DISCUSSION PAPER SERIES

IZA DP No. 2513

# The Social Multiplier and Labour Market Participation of Mothers

Eric Maurin
Julie Moschion

December 2006

Forschungsinstitut
zur Zukunft der Arbeit
Institute for the Study
of Labor

# The Social Multiplier and Labour Market Participation of Mothers

**Eric Maurin**
*Paris School of Economics,*
*CEE, CEPR, CREST and IZA Bonn*

**Julie Moschion**
*CES, University of Paris 1*

Discussion Paper No. 2513
December 2006

IZA

P.O. Box 7240
53072 Bonn
Germany

Phone: +49-228-3894-0
Fax: +49-228-3894-180
E-mail: iza@iza.org

IZA Discussion Paper No. 2513
December 2006

# ABSTRACT

## The Social Multiplier and Labour Market Participation of Mothers*

A mother's decision to participate in the labour market is correlated with those of the other mothers living in the same neighbourhood. This paper studies the extent to which this is causal. An identification problem exists because mothers with similar characteristics are often observed living in close proximity. Our identifying strategy uses instrumental variables. Specifically, the sex of the eldest siblings of the other mothers living in the neighbourhood is used as an instrument to identify the effect of neighbours' participation in the labour market on own participation. The IV estimate suggests a strong elasticity of own participation to neighbours participation. Interestingly enough, estimates using the quarters of birth of the children of the other mothers living in the neighbourhood as instruments are as large as estimates using the sex-mix instruments. We provide additional evidence showing that the random fertility shocks that affect the timing of births and the participation in the labour market of a mother, affect the participation in the labour market of the other mothers in the neighbourhood too.

JEL Classification: J22

Keywords: female participation in the labour market, neighbourhood effects, social multiplier

Corresponding author:

Eric Maurin
Paris School of Economics (PSE)
48 Bd Jourdan
75014 Paris
France
E-mail: Eric.Maurin@ens.fr

* We thank participants at the "Social Interactions and Network" seminar of University Paris 1, at the CREST econometric seminar in Paris, at the European meeting of the Econometric Society in Vienna, at the meeting of the "Coalition Theory Network" in Warwick and at the annual meeting of the French Economic Association, for helpful comments.

## I. Introduction

This paper provides an evaluation of the influence of close neighbours on a mother's decision to participate in the labour market using a new French database. The question is whether the participation of a mother is influenced by that of the other mothers living in the same close neighbourhood. To the best of our knowledge, there is still very little micro-econometric evidence on this issue, even though neighbourhood effects have received much attention in the recent economic literature[4].

Generally speaking, the influence of neighbours' behaviour on individual behaviour can amplify the effect of small changes in the distribution of private incentives and resources. This amplification is known as a "social multiplier" (Cooper and John, 1988, Manski, 1993, Glaeser, Sacerdote and Scheinkman, 2003) and represents one important reason for the attention given to neighbourhood effects. For example, supporting a few women to find work may lead their neighbours to do the same and have a very large and persistent social effect. From a theoretical viewpoint, these imitative behaviours may reflect an intrinsic desire to behave like others. It may also be due to interactions in the constraints that neighbours face, so that the indirect utility of a given behaviour (for example, not working) depend on whether close neighbours do the same. It may also reflect interactions in information transmission, so that the choices of any single person modify the information available to all her neighbours.

These effects have long been identified as a potential explanation for the puzzling variations in labour market participation across subgroups of workers, across time periods or across areas (see e.g Alesina, Glaeser and Sacerdote, 2005). Empirical evidence remains very weak, however. As a matter of fact, researchers who try to identify empirically the influence of

[4] In his survey, Durlauf (2004) provides a description of a selection of twenty five recent studies on neighbourhood effects and none is about women's participation in the labour market. See also the multi-disciplinar survey by Dietz (2001) and the Canadian survey by Oreopoulos (2005). There exist a small literature on the effect of social interactions on the number of hours worked by men (see Grodner and Kniesner, 2006)

neighbours' behaviours on individual decisions have to face many difficult challenges. One basic issue is that neighbourhoods measured in available datasets are often considerably larger than those which matter for outcomes (i.e., close neighbourhoods). Sociological surveys on neighbourhood interactions suggest that we actually interact with a very little number of neighbours only (2 or 3 maximum, see Héran, 1986 for an interesting analysis of the French situation). In contrast, studies on neighbours' influence typically proxy neighbourhood with census tracts that is, with very large groups of people (several thousands). The survey used in this paper enables us to overcome this problem. The sampling unit consists of small groups of about 20 to 30 adjacent housings. It provides us with a large sample of mothers with detailed information on the situation of all the other mothers living in their close neighbourhood. It makes it possible to analyse how mothers living in adjacent houses actually influence each other[5].

Another basic issue is to isolate variations in neighbours' decisions which are exogenous to individual decisions. Women living in the same neighbourhood tend to take similar participation decision. It is unclear whether it is because they influence each other or because neighbours typically share the same background and the same preferences. Ideally, we would like to analyse the behaviour of each mother depending on whether we facilitate or not (experimentally) her neighbours' participation in the labour market[6]. Without such a controlled experiment, our strategy has to rely on the observation of variables which affect the decision of each woman, but which has, as such, no effect on her neighbourhood choice nor

[5]There exist a related literature which studies interactions among close neighbours, even though the focus is not on the labour market participation of women (see e.g., Ioannides, 2002, Ioannides, 2003, Ionnadies and Zabel, 2003, Case and Katz, 1991, Solon, Page and Duncan, 2000).Also Goux and Maurin (2006) use French Labour Force surveys to evaluate the effect of close neighbours on adolescents' educational outcomes.

[6] An example of quasi experiment is provided by the Moving to Opportunity demonstration. The demonstration provides housing vouchers to a randomly selected group of poor families in five American cities. Recent evaluation suggests that the program has significant effects on children's behaviour whereas the effects on adults are more mixed (see e.g. Goering, Feins and Richardson, 2002). Notice that it is not clear whether the effects of such programs are attributable to the shift in neighbourhood or to the increase in income (and/or housing quality) associated with voucher eligibility.

on her neighbours' decisions. Specifically, the first identification strategy used in this paper is based on the observation of the sex of the two eldest siblings of families.

As shown below, the sex of the two eldest siblings has a significant influence on the final number of children of a family and, consequently, on the participation in the labour market of the mother. These relations are observed in France as in the US (see e.g. Angrist and Evans, 1998). In contrast, the sex of the two eldest children has no perceptible influence on neighbourhood choice. Specifically, there is no significant difference between the actual distribution of families with same-sex siblings across neighbourhoods and the distribution that would be observed if these families were randomly assigned across neighbourhoods. Also there is no significant correlation between the sex of the two eldest siblings of a mother and the observed demographic characteristics of her close neighbours. Given these facts, the observed shifts in the proportion of same-sex siblings' families across neighbourhoods are interpretable as quasi-experimental random shocks to the proportion of close neighbours participating in the labour market. This is typically what is needed to isolate the influence of neighbours' participation in the labour market on individual's participation. Do mothers living near families with different-sex siblings participate more in the labour market than the other mothers?

The survey used in this paper provides us with a positive answer to this question. A mother's probability to participate in the labour market is significantly higher when the other mothers in her very close neighbourhood have different sex siblings than in the opposite case. This difference is observed regardless of whether her own eldest siblings are same-sex or not. Interestingly enough, the excess of participation in the labour market of a mother whose neighbours have different-sex siblings is approximately as big as the excess of participation of the neighbours themselves, due to their own children's sex. Assuming that the sex of neighbours' siblings influence a woman's participation only through its impact on their own

participation, this result suggests a strong causal impact of neighbours' participation on a woman's participation. Using the sex of neighbours' eldest children as an instrumental variable, we obtain an estimation of the elasticity of a woman's participation with respect to her close neighbours' participation of about 0.8.

