the normal evolution of family composition between 1999 and

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The scope of our study is further reduced by the need to have a reliable measure of income and our desire to model participation while neglecting the decision to pursue studies. We only consider women less than 50 who have finished their studies for more than two years. We have excluded the civil servants. The survey does not contain information on pensions, nor on non-wage income. Finally, as already mentioned, we leave aside part-time employees.

To sum up, we work on 7,379 observations that represent 3.6 millions women, 5,785 femmes living with a partner and 1,594 alone. 48% hold a full time salaried job, the others do not work. Out of these 7,379 households, 461 have seen a birth during 1999; this represents 230,000 births, approximately a third of the registered births.

2000. Indeed,

$$\begin{cases} R_{00} &= R(0, F_{00}(0)) \\ R_{01} &= R(0, F_{00}(1)) \\ R_{10} &= R(C, F_{00}(0)) \\ R_{11} &= R(C, F_{00}(1)) \end{cases}$$

where $F_{00}(0)$ (resp. $F_{00}(1)$) is the family composition "made older" by one year and taking into account 0 (resp. 1) birth in 1999.

- the decision to have a child is not necessarily followed by a birth, and a birth is not always voluntary. However, the data do not allow us to separate these circumstances, except by functional form assumptions. We therefore identify willingness to have a child with birth.

3 Measuring Financial Incentives

Our estimation strategy relies on the variation in financial incentives across women. To give an idea of the magnitudes involved, let us consider a couple of examples. The woman we consider in this section has a husband who gets a monthly net wage of 1,200 euros if he has a job; she may also be employed, at a net wage of 900 euros (which was slightly above the minimum wage in 1999-2000). We study in Table 1 four subcases, depending on whether the husband is working and whether the couple already has a (young) child at the beginning of the observation period.

There are two striking lessons from Table 1. The first one is that financial incentives to work, as measured by $(R_{11} - R_{01})$ and $(R_{10} - R_{00})$, depend heavily on whether the husband has a job: the net wage of 900 euros that the woman earns increase the net resources of her household by 600 to 800 euros when the husband has a job, and by 150 to 250 euros only when he is unemployed. In the latter case, the household gets the guaranteed minimum income of about 500 euros when it earns no wages; and this transfer gets withdrawn at a 100% tax rate when the woman starts earning wages. This is an instance of the poverty trap. The only exception to this stylized fact is the small value of $R_{11} - R_{01} = 292$ euros in the third subcase: then the birth of a second child makes the woman eligible to the APE provided that she stops working, which induces a high withdrawal rate.

Table 1 also illustrates how the tax-benefit system influences the financial incentives for a woman to stop working and have a child, as measured by $(R_{01} - R_{10})$. The simplest case is the first line of the Table, when the household loses about 600 euros when the woman stops working: it loses her after-tax wage and child benefits for the first child are negligible. On the

Table 1: Financial Incentives

Subcase	R_{00}	R_{01}	R_{10}	R_{11}
Husband employed, no child	1,173	1,330	1,954	2,079
Husband unemployed, no child	752	888	967	1,124
Husband employed, child aged 2	1,255	1,907	2,004	2,199
Husband unemployed, child aged 2	888	1,059	1,048	1,304

second line, the husband is unemployed and the couple is in the poverty trap, so it loses less money (only about 80 euros) when the woman stops working. The third line shows the APE in action: since the husband is working, the woman now loses more than 700 euros in after-tax wages, but the APE cuts this loss to about 100 euros. Finally, the financial loss is almost zero in the fourth line, where the woman's after-tax wage is smaller but part of the APE cuts in the minimum income guarantee.