We compare these findings to estimates produced using a completely different instrumental variable, i.e., the distribution of quarters of birth of the other children living in the neighbourhood. The participation of French mothers in the labour market is influenced not only by the sex of her siblings, but also by their quarter of birth. Children born at the end of the year cannot be sent at school as early as the other children and –because they are the less mature of their year-group- perform less well at the beginning of primary school. Within this context, mothers whose children were born at the end of the year are not less educated and do not have more children than the other mothers, but have nonetheless less incentive to work and more incentives to spend more time at home with their children. Our data confirm that they participate in the labour market significantly less than the other mothers. Hence, children's quarter of birth affects mothers' participation in the labour market, but has no perceptible effect on residential choices. The distribution of children's quarter of birth across neighbourhoods is actually not different from random assignment. Given these facts, the variations in the proportion of children born at the end of the year across neighbourhoods can be used exactly as the variation in the proportion of same-sex families to identify the endogenous social effect on mothers' labour market participation. Interestingly, the quarter-of–birth instrument provides us with almost exactly the same evaluation of the endogenous social effect as the same-sex instrument (i.e., 0.8). Also, it is worth emphasizing that our instruments, i.e., the proportion of mothers with same-sex children or with children born at the end of the year in the neighbourhood, do not have any significant effect on the labour market participation of fathers nor on the labour market participation of women without

children. This result is consistent with the assumption that a mother is influenced by the sex (and quarter of birth) of the siblings of the other mothers living in the neighbourhood only through social interactions and not because of correlated neighbourhood effects.

The timing of births is partly under the control of parents. Hence the age differences between siblings cannot be interpreted as pure random shocks to parents' decisions and cannot be used as instruments the same way as the sex (or quarter of birth) differences between siblings. That said, it is also well known and documented by demographers that the timing of births is affected by relatively large random fertility shocks and that it is not possible to chose the exact age difference between consecutive children. In the last section of this paper, we show that these random fertility shocks generate discontinuous variations in mothers' participation in the labour market and we investigate whether they also affect the participation of the other mothers living in the neighbourhood. Interestingly enough, the answer is positive which provides an additional piece of evidence of the effect of neighbours' behaviours on a mother's participation in the labour market.

The paper is organised as follows. The next Section provides a short discussion of related literature and Section III describes the data. Section IV shows the influence of the sex of the two eldest siblings on the labour market participation of French mothers. Section V provides several pieces of evidence suggesting that the sex of the two eldest siblings does not influence neighbourhood choice. Section VI estimates the (strong) influence on a mother's participation in the labour market of her neighbours' participation, using the sex of the two eldest siblings of the neighbours as an instrumental variable. Also we compare the estimates obtained with the quarter-of-birth instrument with those obtained with the sex-mix instrument. Section VII provides an additional comparison with the estimates obtained using the available information on the age difference between the two eldest siblings as a source of identification. Last section concludes.

## II . Related literature

This paper belongs to the literature which tries to clarify the contribution of social interactions on women's increased involvement in modern economies. We are not aware of studies analysing the influence of close neighbours on women's labour market decisions. Existing studies have mostly focused on social interactions between members of the same (broadly defined) family. For example, Fernandez, Fogli and Olivetti (2004) make use of the difference across US states in the impact of WWII on mothers' participation to show that a man who is brought up by a working mother is more likely to be married to a woman who works. The authors build on this result to argue that a determinant of the increase in women's involvement in the labour market has been the increasing number of men who, over time, grew up with a different family model. In a related paper, Neumark and Postlewaite (1998) suggest that women's decisions to participate in the labour market are influenced by the decision of their sisters and by the social status of their sisters in law (see also Del Boca, Locatelli and Pasqua, 2000). Woittiez and Kapteyn (1998) analyse the labour supply behaviour of married females using a survey in which questions where asked about the age and education of the people frequently met by the respondents. They show a correlation between a married woman's labour supply behaviour and the number of hours worked by the females who have the education and age indicated by the woman as typical of her social environment.

At a more general level, Goldin (2006) describes how each generation of women has been influenced by its immediate predecessors and how this process progressively altered the identity of women and shifted it from a family centred world to a more career oriented one. Goldin and Katz (2002) show that the extremely large effect of the pill on women's

educational and occupational choices cannot be fully understood without taking social interactions into account. They argue that when a woman decides to delay marriage, her potential spouses remain in the marriage market longer and, consequently, remain available to other women. Hence, any exogenous shock delaying one woman's marriage (such as pill availability) diminishes the cost for other women of delaying their own marriage and this creates social multiplier effects.

Our study can also be seen as a contribution to the literature analyzing the variation in labour market outcomes across areas or across subgroups of workers within areas. Alesina, Glaeser and Sacerdote (2005) argue that part of the very strong difference in labour market outcomes between the US and Europe is due to positive complementarities across people in the enjoyment of leisure time. They provide several pieces of evidence which support the assumption that one person's leisure increases the returns to other people's leisure. One such piece of evidence is the strong convergence to a common two days week-end (i.e., Saturday and Sunday) despite the many disadvantages of crowding infrastructure usage during five days and living this infrastructure underutilized during two other days.

## III. Data Description

The data used in this paper come from the 12 French Labour Force Surveys (LFS) conducted each year between 1990 and 2001 by the French Statistical Office (INSEE). The annual LFS is a large sample representative of the French population aged 15 or more ($N$=150,000, sampling rate=1/300). For each respondent, we have standard information on his date of birth, sex, family situation, place of birth, education, labour market participation (employed versus non-employed). Also, for each household, we know the number, sex and birth date of the children living in the home. In the remainder, we will focus on the sample of mothers 21 to 35

years old, living in two-parents families and having at least two children at the time of the survey ($N$ = 30,423). As Angrist and Evans (1998), we only have information on children still living with their parents. Focusing on mothers who are less than 35 prevents us from underestimating women's total number of children and from introducing errors on the rank of the children in the family. Women who are more than 35 possibly have adult children, i.e., children who have a higher probability of having left the parental home. Another interest of concentrating on 21-35 years old mothers is that our analysis of the links between the sex of the two eldest siblings and individual labour supply (first stage) will be directly comparable to Angrist and Evans'(1998) analysis on American data.

One key feature of the French LFS is that the basic sampling units actually consist of groups of about 20 adjacent households[7] (*aires*). More specifically, a typical LFS consists of a representative sample of about 3,500 *aires*. Each year, within each *aire*, all the households are surveyed and, within each household, all the persons aged 15 or more are surveyed. The French statistical office (INSEE) has chosen this sampling strategy in order to reduce the travelling expenses of the investigators who are in charge of the survey.

For each woman in our sample, we observe on average four other women with two or more children living in the same small neighbourhood (see Table A1). Hence, for each woman in our sample, we can construct several variables describing the average characteristics of the other families with two or more children living in her *aire*, namely the proportion of families in which the two eldest children are same sex, the proportion of families whose second child was born at the end of the year and the proportion of families where the mother participates in the labour market. Using the terminology of Manski (1993), the impact of other mothers' labour market participation on a mother's participation in the labour market corresponds the endogenous effect. Let us emphasize that, for each respondent, the different *aire*-level

[7] This is also a feature of the Panel Survey on Income Dynamics (PSID). See Gary Solon, Marianne Page and Greg Duncan, (2000). The sample of the PSID is much smaller than the LFS sample however.

indicators are constructed using only the information on the individuals who do not belong to the family of the respondent.

As far as we know, there is very little empirical evidence on the influence of neighbours on a mother's participation in the labour market. However, in the early 1980's, the French Statistical Office has carried out an interesting sociological survey on the intensity of social interactions within neighbourhoods (Héran, 1986). One of the clearest result is that we interact with a very little number of neighbours (2 or 3 on average). Also the relationships with neighbours are maintained mostly by women, and especially women with children. What emerges from this study is that mothers are actually much more exposed than others to the effect of neighbourhood interactions. The results of this study backs up our choice of focusing the analysis on women with children.

## IV. Sex of eldest siblings, fertility and participation in the labour market

Table 1 analyses the participation in the labour market of the mothers in our sample according to the sex of the two eldest siblings. Among mothers with same sex siblings, the proportion of working women (0.588) is 1.7 percentage points lower than among mothers with different sex siblings (0.605). This difference is perceptible regardless of whether the first born is a boy or a girl, even if it is more significant (2.2 points) when it is a boy. Mothers' participation is not as well measured in the general census of the population as in the LFS. However, we have checked that the last census of the population (carried out in 1999) provides the same result: mothers whose eldest children are same-sex work significantly less than others, the difference being a little more than 1.1 point in the census. Angrist and Evans (1998) find the same result in the US, even though the effect is not as strong in the US as in France.

There are several potential explanations to this relation between the sex of the eldest siblings and the participation of mother in the labour market (see e.g. Rosenzweig and Wolpin, 2000). Same-sex children may be less costly to rear and having same sex children may make it less urgent for a mother to work (direct effect). The most plausible explanation is indirect, however: the sex of the eldest siblings influences the participation of mothers because it affects the final number of children in the family. French and American mothers with two girls or two boys are more likely to have a third child than mothers who already have a boy and a girl (see Goux and Maurin, 2005; Angrist and Evans, 1998). Table 1 confirms that the proportion of families with at least three children is about 4 points higher in families where the eldest siblings are same-sex (31.5%) than in families where the eldest siblings are different sex (27.7%). Table 2 shows that these differences in the final number of children cannot be explained by differences in the standard individual determinants of fertility. There is no significant difference in age, education level, nationality or in birth timing between mothers according to the sex of their eldest siblings.

Table A2 in Appendix reports the results of regressions showing that the effect of the sex of the two eldest siblings on the probability of having a third child (about 3.7 percent points) or on the probability of participating in the labour market (about 1.7 percent points) is almost exactly the same regardless of whether we use a detailed set of socio-demographic control variables or not. These regressions confirm that the relationships between the sex of the two eldest siblings and mothers' outcomes are not due to variation in the socio-demographic characteristics of mothers according to the sex of their eldest children. What is at stake here really seems to be a preference of parents for mixed sex siblings and it is this preference that influences mothers' participation decisions.

These results are consistent with the literature, and notably with the results of Angrist and Evans (1998): the sex of the two eldest siblings affects the total number of children, but also the participation of mothers in the labour market. The magnitude of the effect of children's sex on fertility and participation is however different in their study on American data than in our French study, even though the method and the samples are defined the same way. The sex of the two eldest siblings have a smaller impact on fertility in France than in the United States (about 6 points in the United States against 4 points here), but a higher impact on mothers' participation (-0.5 points in the US against -1.7 in France).

Assuming that the sex of the eldest siblings affects the participation of mothers only because it influences the total number of children, the ratio between the impact of the sex of the two eldest siblings on participation and its impact on fertility provides us with an estimate of the causal effect of having a third child on the mothers' probability of participating in the labour market. This Wald estimate (about -0.4) suggests a higher elasticity in France than that estimated by Angrist and Evans (1998) in the US (about -0.1). The total number of children seems to have a more negative impact on mothers' participation in France than in the US. This difference has plausibly deep institutional causes, which analysis would exceed the scope of this paper. For now, it is enough remembering that the sex of the two eldest siblings influences the participation of French mothers more than American ones and that this is probably because the effect of the number of children on mothers' participation is more negative in France than in the US.

## V. Sex of eldest siblings and neighbourhood choice

The sex of the eldest siblings affects the decision of having a third child, which in turn often entails a residential change. Hence, we cannot exclude that the sex of the two eldest siblings

also determines (indirectly) the neighbourhood in which mothers bring up their children and take their labour market decisions.

If this was the case, the sex of the two eldest siblings of a family would be correlated with the sex of the two eldest siblings of other families in the neighbourhood and families with same-sex eldest children would not be randomly distributed across neighbourhoods. They would be concentrated in some specific neighbourhoods. To test this assumption we have compared the actual distribution of the number of families with same-sex eldest children across neighbourhoods with the distribution that would be observed if these families were randomly assigned across neighbourhoods[8]. Table 3 shows that the two distributions are very similar. A chi-squared test does not reject the random assignment assumption at standard level. Table A3 in the appendix demonstrates that the distribution of families with same-sex eldest children is actually not distinguishable from random assignment even when we make the comparison conditional on the number of families living in the neighbourhood.

Overall, our data do not show any significant residential concentration of families with same-sex eldest children. Table 4 further confirms that there is no correlation between the sex of the eldest siblings of a mother and the demographic characteristics of the other mothers in the neighbourhood. Specifically there is no correlation between the sex of the eldest siblings of a mother and the age, education or nationality of the other mothers in the neighbourhood. Also, the sex of the two eldest children of a mother is not correlated with the number of children of the other families in the neighbourhood. The average number of children of neighbours is exactly the same when own eldest children are same-sex as when they are not same-sex.

## VI. The influence of neighbours' behaviour on own behaviour

[8]Under the random assignment assumption, the probability of observing $k$ same-sex families in a neighbourhood of size $n$ is simply $C(n,k)P^k (1-P)^{n-k}$ where $P$ denotes the proportion of same-sex families in the population;

The sex of the two eldest children of a woman is a determining factor of her participation in the labour market. On the other hand, the distribution of families with same-sex eldest children across neighbourhoods is not distinguishable from random assignment. Given these facts, the variation across neighbourhoods in the proportion of families with same-sex eldest children provides us with a plausible instrument to identify the effect of neighbours' participation on a mother's participation in the labour market. It is interpretable as a random shock to neighbours' participation. To be more specific, assume that the participation decisions of family *i* can be described by the following reduced-form equation:

$$(1) \qquad P_i = aVP_i + bS_i + u_i$$

where $S_i$ indicates whether the two eldest children are same sex, $P_i$ indicates if the mother participates in the labour market and $VP_i$ represents the proportion of *i*'s neighbours who participate in the labour market. The variable $u_i$ represents the set of individual and/or contextual factors (other than $VP_i$ and $S_i$) that affects the participation decision of *i*. The parameter *a* represents the influence of the context that we want to identify, the parameter *b* represents the set of direct and indirect influences (particularly via the size of the sibship) of the sex of the two eldest siblings on the participation decisions. Formally, this linear-in-means model describes the equilibrium decisions of mothers who – conditional on neighbourhood membership – take their decisions $P_i$ in order to maximize a conformist indirect utility function which decreases with the squared distance between $P_i$ and the expected decisions of neighbours[9]. For the sake of simplicity, mothers are assumed to anticipate exactly their neighbours' decisions.

Averaging equation (1) across neigbours and reorganizing, the proportion $VP_i$ can be written :

$$(2) \qquad VP_i = cVS_i + dS_i + v_i$$

[9]Such a conformist utility function is used by Akerlof (1997). See further discussion of the linear-in-means model in Manski (1993) or Brock and Durlauf (2001).

where $VS_i$ represents the proportion of neighbours having same sex children, where the new error term $v_i$ is a linear combination of the $u_j$ residuals affecting the decisions $P_j$ of $i$'s neighbours, and the parameter $c$ is proportional to $b$ and the parameter $d$ is proportional to $ab$. Assuming that $S$ actually affects $P$ and that it is uncorrelated with the error terms, $VS$ affects $VP$ and is uncorrelated with the error terms. Put differently, under the two assumptions $b \neq 0$ and $E(Su) = 0$, $VS$ provides us with a plausible instrument for identifying the effect of $VP$ on $P$, i.e. it affects the individual participation of a mother $P$ only insofar as it affects the participation of the other mothers in the neighbourhood $VP$. The next section proposes an evaluation of $a$ using this instrumental variable.