4 Estimation Results

The wage and disutility of labor equations have standard specifications. The explanatory variables X of the wage equation include the age at the end of studies and its square, experience[6] and its square, and indicator variables for the six levels of diplomas. The variables Z which explain the disutility of labor are the numbers of children less than one year old, less than three years old, between 3 and 6, and between 6 and 18, the age of the woman, an indicator of marital status, income when not working and its interactions with family composition and marital status. As explained in section 2, the disutility of labor should also be allowed to vary when the woman has just given birth; thus we also include interactions of the dummy for a newborn child with the numbers of older children and $R(0)$. We specify the sensitivity of labor disutility with respect to financial incentives α_d as a quadratic function of age.

Specifying the fertility equation is not as straightforward. The willingness to give birth certainly depends on several groups of variables, such as diplomas, matrimonial status, family composition and age. There is no obvious way to parsimoniously combine these variables, and experimenting is costly. Moreover, a number of these variables have some endogenous features. Finally, it is likely that the sensitivity of fertility to financial incentives, if it exists, varies both with age and with the rank of the child.

[6] Measured, lacking better information, as the time since the end of studies.

Table 2: Productivity equation

Variable	Coefficient	Standard error
Age at end of studies	0.113	0.013
Age at end of studies square	-0.002	0.000
Experience	0.033	0.003
Experience squared	-0.000	0.000
Graduate	0.721	0.027
Baccalauréat + 2 years	0.533	0.022
Baccalauréat, or equivalent	0.353	0.018
CAP, BEP or equiv	0.198	0.015
BEPC only	0.166	0.020
Constant	5.461	0.138
Standard error	0.287	0.004

For all these reasons, our specification is not fully satisfactory. After several trials, the explanatory variables V retained here include the number of children less than one year old, between 1 and 2, between 2 and 3, between 3 and 18, an indicator variable of presence of a partner, and income when not working $R(0)$. All these variables are included as such, as well as their products with A_{40} and its square, where A_{40} is the age of the woman, truncated at 40; furthermore, V also includes a variable equal to one when the woman is older than 40. Our attempts to include the age at leaving school or diploma variables were not conclusive: the estimated coefficients were small and insignificant.

If it is hard to choose the variables to be included in V, it is even harder to decide what α_v should be allowed to depend on. Early experiments showed that the older the woman the less sensitive fertility is to financial incentives. Thus we retained a linear decreasing function of age, which goes to zero at a limit age which is to be estimated. As we will see, the estimated sensitivity parameter also varies dramatically with the rank of the child; we therefore let α_v depend on whether the woman already has zero, one or at least two children.

Table 2 presents the estimates of the productivity equation, i.e. the coefficients β and the standard error σ. The inclusion of the fertility equation in the model only marginally modifies the results of our previous studies.

The estimates of the disutility of labor coefficients γ and ρ are reported in Table 3. In this table, the variables are fixed at their observed value in the January 1999 survey. $R(0)$ is the household disposable income when

Table 3: Labor disutility

Variable	Coefficient	Standard Error
$R(0)/1000$	0.463	0.069
$R(0) \times C_{-3}/1000$	-0.122	0.077
$R(0) \times C_{3-6}/1000$	0.021	0.057
$R(0) \times C_{6-18}/1000$	0.103	0.028
$R(0) \times M/1000$	-0.148	0.073
C_{-3}	0.584	0.160
C_{3-6}	0.363	0.111
C_{6-18}	0.066	0.053
Age-25	0.029	0.008
M	0.370	0.105
C_{-1}	1.109	0.223
$C_{-3} \times C_{-1}$	0.071	0.226
$C_{3-6} \times C_{-1}$	-0.094	0.156
$C_{6-18} \times C_{-1}$	-0.193	0.091
$R(0) \times C_{-1}/1000$	-0.261	0.123
Constant	-0.557	0.153
ρ	0.232	0.062

the woman does not work, C_{-1} is the number of children less than one year old, C_{-3} the number of children less than three, C_{3-6} the number of children between three and six, C_{6-18} the number of children between six and eighteen, and M is an indicator variable equal to one when the woman is married. Most of the coefficients are significantly different from zero and have the expected sign: the presence of children increases the disutility for labor, especially when the children are young. The disutility of labor also increases with the wage of the partner, through $R(0)$, and with age. The matrimonial status has the expected sign: married women are less eager to get a job on the labor market. The estimated value of ρ implies that a high productivity is associated with a high labor disutility, everything else equal. All these results are in line with our previous work. The presence of a newborn child has a very strong disincentive effect on participation, as shown by the estimated coefficient of C_{-1}; this effect is more pronounced for women whose partner (if any) has low wages.