## A Results

The first column of Table 5 shows the results of the estimation of equation (2). This first stage regression confirms the existence of a significant negative effect of the proportion of neighbours having same-sex children on their own rate of labour market participation. The proportion of mothers participating in the labour market is 2.2 percentage points larger when their siblings are different-sex than when they are same-sex[10]. The second column presents the regression of a woman's participation in the labour market on the sex of her two eldest children and the sex of the two eldest children of the other women living in the neighbourhood. Interestingly enough, this reduced form equation shows the existence of a significant effect of the proportion of same-sex neighbours on a woman's participation in the labour market. The size of this effect is as large as that of the direct effect of her children's sex on her own participation. A mother's probability to participate in the labour market is 1.8

[10]Interestingly, the first-stage impact of the same-sex instrument on neighbours' participation (0.22) is greater than its effect on individual participation (0.18) which is consistent with the prediction that social effects generate an excess variation in aggregate outcomes at the neighbourhood level. The same result will hold true with the other set of instruments used in this paper.

percent points larger when the other mothers have different-sex rather than same-sex siblings. The sex composition of the siblings of neighbours has almost the same effect on a woman's participation than on the participation of her neighbours themselves. This result suggests a strong elasticity of a woman's participation to that of her neighbours. As a matter of fact, the elasticity estimated by the IV method is 0.8 (column 4). A 10 percent points increase in the proportion of neighbours participating in the labour market generates an 8 percent points increase in the probability of participation of a woman.

As discussed above there is no significant correlation between the number of children of a mother and the sex of the siblings of her neighbours. Given this fact, the correlation between the labour market participation of a mother and the sex of the siblings of her neighbours cannot be interpreted as reflecting the impact of family size on labour market participation. The last column of Table 5 confirms that our IV estimate remains almost exactly the same when we add family size as a supplementary control variable.

Table 6 provides an alternative evaluation using a characterization of the sex composition of the siblings by a complete set of four dummies (boy-girl, girl-boy, girl-girl, and boy-boy being the ref.) rather than by a single same-sex dummy variable. The first-stage *F*-statistics shows that the proportions boy-girl, girl-boy and girl-girl in the neighbourhood represents a set of relatively powerful instruments ($P<.01$). The IV estimates are very similar to those obtained in Table 5, but better estimated. The over-identifying restrictions are not rejected at standard level. Comfortingly, the sex composition of the siblings has the same impact on own participation in the labour market as on neighbours' participation. Mothers with two boys participate relatively less than other mothers. Also, they increase the participation of their neighbours relatively less than other mothers. In contrast, mothers with a boy and a girl participate relatively more and increase the participation of their neighbours relatively more than the other mothers.

Lastly we have checked that there is no significant difference in the labour market participation of fathers - nor in the labour market participation of women without children - with respect to the sex of the siblings of the mothers living in the same neighbourhood (Table A4). This result is consistent with the assumption that a mother is influenced by the sex of the siblings of the other mothers in the neighbourhood because of social interactions and not because of correlated neighbourhood effects.

In table 5, the IV estimate is much higher than the OLS estimate (0.2), even if strictly speaking the difference between the two estimates is not significant. It is something of a puzzle, since endogenous neighbourhood selection is typically likely to bias OLS coefficient upward[11]. One possible explanation is that we measure *P* with an error that affects mechanically *VP*, the explanatory variable of interest. This results in an attenuation bias on the OLS estimate. The bias is all the more significant that the variance of the errors is large. If this interpretation is correct, the difference between the OLS and the IV estimate should decrease when focusing on neighbourhoods with more mothers (i.e., a smaller variance in the error affecting the measurement of *VP*). This is actually what we observe: the OLS estimate is about three times as large (about 0.5) when we restrict the sample to neighbourhoods with at least 7 neighbours, whereas the IV estimate is almost unchanged (see Table 7).

### B. A re-evaluation using children's quarter of birth as an instrument

This section compares the estimates produced using the sex-mix instrument to estimates obtained with the distribution of quarters of birth of the other children in the neighbourhood.

[11]Interestingly enough, comparing experimental and non-experimental estimates, Kling et al. (2004) do not find evidence of upward bias from non-random sorting of households across neighbourhoods, as would occur under assumption that persons with good unobservables have also good outcomes and live in good neighbourhood. A similar finding is reported by Goux and Maurin (2006) in their analysis of neighbourhood effects on early performance at school.

Specifically, our second identifying strategy builds on the fact that French mothers' whose children were born at the end of the year participate less in the labour market than other mothers, due to specific feature of the French pre-elementary and elementary schools.

Children born at the end of the year cannot attend school as early as the other children, because of the specific enrolment rules of French pre-elementary schools[12]. Also, pupils born at the end of the year are the youngest of their year-group and, as a consequence, perform less well at the beginning of primary school[13]. Within this framework, mothers whose children were born at the end of the year have more incentive to stay at home with their children and less incentive to work.

When we focus on the sample of mothers with two or more children, our data confirm that those whose second child was born at the end of the year participate significantly less in the labour market than the other mothers (Table 8, first column). Also the two last column of Table A2 in the appendix shows that this participation gap cannot be explained by variation in births' seasonality across mothers' with different background. The effect of second child's quarter of birth on participation in the labour market is almost exactly the same regardless of whether we control for mother's education, age, nationality or not. As a matter of fact, Table 8 confirms that mothers whose second child was born during the last quarter of the year are neither more educated nor more often non-French than the other mothers. They do not have more children neither. Also, the LFS data do not reveal any specific residential concentration of families whose second children were born at the end of the year. The distribution of

[12] In France, the majority of children begin pre-elementary public school in september of the year of their third birthday. A significant fraction (about 30%) are even allowed to begin school one year earlier, in september of the year of their second birthday. School heads are asked to give priority to children whose second birthday is before September, however (i.e., to children who are actually 2 years old in September). As a consequence, the proportion of early starters is much weaker for children born after September (18%) than for children born before September (40%). Parents whose children were born at the end of the year have less access to this specific form of free child-care and more incentives to stay at home to take care of their children than other parents.

[13] The national evaluations conducted each year at entry into third grade show an average difference of about 1/2 of a standard deviation between the scores of children born in January (the most mature of their year-group) and those of children born in December (the least mature).

families whose second child was born at the end of the year across neighbourhoods is not distinguishable from random assignment (see chi-squared tests in Table 9 and Table A5 in the Appendix). Table 10 confirms that there is no significant correlation between the quarter of birth of the second child and the demographic characteristics of the other mothers in the neighbourhood.

Given these facts, the variation across neighbourhoods in the proportion of mothers whose second child was born at the end of the year provides us with a plausible alternative instrument for identifying the impact on a mother's labour market participation of the participation of the other mothers living in the same neighbourhood.

The first-stage regression confirms that the proportion of mothers in the neighbourhood who participate in the labour market is negatively correlated with the proportion of mothers whose second-born children were born at the end of the year (Table 11, column 1). Most interestingly, the reduced-form regression reveals that a mother's probability of participating in the labour market is significantly reduced when the second child of the other mothers were born at the end rather than at the beginning of the year. The last column shows the result of a regression of a mother's participation in the labour market on the participation of the other mothers, using the quarter of birth of the second child of the other mothers as an instrumental variable. The IV estimate is as large as the estimate obtained with the sex-mix instrument.

Table 12 shows the results of first-stage and second-stage regressions when we use jointly the same-sex and quarter-of-birth instruments to identify the endogenous social effects. The first-stage *F*-statistics shows that the proportions of same-sex and of second child born at the end of the year in the neighbourhood represent a set of powerful instruments. Also over-identification restrictions are not rejected. We find almost exactly the same IV estimates as when the instruments are used separately, but they are estimated much more precisely.

## VII. Additional Evidence Using Information on Age Difference between Eldest Siblings in the Neighbourhood

In each family, the age difference between the two eldest siblings (*D*) may be interpreted as the combination $D^*+z$ of an age difference $D^*$ desired by the parents[14] and a fertility hazard *z* which is not under their control. If we observed *z*, we could use the same strategy as before and analyse the link between a mother's participation *P* in the labour market and the fertility shocks (*Vz*) that have affected the participation of her neighbours. The problem is that we do not observe *z*, but only *D*, which cannot be interpreted as an exogenous shock on individual participation in the labour market. The observed age difference *D* depends directly on the desired age difference $D^*$ and, as such, expresses a choice of parents[15]. This choice has plausibly been determined by the same unobservable characteristics as their participation in the labour market. As these unobservables are also likely to influence the neighbourhood choice, the variations in a mother's participation according to the age difference between neighbours' eldest siblings do not necessarily reflect the influence of social context on individual participation.

Using available knowledge on the distribution of fertility random shocks *z* enables us to overcome this problem. Demographic studies[16] show that a woman aged 25-30 having stopped contraception has a probability of becoming pregnant each month of about 0.25, i.e. a probability $P_t = 0.25(1-0.25)^t$ of becoming pregnant *t* months after having stopped contraception (with our notations, $P_t$ is the probability of observing $z = t$). Assuming that fertility random shocks are independent of parents' preferences and characteristics, the distributions of desired and observed age difference are linked by the following relationship:

[14] This desired difference can be defined as the age of the eldest child when the mother stops contraception to have a second child.
[15] If *P* is easier when *D* is higher, women with the strongest preference for participation will precisely choose the highest $D^*$. In such a case, the correlation between *P* and *D* is indeed the combination of *D*'s true effect on *P* and a selection effect.
[16] See for example, Cazelli et al. (2002).

$$\Pr(D = k) = \Pr(D^* = k)P_0 + ... + \Pr(D^* = k - t)P_t + ... + \Pr(D^* = 10)P_{k-10}$$

Knowing the $P_t$, it is easy to invert this formula and express the distribution of desired age differences as a function of the observed age differences. We can then reconstitute the distribution of fertility random shocks *z* within groups of families sharing the same observed age difference *D*[17]. Table A6 in Appendix A provides us with a detailed description of these distributions. Unsurprisingly, the probability of observing a small fertility shock (z < 3 months) is maximum for mothers whose age difference between their eldest children is minimum (i.e. 9-12 months). By definition, women with a 9-12 months age difference between their two eldest children got pregnant almost immediately after their first pregnancy and the random fertility shock cannot have been large in their case. In contrast, groups of mothers with a higher age difference between their two eldest children are a mix of mothers having incurred small and large fertility shocks. Focusing on groups of mothers with an age difference between the two eldest children comprised between *k = 5* and *k = 10* quarters[18], the probability of small random shocks (< 3 months) is about 65%, whereas the proportion of 3-5 months random shocks stays close to 25% and the proportion of 6-8 months random shocks about 10% (higher random shocks are statistically negligible). Interestingly enough, this probability distribution is very close to the distribution obtained by recent medical studies using prospective data on time to pregnancy (Gnoth et al., 2003). These results enable us to recover the evolution of the latent distribution of desired age difference *D** when the observed age difference *D* increases from (say) *D = k-1* to *D = k* quarters: it mostly consists in substituting (a) about 65% of *D* = k* to the same proportion of *D* = k-1*, (b) about 25% of *D* = k-1* to the same proportion of *D* = k-2*, and (c) about 10% of *D* = k-2* to the same proportion of *D* = k-3*. In other words, each elementary variation of *D* is accompanied by a

[17] The probability of observing *z = t* conditionally on *D = k* is (*$P_t$ Prob(D*=k-t)/Prob(D=k)*).
[18] We consider the age difference in quarters to have enough families in each group (defined by the same age difference between eldest siblings).

mix of elementary variations in *D**, this mix evolving progressively as *D* increases. Given this fact, the variations in mothers participation in the labour market according to the age difference between their two eldest siblings is partly explained by a composition effect (i.e., unobserved elementary variations in *D** distribution), but this composition effect has the particularity to vary progressively only with *D*, because of the smoothing effect of the random shock *z*. This result enables us to propose an identification strategy based on the discontinuity of the link between *D* and *P*.

### A. Discontinuity in women's participation in the labour market

The last column of table 13 shows the variation in *P* as the age difference between the two eldest siblings *D* increases from 3 quarters to 11 quarters. For reasons that will soon become clear, we focus on the variations observed before and after *D=7* quarters. Unsurprisingly, the participation increases significantly with *D*, the participation gap being of about 16 percentage points between the mothers whose age difference between the two eldest siblings is 11 quarters (61.5%) and the ones with a difference of only 4 quarters (45.5%). Interestingly, this rise is highly discontinuous, most of the increase being observed between *D = 6* and *D= 7* quarters (+6.5 points). The increase between *D = 6* and *D= 7* quarters is three times as big as it is on average between *D = 4* and *D= 6* quarters and six times as big as it is on average between *D = 7* and *D= 9* quarters. Actually, we observe no significant increase between *D = 7* and *D= 8* quarters, which means not only that this elementary variation of *D* has no significant effect on *P*, but also that there is no significant composition effect associated with elementary substitutions of families of type *D** = 8, 7 or 6 to families of type *D** = 7, 6, or 5. Also, the relative weakness of the rise in participation when *D* increases from 4 to 6 (compared to the rise observed between 6 and 7) indicates that elementary substitutions of

families of type $D^* = 6$ or 5 to families of type $D^* = 5$, or 4 can only account for a small part of the rise observed when $D$ increases from 6 to 7. As a matter of fact, the small variations of $P$ before and after $D = 6$ quarters allows us to interpret the important rise between $D = 6$ and $D = 7$ quarters as the pure effect of this elementary variation in age difference. Whatever their latent preferences $D^*$, mothers whose oldest sibling is a little less than two years old after the birth of the second child seem significantly more reluctant to come back in the labour market than the ones whose eldest sibling is a little more than two years old. Two years old is a crucial threshold in the development of children and this may explain our result.

### B. An evaluation of contextual effects using a regression-discontinuity design

Assuming that the increase in individual participation between $D = 6$ and $D = 7$ quarters really comes from a true effect of $D$ on $P$ (and not from self-selection), the next question is whether a mother's participation in the labour market increases when the age difference of her *neighbours*' eldest siblings is 7 quarters rather than 6 quarters. Interestingly, the column 2 of Table 14 provides us with a positive answer to this question: a mother's participation in the labour market increases significantly (by 8 percentage points) when her neighbours' eldest siblings are characterised by an age difference of 7 quarters rather than 6 quarters. In contrast, we do not observe any significant variation in individual participation associated with changes in the proportion of neighbours having age differences between their children of $D$=4, 5 or 6 quarters. Similarly, we do not observe any significant variation for change in the proportion with $D$=7, 8 or 9 quarters. In other words, the participation of a mother in the labour market and that of her neighbours vary in the same discontinuous way according to the age difference of neighbours' siblings. Under the maintained assumption that the proportion of 6 quarters' age difference relative to 7 quarters' is exogenous to the neighbourhood choice process, it

provides us with another way to identify contextual effects on mothers' participation in the labour market. The last column of Table 15 proposes a revaluation of the effect of neighbours' participation on individual participation using this discontinuity as a source of identification. This strategy gives us an endogenous effect of about 0.5 and provides us with another piece of evidence on the strong effect of neighbours' behaviours on own participation decisions.