Table 4 presents the estimates δ of the fertility equation. The variables appearing in the Table and not previously defined are:

- C_{1-2} : number of children aged one

- C_{2-3} : number of children aged two
- C_{3-18} : number of children aged three to eighteen
- Co : indicator variable of presence of a partner
- A_{40} : age of the woman, truncated at forty
- A_{+} : variable equal to one if the woman is older than forty.

A number of these variables and of their interactions are not significantly different from zero. Moreover, the explanatory power of the equation is modest, as we shall see later. Finally, it is not easy to read the effects on fertility from the table, given the interactions with A_{40} and its square. A closer look at the estimates shows that

- As might have been expected, the presence of very young children (less than two years old) has large negative effects on fertility. On the other hand, a child aged two to three increases fertility, which suggests that the women plan an interval of three years between two births.
- Living with a partner always substantially increases fertility.

The most important coefficients for our purpose are those that measure the sensitivity of labor supply and fertility to financial incentives, α_d and α_v. Table 5 presents the estimates of the sensitivity of labor supply to financial incentives, and its variations with the age of the woman are depicted on Figure 6, along with a two standard-errors band. Note that although the three coefficients are separately insignificant, the estimators are highly correlated so that the confidence intervals are rather narrow. The sensitivity of participation to financial incentives seems to be smaller for older women. The average estimated value of α_d is in line with our previous results.

The main purpose of the paper is to estimate the sensitivity of fertility to financial incentives α_v. Remember that we specified α_v as a truncated linear function of the woman's age. This is equal to μ_i at age 20 and to zero for all women older than A_v, where A_v is to be estimated and $i = 1, 2, 3$ stands for births of rank 1, 2 or higher. The estimates of these parameters are in Table 6. The effect of financial incentives on fertility is not very precisely estimated, but it appears to be stronger for births of low rank. On the other hand, we failed to find a positive effect of financial incentives on births of rank 3 or higher, so that we fixed μ_3 at zero. We come back to this somewhat counterintuitive result in the conclusion.

There a number of ways to describe the quality of the fit of the model. We focus on fertility. Given the estimated coefficients, it is easy to compute

Table 4: Fertility

Variable	Coefficient	Standard error
C_{-1}	9.133	3.681
C_{1-2}	8.330	3.468
C_{2-3}	6.248	2.749
C_{3-18}	4.375	1.430
Co	-3.378	3.435
$R(0)/1000$	-2.751	2.043
A_{40}	-0.062	0.218
$A_{40} \times C_{-1}$	-0.736	0.244
$A_{40} \times C_{1-2}$	-0.603	0.234
$A_{40} \times C_{2-3}$	-0.406	0.176
$A_{40} \times C_{3-18}$	-0.280	0.088
$A_{40} \times$ Co	0.342	0.217
$A_{40} \times R(0)/1000$	0.170	0.124
A_{40}^2	0.001	0.003
$A_{40}^2 \times C_{-1}$	0.013	0.004
$A_{40}^2 \times C_{1-2}$	0.010	0.004
$A_{40}^2 \times C_{2-3}$	0.007	0.003
$A_{40}^2 \times C_{3-18}$	0.004	0.001
$A_{40}^2 \times$ Co	-0.007	0.003
$A_{40}^2 \times R(0)/1000$	-0.003	0.002
A_+	-0.624	0.148
Constant	-0.465	3.461