## VIII. Conclusion

A mother's decision to participate in the labour market is correlated with those of the other mothers living in the same neighbourhood. This studies the extent to which this is causal. Our identifying strategy uses instrumental variables. In France, the sex of the two eldest siblings has a significant impact on the decision of mothers to participate in the labour market. In contrast, the sex of the two eldest siblings does not have any perceptible effect on neighbourhood choice. Given these facts, the distribution of the sex of the eldest siblings of the neighbours provides us with a plausible instrument to identify the effect of neighbours' participation in the labour market on own participation. Interestingly enough, the reduced-form analysis shows a significant influence of the sex of the neighbours' siblings on own participation and the IV estimate suggests a very strong elasticity of own participation to neighbours participation. We compare this result to estimates produced using the distribution of children's quarters of birth to generate instruments. Mothers whose children were born during the fourth quarter of the year cannot send their children to pre-elementary school as early as the other mothers and participate less in the labour market. Estimates using the distribution of quarters of birth in the neighbourhood as instruments are as strong as estimates using the sex-mix instrument. Understanding variation in women's labour supply across areas

and over time is a very difficult task. This paper suggests that one plausible explanation is the existence of a strong social multiplier, where the utility of not working is strongly linked to the proportion of close neighbours who do not work.

**References:**


Akerlof, Georges A., (1997), "Social Distance and Social Decisions", *Econometrica,* 65 (5), 1005-1027.

Alesina, Alberto, Edward Glaeser, and Bruce Sacerdote (2005), "Work and Leisure in the US and Europe: Why so Different?", *Unpublished Manuscript.*

Angrist Joshua D. and Evans, William N., (1998) "Children and Their Parents' Labour Supply: Evidence from Exogenous Variation in Family Size," *American Economic Review,* vol. 88(3), 450-77.

Brock, William A. and Steven N. Durlauf, (2001), "Interaction-based models", in *Handbook of Econometrics*, vol:V, James J. Heckman and Edward E. Leamer eds, Amsterdam: Noth-Holland, 3297-3380.

Case, Anne C. and Lawrence F. Katz, (1991), "The Company You Keep: The Effects of Family and Neighbourhood on Disadvantaged Youths," *NBER Working Paper 3705*, National Bureau of Economic Research, Cambridge, MA.

Cazelli, G., J. Vallin, G. Wunsch, (2002), *Démographie : analyse et synthèse II. Les déterminants de la fécondité*, Institut National Etudes Démographiques, Paris**.**

Cooper, Russell and Andrew John, (1988), "Coordinating coordination failures in Keynesian models", *Quarterly Journal of Economics*, 103 (3), 441-463.

Del Boca, Daniela, Locatelli, Marilena and Silvia, Pasqua (2000), " Employment Decisions of Married Women: Evidence and Explanations," *Labour*, 14 (1), 35-52.

Dietz, Robert (2001), "Estimation of Neighbourhood Effects in the Social Sciences: An Interdisciplinary Literature Review", *Social Sciences Research*, 31, 4, 539-575.

Durlauf, Steven N. , (2004), "Neighborhood Effects", in *Handbook of Regional and Urban Economics,* vol. 4, J.V. Henderson and J.F.Thisse eds., Amsterdam: North Holland.

Fernandez, Raquel, Alessandra Fogli and Claudia Olivetti (2004), "Mothers and Sons: Preference Development and Female Labor Force Dynamics," *Quarterly Journal of Economics*, 119(4): 1249-1299.

Glaeser, Edward L., Bruce L. Sacerdote and Jose A. Scheinkman, (2003), "The Social Multiplier", *Journal of the European Economic Association,* Vol:2-3, 345-355.

Gnoth C., D. Godehardt, E. Godehardt, P. Frank-Herrmann, and G. Freundl, (2003), “Time to Pregnancy: Results of the German Prospective Study and Impact on the Management of Infertility”, *Human Reproduction*, 18 (9), 1959-1966.

Goering, John, Judith Feins, and Todd Richardson (2002), “A Cross-Site Analysis of Initial Moving to Opportunity Demonstration Results”, *Journal of Housing Research*, 13(1):1-30

Goldin, Claudia (2006), “The Quiet Revolution That Transformed Women’s Employment, Education and Family”, *NBER Working Paper 11953*, National Bureau of Economic Research, Cambridge, MA.

Goldin, Claudia, and Lawrence F. Katz (2002), “The Power of the Pill: Oral Contraceptives and Women’s Career and Marriage Decisions”, *Journal of Political Economy*, 110 (4), 730-70.

Goux, Dominique, and Eric Maurin (2005), “The Effect of Overcrowded Housing on Children’s Performance at School”, *Journal of Public Economics*, 89, 797-819.

Goux, Dominique, and Eric Maurin, (2006), “Close Neighbours Matter: Neighbourhood Effects on Early Performance at School”, IZA DP n°2095, forthcoming *Economic Journal*.

Grodner, Andrew, and Thomas J. Kniesner, (2006), “An Empirical Model of Labor Supply with Social Interactions: Econometric Issues and Tax Policies Implications”, *Unpublished Manuscript*.

Héran, François, (1986), "Comment les Français voisinent", *Economie et Statistique*, n° 195, 43-59.

Ioannides, Yannis M., (2002), "Residential Neighbourhood Effects", *Regional Science and Urban Economics*, 32, 2, 145-165.

Ioannides, Yannis M.,(2003), "Interactive Property Valuations", *Journal of Urban Economics*, 56, 435-457.

Ionnadies, Yannis M. and Jeffrey E. Zabel, (2003), "Neighbourhood Effects and Housing Demand", *Journal of Applied Econometrics*, 18, 563-584.

Kling, Jeffrey R., Jeffrey Liebman, and Lawrence R. Katz, (2004), "Experimental Analysis of Neighbourhood Effects", forthcoming, *Econometrica*.

Manski, Charles F. (1993) "Identification of Endogenous Social Effects : The Reflection Problem ", *Review of Economic Studies*, 60:531-542.

Neumark, David and Andrew Postlewaite, (1998) “Relative Income Concerns and the Rise in Married Women's Employment", *Journal of Public Economics*, 70, pp. 157-183.

Oreopoulos Philip, (2005), “Neighbourhood Effects in Canada: a Critique”, *Unpublished Manuscript*.

Rosenzweig, Mark R. and Kenneth I. Wolpin, (2000) “Natural “Natural Experiment” in Economics”, *Journal of Economic Literature*, vol. 38(4), 827-874.

Solon, Gary, Marianne E. Page, and Greg J. Duncan, 2000, "Correlation between Neighboring Children in their Subsequent Educational Attainment", *Review of Economics and Statistics*, 82 (3), 383-392.

Woittiez, Isolde and Arie Kapteyn, (1998), “Social Interactions and Habit Formation in a Model of Female Labour Supply”, *Journal of Public Economics*, 70, 185-205.

**Table 1**: Impact of the Sex of the Two Eldest Children on Mothers' Fertility and Participation

| | Sex of the two eldest children | | | | | | |
|---|---|---|---|---|---|---|---|
| | 2 boys | 2 girls | boy, girl | girl, boy | Same sex (1) | Different sex (2) | Difference (1)-(2) |
| Proportion in population | .262 (.002) | .242 (.002) | .250 (.002) | .246 (.002) | .504 (.002) | .496 (.002) | .008 (.002) |
| Proportion 3 children or more | .315 (.005) | .316 (.005) | .273 (.005) | .282 (.005) | .315 (.004) | .277 (.004) | .038 (.005) |
| Proportion participating in labor market | .585 (.006) | .590 (.006) | .610 (.006) | .601 (.006) | .588 (.004) | .605 (.004) | -.017 (.006) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.

**Table 2:** Demographic Differences between Mothers According to the Sex of their Two Eldest Children .

| | Individual characteristics of mothers | | | | |
|---|---|---|---|---|---|
| | Age | Age at first birth | [French=1] | Nb. Children | [High school grad.=1] |
| Same sex (MS) | 31.03 (.02) | 22.95 (.03) | .910 (.002) | 2.42 (.006) | .711 (.004) |
| Different sex (SD) | 31.03 (.02) | 22.96 (.03) | .914 (.002) | 2.37 (.006) | .711 (.004) |
| Difference MS-SD | .0030 (.036) | -.013 (.040) | -.004 (.003) | .058* (.008) | -.0012 (.0052) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, with two children or more.