Table 5: $1000 \times \alpha_d$

Variable	Coefficient	Standard Error
Age	47.856	58.314
Age squared	-0.964	0.703
Constant	1.140	1.212

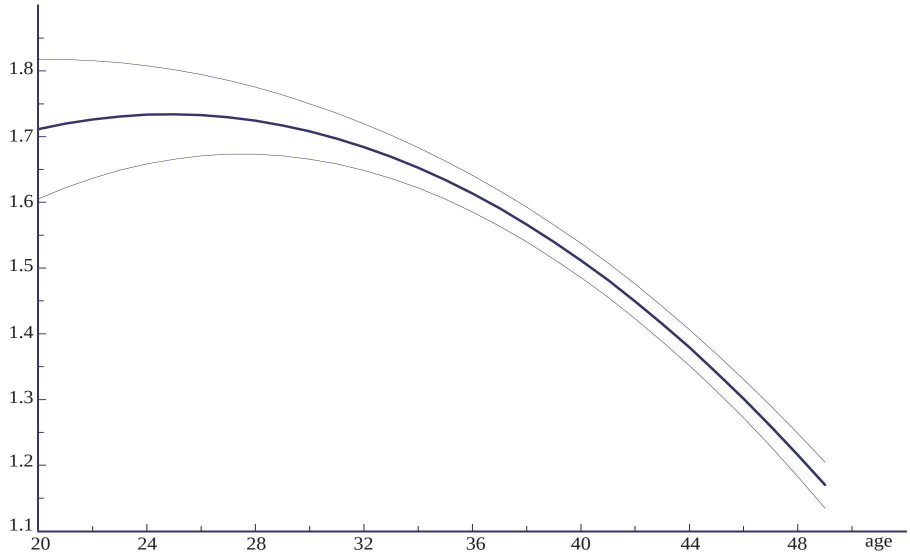

Figure 6: $1000 \times \alpha_d$

Table 6: $1000 \times \alpha_v$

Variable	Coefficient	Standard error
μ_1	1.323	0.514
μ_2	0.782	0.317
μ_3	0	—
A_v	38.106	4.465

Table 7: The Fit of Fertility on the Sample

Criterion	Observations		Fit
	Number	Fertility rate	
All	234,138	0.066	0.066
Rank of the birth			
Rank one	71,712	0.052	0.056
Rank two	93,033	0.091	0.077
Rank three or more	69,393	0.059	0.068
Presence of a young child			
$C_{-1} = 0$	224,814	0.068	0.069
$C_{-1} > 0$	9,324	0.033	0.030
Age of the mother			
20-24	19,530	0.195	0.208
25-26	30,126	0.182	0.199
27-28	35,529	0.145	0.150
29-30	41,270	0.151	0.132
31-35	67,554	0.085	0.093
36-40	34,307	0.047	0.040
41-49	5,823	0.005	0.005
Mother's diploma			
Graduate	16,539	0.072	0.072
Undergraduate	36,078	0.090	0.076
High school	44,451	0.082	0.076
Basic technical training	55,325	0.056	0.070
Junior high school	17,489	0.057	0.058
No diploma	64,257	0.059	0.055
Partner status and employment status			
Alone	16,994	0.023	0.025
With partner	217,145	0.077	0.077
Salaried in 1999	104,547	0.060	0.065
Unemployed	129,591	0.071	0.067

the probability of a birth in each dwelling of the sample, conditional on the exogenous variables and on the (endogenous) employment status and wage. This probability indeed is a by-product of the computation of the likelihood function. The average of this probability on the households where a birth occurred is 0.18, while it is equal to 0.06 on the other households. The pseudo R^2, ratio of the variance of the above probability to the variance of the birth indicator variable, is 0.22.

Table 7 compares the observed fertility rates with those estimated for the whole sample and for various subgroups. The model correctly predicts that lower-skilled women and (spectacularly) women without a stable partner have fewer children; it also gives a reasonably good fit for the age profile of women who give birth. On the other hand, the fit is less good when we break down births by rank. Also, the model fails to predict that women who were not employed at the beginning of 1999 are more fertile during 1999.

To test for the importance of economic variables in explaining fertility, it makes sense to compare the value of the log-likelihood function associated with births with that of a simple probit model of births, where the explanatory variables are exactly those in V, except for $R(0)$; thus we focus on demographic determinants and we leave aside all economic determinants. The difference of the log-likelihood functions is 2.7, which is disappointingly small given the number of data points and the efforts required to set and estimate the full model.

As the data shows, fertility is very strongly related to the age of the woman, and our specification of the variables in V, with its quadratic functions of age, may not take this into account properly. Moreover, it would be better to specify separate fertility equations for births of different ranks. As a robustness check, we estimated another model on women aged 25 to 35 who have a stable partner. Since these women are a more homogenous age group, we dropped all age effects; on the other hand, we set up three independent fertility equations, for births of rank 1, of rank 2, and of rank 3 or higher. The results (see Appendix for details) are only illustrative, as the subsample contains only 1,997 women. The estimated α_v parameters are respectively 0.78, 0.20 and 0.02. Given that the reference specification models α_v as a decreasing function of age, the estimate is similar to that in Table 6 for rank 1 births, and roughly twice smaller for rank 2 births. The somewhat puzzling result that births of higher rank do not seem to react to financial incentives is confirmed.

Remark: We experimented along several other directions to check the robustness of the results. One of the weak points of the model is the measure of the financial consequences of a birth. The assumed myopic behavior is

Table 8: Weights of the various family benefits

Benefit	Weight	Standard error
AF	1.92	1.62
MAJ	0.08	12.3
CF	5.95	1.80
APJE	0.53	0.95
APE2	0.18	0.19
APE3	0.58	0.24

convenient, but far from wholly satisfactory. It treats equally all benefits in the year following a birth. But, even if one sticks to family benefits, the APE is only given for three years (at least if there is no other birth in between), like the Allocation pour Jeune Enfant (APJE), while the Allocations Familiales (AF) (with supplements, Majorations, (MAJ) for teenagers) are given while the child is below 20, just as the Complément Familial (CF), which is means-tested. As a rough check, instead of simply adding the family benefits to other income, we allowed them to have a (constant) weight, possibly different from one, to be estimated. The general results appear robust to this change. Table 8 reports the estimated weights, which have large standard errors[7]. It does seem that the long run benefits AF and CF, served during the whole raising of the child, have larger weights than the post birth APJE, APE2 and APE3, while MAJ which is given when the child is above 14, has a negligible point estimate. This suggests that a horizon longer than three years might be appropriate and a potentially fruitful direction for further research.

In a similar vein, we estimated a model where the global family benefits received in 2000 are replaced with a measure of discounted family benefits over a twenty period horizon. The forecast was computed under strong assumptions: the work status is kept fixed as in 2000, as well as the wages; no new birth (nor death) are forecasted and the family is supposed to age with the constant 2000 structure. The constant discount rate which the model suggests in this circumstance is 5.6% per year, with a standard error of 10.9%, again an indication that the myopic assumption is not the most appropriate.

[7] APE2 (resp. APE3) refers to the APE given to families with two children (resp. three children or more).

Table 9: Simulation of Various Reforms

Unit %

Reform	Fertility	Employment
Nonlabor income +100	1.1	-2.3
Own labor income +100	-1.0	+8.1
Abolition of APE	-4.1	+4.7
Abolition of APE for second-born	-3.8	+2.7
Child support	+24.4	-1.2
Child support, financed	+13.3	+5.1

5 Simulations of Policy Reforms

It is hard to figure out the size of economic incentives on fertility from Table 6 alone. Thus, to give a better idea of the orders of magnitudes involved, we simulate some reforms of the French system of family benefits. In our previous work, we studied in detail policies aimed at labor supply or demand: here we shall focus on fertility. The computed impacts of policies are conditional on the explanatory variables, including in particular family composition at the start of the year. Our measures of the effects of policies are therefore static; we present in Section 6 a dynamic exercise which takes into account the implied changes of family composition occurring over the years.