**Table 3:** The Distribution of Families with Same-Sex Children across Neighbourhoods and its Distance to Random Assignment.

| Nb mothers with same-sex eldest siblings | Observed distribution of neighbourhoods (P, in %) | Distribution under random assignment assumption ($P_0$, in %) | $n(P-P_0)^2/P_0$ |
|---|---|---|---|
| 0 | 12.99 | 11.84 | .1408 |
| 1 | 3.74 | 31.1 | .3163 |
| 2 | 28.46 | 28.25 | .1162 |
| 3 | 14.47 | 14.3 | .1498 |
| 4 | 7.09 | 7.32 | .5597 |
| 5 | 3.41 | 3.45 | .0352 |
| 6 et + | 3.84 | 3.74 | .1953 |
| Chi-2 stat. | - | - | 1.51 |
| (P-value) | | | (.95) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.
Reading: We observe 11.99 % neighbourhoods without any same-sex families. The proportion would be 11.84% if same-sex families were randomly assigned across neighbourhoods. A chi-squared test does not reject the random assignment assumption

**Table 4:** Demographic Differences Between Other Mothers in the Neighbourhood According to the Sex of the Eldest Children of a Mother.

| | Average characteristics of other mothers in the neighbourhood | | | | |
|---|---|---|---|---|---|
| | Age | Age at first birth | [French=1] | Nb. Children | [High school grad.=1] |
| Same sex (MS) | 31.0 (.02) | 22.95 (.03) | .911 (.002) | 2.39 (.006) | .711 (.004) |
| Different sex (SD) | 31.0 (.02) | 22.96 (.03) | .912 (.002) | 2.39 (.006) | .711 (.004) |
| Difference MS-SD | .00 (.04) | -.01 (.04) | -.004 (.003) | .00 (.01) | .000 (.005) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, with two children or more.

**Table 5 :** The Endogenous Effect on Mothers' Labour Market Participation : an Evaluation using the Proportion of Same-Sex Families in the Neighbourhood as an Instrumental Variable.

| Independent Variables | | Dependent variable : [Participation Lab. Market=1] | | | |
|---|---|---|---|---|---|
| | First stage (1) | Reduced form | OLS | IV | IV |
| *Characteristics of other mothers in the neighbourhood* | | | | | |
| % [Participation L.M. =1] | - | - | .19 | .80 | .81 |
| | | | (.01) | (.44) | (.43). |
| % [Same Sex=1] | -.022 | -.018 | - | - | |
| | (.006) | (.009) | | | |
| *Individual Characteristics* | | | | | |
| [Same Sex=1] | -.07 | -.018 | -.016 | -.012 | -.003 |
| | (.004) | (.006) | (.006) | (.007) | (.006) |
| [Three children or more=1] | - | - | - | - | -0.16 |
| | | | | | (.02) |
| Nb of Obs. | 30423 | 30423 | 30423 | 30423 | 30423 |

Source: LFS, t=1991 to 2002, Insee. Sample : Women aged 21-35 years old, with two children or more.
Note (1): The dependent variable of the first-stage regression is the proportion of other mothers in the neighbourhood participating in the labour market. The dependent variable of the other regression is the individual participation in the labour market.

**Table 6 :** The Endogenous Effect on Mothers' Labour Market Participation : an Evaluation using the Sex Composition of Other Families in the Neighbourhood as an Instrument.

| Independent variables | | Dependent variable : [Participation Lab. Market=1] | | | |
|---|---|---|---|---|---|
| | First stage (1) | Reduced-form | OLS | IV | IV |
| *Characteristics of other mothers in neighbourhood* | | | | | |
| % [Participation L.M. =1] | - | - | .19 (.01) | .93 (.42) | .95 (.42) |
| % [boy-girl=1] | .029 (.008) | .030 (.013) | - | - | - |
| % [girl-boy=1] | .024 (.008) | .027 (.013) | - | - | - |
| % [girl-girl=1] | .010 (.008) | .022 (.013) | - | - | - |
| % [boy-boy=1] | ref | ref | - | - | - |
| *Individual Characteristics* | | | | | |
| [boy-girl=1] | .011 (.005) | .025 (.008) | .023 (.008) | .015 (.010) | .003 (.009) |
| [girl-boy=1] | .010 (.005) | .015 (.008) | .013 (.008) | .006 (.010) | -.003 (.009) |
| [girl-girl=1] | .008 (.005) | .005 (.008) | .003 (.008) | -.003 (.009) | -.003 (.009) |
| [boy-boy=1] | ref | ref | ref | ref | ref |
| [Three children or more=1] | - | - | - | - | -.26 (.02) |
| *F*-statitistics *(Pr>F)* | 5.1 *(.0016)* | - | - | | |
| Over-id. Test *(Pr>F)* | | | | .35 (*.78*) | .37 (*.77*) |
| Nb of Obs. | 30423 | 30423 | 30423 | 30423 | 30423 |

Source : LFS, t=1991 to 2002, Insee. Sample : Women aged 21-35 years old, with two children or more.
Note (1): The dependent variable of the first-stage regression is the proportion of other mothers in the neighbourhood participating in the labour market. The dependent variable of the other regression is the individual participation in the labour market.

**Table 7:** Variation in OLS and IV estimates of the endogenous effect across sub-samples

| | Full Sample | | Sub-Sample with nb of neighbours>4 | | Sub-sample with nb of neighbours >6 | |
|---|---|---|---|---|---|---|
| | OLS | IV | OLS | IV | OLS | IV |
| Endogenous Effect | .19<br>(.02) | .80<br>(.44) | .37<br>(.02) | .67<br>(.31) | .50<br>(.02) | .88<br>(.47) |
| Nb of Obs. | 30423 | | 15855 | | 8936 | |

Source : LFS, t=1991 to 2002, Insee. Women aged 21-35 years old, with two children or more.

**Table 8 :** Demographic Differences Between Mothers According to the Quarter of Birth of their Second Child .

| | Individual characteristics of the mother | | | | | |
|---|---|---|---|---|---|---|
| | Particip. in Lab. Market. | Age | Age at first birth | [French=1] | Nb Child. | [High-school =1] |
| Born fourth quarter (Q1) | .582<br>(.0057) | 30.97<br>(.036) | 23.01<br>(.039) | .912<br>(.003) | 2.39<br>(.008) | .711<br>(.005) |
| Born before fourth quarter (Q0) | .601<br>(.032) | 31.05<br>(.021) | 22.94<br>(.023) | .912<br>(.002) | 2.39<br>(.004) | .711<br>(.003) |
| Diff. (Q1-Q0) | -.019*<br>(.006) | -.078<br>(.041) | .069<br>(.046) | .0003<br>(.0037) | -.0036<br>(.0095) | -.003<br>(.006) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, with two children or more.

**Table 9 :** The Distribution of Families with Second Child Born during the Last Quarter of the Year and its Distance to Random Assignment.

| Nb mothers s.t.second child born last quarter | Observed distribution of neighbourhoods (P, in %) | Distribution under random assignment assumption ($P_0$, in %) | Chi-2 $n(P-P_0)^2/P_0$ |
|---|---|---|---|
| 0 | 37.15 | 37.64 | 0.4848 |
| 1 | 37.56 | 37.08 | 0.4602 |
| 2 | 16.75 | 16.84 | 0.03628 |
| 3 | 5.52 | 5.35 | 0.3928 |
| 4 | 1.79 | 1.79 | 0 |
| 5 et + | 1.23 | 1.3 | 0.2989 |
| *Chi-2 statistics* | | | *1.67* |
| *(P-value)* | | | *(0.90)* |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.
Reading: 37,15% of neighbourhoods have no mothers with last-quarter second child. The expected proportion under the random assignment assumption is 37,64%. A chi-squared test does not reject the random assignment assumption at the 90% level.