We first focus on the "Beckerian" effects that fertility should decrease with the woman's market wage and increase with her nonlabor income. We measure these effects by increasing by 100 euros/month the wages offered to all women in our sample or their nonlabor income (which could result for instance from an increase in partners' wages).

We then turn to the effect of the Allocation Parentale d'Éducation. We consider two reforms which abolish the APE, or only its extension to the second-born in 1994. The results illustrate how the introduction or the extension of APE may have stimulated fertility.

The second group of policy reforms describes a "child support" of 500 euros per month per child less than three years old, in two guises. First, this support comes on top of the existing legislation. In the second, the support is partly financed by removing all the existing family benefits[8].

The results are summarized in Table 9. They are shown in percentage difference from the reference situation. Our sample represents 230,000 births in 1999 (approximately one third of total births in France) and 1,700,000

[8]We did not compute the exact financial outcome of this reform.

employees. As a consequence, a change of 1% of the number of births corresponds approximately to 2,300 births on our sample, and 7,500 if one dares to extrapolate proportionately to the whole of France[9]. A 1% change in employment corresponds to 17,000 jobs on our sample, and this certainly cannot be extrapolated to the overall population, given the specifics of the female labor force.

The first two lines show that wage income and nonlabor income have the effects predicted by the economic theory of fertility: better wage prospects for women reduce their fertility, while an increase in their nonlabor income increases it. The wage increase has a strong effect on employment through increased participation; conversely, the increase in nonlabor income has a negative income effect on participation.

The employment effects of the APE computed on the next two lines are very close to earlier results: denying the APE to families with two children would create 45,000 jobs on this population. As far as fertility is concerned, we find that the extension of APE to the second-born in 1994 may have increased the total annual number of births in France by around 30,000. This is a substantial impact, as it accounts for most of the recovery in fertility (approximately 40,000 births per year) over the past five years[10].

To be eligible to the APE, a woman has to stop working (or at least to go part-time for an APE at reduced rate). By contrast, the child support which we simulate here would not be conditional on any employment status: it would also be given to working women. This explains why its effects on fertility would be much larger than those of the APE, even though it is calibrated at 500 euros per month, close to the level of the APE benefit. Our estimates suggest that the creation of such a child support, on top of the existing family benefits, would induce a major increase of fertility (of the order of 180,000 extra annual births in France), at the cost of a small decrease in employment. Such a support however would be rather expensive[11]. It is somewhat more realistic to assume the substitution of family benefits with this support. The impact on fertility then would be twice times smaller. Note however that replacing transfers that decrease with income (and therefore implicitly with

[9]This is very risky. The more mobile part of the population, the persons that moved at the time of a new birth, are absent from our sample. Also, the students and civil servants are missing.

[10]This result appears to depend a lot on the estimated value of α_v, the sensitivity of fertility to financial incentives. In the model restricted to women aged 25 to 35, we get an estimate of α_v which is approximately half of the basis case, and the corresponding increase in the number of births is also halved.

[11]With 800,000 births per year, the cost would amount to $800{,}000 \times 3 \times 12 \times 500$, or about 15 billion euros per year, or 1 percent of French GDP.

employment) with a support independent of activity increases employment, as shown in the Table. Of course, the redistributive consequences of such a reform may not be as favorable.

6 Using the model for a dynamic exercise

Under the very strong underlying behavioral hypothesis (in particular the myopia of the fertility decision), the model provides an estimate of the probability of giving birth in 1999 for the women in the sample, conditional on all the (predetermined or exogenous) characteristics entering the equations: marital status, wage of partner if any, diploma, age, family composition, etc...

It is of interest, as a scholastic exercise investigating the robustness of the model, to see the consequences of the model in terms of total fertility, under the assumption that the coefficients keep their point estimate values over time. To undertake such an exercise, additional assumptions are required, regarding the evolution of the exogenous or predetermined variables. The basic idea is to take a (reasonably representative) sample of women at a young age, without children initially, and to iterate the model for twenty years, examining the size of families and the total fertility eventually achieved.

We proceed as follows. First, we are not in a position to predict changes in marital status, which would require a separate model altogether: we consider women with a partner, and we assume that they keep the same partner all along the simulation. More precisely, we consider the subsample of 2,246 women aged between 22 and 35, with a partner and we work with the observed structure of the sample, taking as given from the survey the women's diploma, age at end of studies, type of housing, wage of partner (while the women's age, their children, their wage and employment status are endogenous in the simulation). We work with constant 1999 euros, assume that the wage of the partner stays unchanged and keep the tax and benefit schedule at its 1999 specification.

The women's ages are initialized at their ages at end of studies plus two, mimicking our sample selection. Then the model is iterated for twenty periods, taking into account the (endogenous) formation of the families and its dynamic impact on the fertility decisions. The random term associated with the fertility decision is drawn independently at each date.

The overall fertility rate is 2.20, with large differences according to the women's diploma, from 1.52 for the college graduates to 2.66 for women without diploma. These differences seem to be related to the average age at first birth, 27.0 overall, 31.0 for the graduates, 24.7 when without diploma. While lower-skilled women have lower fertility rates at any given age, as seen in Table 7, they start having children earlier. The distribution of completed families by size is: 7% without children, 21% with one child, 33% with two children, 25% with three children, 13% with four children or more. Abolishing the APE for the second born reduces the total fertility rate by 0.07, or about 1/30th of total fertility. This is the same order of magnitude as the static effect described in Section 5.

There are three important sources of bias in the above numbers. First, fertility is underestimated in the model because we miss the children born during the studies or in the two years following the end of studies (this probably contributes to the fertility differences by diploma). In the opposite direction, fertility is overestimated by the sample selection (women with a partner are more likely to have children than women without) and by keeping the other income of the household constant (while the husband's wage should increase with experience). Therefore, we consider the dynamic simulation results as merely illustrative, but indicating that the model, estimated on a cross section for a specific year, behaves reasonably when iterated and therefore may have some stability over time. This can only be confirmed with work on repeated cross sections or, better, panel data.

Concluding Remarks

Our descriptive study suggests that the extension of the APE in 1994 may have increased the number of births in France. At first glance, our structural modeling exercise seems to confirm this finding: according to our estimates, financial incentives play a non-negligible role in explaining fertility, and the extension of the APE may account for one half to three-quarters of the recent rise in the French birthrate. However, a closer look to our structural estimates suggests that this evidence should be taken with a grain of salt. As documented in section 4, economic variables appear to contribute little to explaining fertility on our sample. Moreover, our estimates of the sensitivity of fertility to financial incentives are higher for first-born children, and in fact are zero for births of rank 3 or more. This contradicts both common beliefs and intuition, according to which for many couples, the marginal decision is whether to have a third child; the French family benefit system indeed is built on this hypothesis, as it gives stronger financial incentives for a third child.

A pessimistic view of the results of this study may just be that the effect of economic variables on fertility is hard to isolate from the effect of demographic variables. Indeed, the measure of financial incentives through the function R also depends a lot on the very same demographic variables.

For first-born children, we of course have very few demographic variables at our disposal, and family benefits do not vary much across households; our finding of a strong effect thus may just be due to omitted variable bias. It is easier to account for births of rank 3, as we can rely on family composition variables and a much larger policy-induced variation in economic variables; and then economic variables do not seem to play a role anymore. It is likely that these variables have fairly small effects on fertility anyway, so that we need more and better data to measure them properly.

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Appendix

A model of fertility based on family composition

We present in the Appendix a variant of the model in the main text, where the fertility equation is focussed on the family size and composition. In order to limit the number of explanatory variables, we only consider women aged 25 to 35 (so that the sensitivity of fertility to income can be taken independent of age on this domain), living with a partner and with at most two children in the household. The sample retained for estimation contains 1,997 observations standing for 1 million women. There are 295 observations with a birth in 1999, representing 150,000 births, about 20% of the registered births in France during the year.

Table 10: Fertility

Variable	Coefficient	Standard error
First birth		
Married	0.571	0.135
Age of mother	-0.037	0.029
Constant	0.013	0.837
Second birth		
Married	0.145	0.121
Age of mother	-0.054	0.022
Age of child	-0.048	0.025
Child born in previous year	-1.255	0.213
Constant	0.893	0.652
Third birth		
Age of mother	-0.105	0.028
Age of last born	-0.009	0.052
Age of previous to last born	-0.071	0.046
Child aged less than 1	-178.3	-
Child between 1 and 2	-0.777	0.276
Child between 2 and 3	-0.134	0.194
Constant	2.512	0.900
R(0)/1000	0.062	0.049

Table 10 shows the estimated coefficients of the fertility equation, with their asymptotics standard errors. A number of coefficients are not statistically different from zero, probably because of the small size of the sample. We note that being legally married has a strong positive influence on the first birth (but the exogeneity of the variable is somewhat questionable). The other income of the household, represented with the disposable income $R(0)$ when the woman does not work, does enter positively, but is not statistically different from zero. Having a child born in the previous year, or indeed in the three past years, reduces the chance of a birth[12]. Fertility does not seem to be larger when the first two children are of the same gender.

One of the motivations for estimating this variant of the model is to see whether the results on the sensitivity of fertility to income vary with

[12]For families of two children, if the second one was born in 1998, there will not be any new birth in 1999: the coefficient is -178, i.e. essentially $-\infty$. There are 166 observations of two children families, with a birth in 1998 in the sample, and none of them saw a new birth in 1999.

Table 11: $1000 \times \alpha_v$

	Coefficient	Standard error
No child	0.778	0.360
One child	0.200	0.193
Two children	0.023	0.292
Three or more	0	—

the sample and specification. This can be done by comparing Table 11 with Table 6. In the model of the main text, α_v decreases linearly from a maximum at age 20 to zero at age A_v=38.1. Here α_v is assumed to be constant over the domain 25–35, so that it should approximately be equal to a half of the number appearing in Table 6. Given the large standard errors, the results appear to be consistent (if anything financial sensitivity here is larger for the first born, 0.778 instead of 0.65, smaller for the second born, 0.200 instead of 0.40). The absence of sensitivity to financial incentives for a third birth is confirmed.

Finally, Table 12 shows the fit of the model. As expected, the fit according to the parity of birth is, now by construction, close to perfect.

Table 12: The Fit of Fertility on the Sample

Criterion	Observations: Number	Observations: Fertility rate	Fit: Fertility rate
All	153,137	0.148	0.147
Rank of the birth			
Rank one	49,769	0.193	0.194
Rank two	74,498	0.202	0.204
Rank three or more	28,871	0.073	0.069
Presence of a young child			
$C_{-1} = 0$	149,693	0.171	0.170
$C_{-1} > 0$	3,444	0.020	0.019
Age of the mother			
25-26	27,284	0.206	0.230
27-28	32,471	0.189	0.186
29-30	36,701	0.183	0.165
31-35	56,682	0.107	0.107
Mother's diploma			
Graduate	11,724	0.141	0.154
Undergraduate	28,197	0.169	0.155
High school	34,440	0.169	0.158
Basic technical training	34,293	0.109	0.131
Junior high school	12,164	0.168	0.153
No diploma	32,319	0.164	0.148
Employment status			
Salaried in 1999	80,557	0.145	0.156
Unemployed	72,579	0.151	0.137