**Table 10 :** Demographic Differences Between Other Mothers in the Neighbourhood According to the Quarter of Birth of Own Second Child.

| | Age | Age at first birth | [French=1] | Nb Child. | [High-school=1] |
|---|---|---|---|---|---|
| (a) Born fourth quarter (Q=1) | 31.05<br>(.02) | 22.96<br>(.02) | 91.3<br>(.3) | 2.39<br>(.008) | 71.2<br>(.5) |
| (b) Born before fourth quarter (Q=0) | 30.96<br>(.01) | 22.95<br>(.02) | 90.8<br>(.2) | 2.39<br>(.005) | 70.8<br>(.3) |
| Diff. (a)-(b) | .09<br>(.03) | .01<br>(.03) | .5<br>(.4) | .00<br>(.01) | .4<br>(.6) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.

**Table 11 :** The Endogenous Effect on Mothers' Labour Market Participation : an Evaluation using the Proportion of Children Born at the End of the Year as Instrument

| Independent variables | Dependent variable : [Participation Lab. Market=1] | | | |
|---|---|---|---|---|
| | First stage | Reduced form | OLS | IV |
| *Characteristics of other mothers in the neighbourhood* | | | | |
| % [Participation L.M. =1] | | - | .19<br>(.01) | .79<br>(.36) |
| % [Second child born during fourth quarter=1] | -.030<br>(.007) | -.024<br>(.010) | | - |
| *Individual Characteristics* | | | | - |
| [Second child born during fourth quarter=1] | -.009<br>(.004) | -.018<br>(.006) | -.017<br>(.006) | -.011<br>(.008) |
| Nb of Obs. | 30423 | 30423 | 30423 | 30423 |

Source : LFS, t=1991 to 2002, Insee. Sample : Women aged 21-35 years old, with two children or more.
Note (1): The dependent variable of the first-stage regression is the proportion of other mothers in the neighbourhood participating in the labour market. The dependent variable of the other regression is the individual participation in the labour market.

**Table 12 :** The Endogenous Effect on Mothers' Labour Market Participation : an Evaluation using Jointly Quarter-of-Birth and Sex-mix Instruments.

| Independent variables | | Dependent variable : [Participation Lab. Market=1] | | |
|---|---|---|---|---|
| | First stage | Reduced form | OLS | IV |
| *Characteristics of other mothers in the neighbourhood* | | | | |
| % [Participation L.M. =1] | | - | .19<br>(.01) | .80<br>(.28) |
| % [Same Sex=1] | -.022<br>(.006) | -.018<br>(.009) | - | - |
| % [Second child born during fourth quarter=1] | -.030<br>(.007) | -.024<br>(.010) | - | - |
| *Individual Characteristics* | | | | |
| [Same Sex=1] | -.007<br>(.004) | -.018<br>(.006) | -.016<br>(.006) | -.012<br>(.006) |
| [Second child born during fourth quarter=1] | -.009<br>(.004) | -.018<br>(.006) | -.017<br>(.006) | -.011<br>(.007) |
| First-stage *F*-statistics | 16.7 | | | |
| (*Pr>F*) | (*<.0001*) | | | |
| Over-identification Test | - | - | - | .00 |
| *(Pr>F)* | | | | (*.99*) |
| Nb of Obs. | 30423 | 30423 | 30423 | 30423 |

Source : LFS, t=1991 to 2002, Insee. Women aged 21-35 years old, with two children or more.
Note (1): The dependent variable of the first-stage regression is the proportion of other mothers in the neighbourhood participating in the labour market. The dependent variable of the other regression is the individual participation in the labour market.

**Table 13**: The Probability of Labour Market Participation Conditional on the Age difference Between the Two Eldest Siblings.

| Age difference between eldest sibligs (Nb Quarters=k) | Nb Obs. | Proportion of mothers such that $D=k$. (Pr($D=k$))) | Conditional Probability of Participation the Labour Market (Pr($P=1/D=k$)) |
|---|---|---|---|
| k=3 | 600 | 2.0 | 41.0 |
| | | (0.08) | (2.0) |
| k=4 | 1006 | 3.3 | 45.4 |
| | | (0.09) | (1.5) |
| k=5 | 1330 | 4.4 | 46.3 |
| | | (0.12) | (1.4) |
| ***k=6*** | ***1730*** | ***5.7*** | ***49.7*** |
| | | ***(0.14)*** | ***(1.2)*** |
| ***k=7*** | ***2074*** | ***6.8*** | ***56.1*** |
| | | ***(0.15)*** | ***(1.0)*** |
| k=8 | 2096 | 6.9 | 56.5 |
| | | (0.15) | (1.0) |
| k=9 | 2184 | 7.2 | 58.2 |
| | | (0.15) | (1.0) |
| k=10 | 2305 | 7.6 | 61.7 |
| | | (0.16) | (1.0) |
| k=11 | 2251 | 7.4 | 61.4 |
| | | (0.15) | (1.1) |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.

**Table 14** : Effects on a Mother's Participation in the Labour Market of the Age Difference between Own Eldest Siblings and of the Distribution of the Age Difference between Neighbours' Eldest Siblings.

| Age difference between eldest siblings (Nb Quarters=k) | Effects of (D=k) on [Participation=1] (1) | Effects of (%D=k) on [Participation=1] (1) |
|---|---|---|
| k=3 | -.25 (.02) | -.23 (.05) |
| k=4 | -.21 (.02) | -.15 (.04) |
| k=5 | -.20 (.02) | -.10 (.04) |
| ***k=6*** | ***-.17 (.02)*** | ***-.13 (.04)*** |
| ***k=7*** | ***-.10 (.02)*** | ***-.04 (.04)*** |
| k=8 | -.10 (.02) | -.07 (.04) |
| k=9 | -.08 (.02) | .01 (.04) |
| k=10 | -.05 (.02) | -.03 (.04) |
| k=11 | -.05 (.02) | -.05 (.04) |
| k=12 | -.02 (.02) | -.05 (.04) |
| k=13 | -.01 (.02) | -.05 (.04) |
| k=14 | -.02 (.02) | -.02 (.03) |
| k>=15 | Ref. | Ref. |
| R-squared | .02 | .01 |
| *N* | 30423 | 30423 |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.
Note : The table shows the results of a regression of a dummy indicating whether a mother participates in the labour market on a set of dummies indicating the age difference between her own eldest siblings (first column) and the results of a regression of the same dependent variable on a set of variable describing the distribution of the age differences between the eldest siblings of the other mothers in the neighbourhood (column 2)

**Table 15:** The Endogenous Effect on Mothers' Labour Market Participation : an Evaluation relying on a Regression Discontinuity Design.

| Independent variables | Dependent variable : [Participation Lab. Market=1] | | |
|---|---|---|---|
| | First-stage | Reduced form | IV |
| *Characteristics of other mothers in the neighbourhood* | | | |
| % [Participation L.M. =1] | | | .51 |
| | | | (.09) |
| % ($D$>6) | .16 | .08 | - |
| | (.01) | (.01) | |
| Average $D$ | .0001 | -.0002 | -.0003 |
| | (.0001) | (.0002) | (.0002) |
| *Individual characteristics* | | | |
| ($D$>6) | .027 | .12 | .11 |
| | (.005) | (.01) | (.01) |
| R-squared | .02 | .01 | .01 |
| Nb of Obs. | 30423 | 30423 | 30423 |

Source : LFS, t=1991 to 2002, Insee. Sample : Women aged 21-35 years old, with two children or more.
Note (1): The dependent variable of the first-stage regression is the proportion of other mothers in the neighbourhood participating in the labour market. The dependent variable of the other regression is the individual participation in the labour market.

# Appendix A

Consider a neighbourhood of size *n* and let *P* represent the (*n,1*) vector of dummies characterizing mothers' participation, *S* the (*n,1*) vector of dummies characterizing eldest siblings' sex, and *U* the vectors of residuals. Equation (1) can be rewritten,

(1) $MP=bS+U$

where *M* is a (*n,n*) matrix such that

$m(i,i)=1$ and $m(i,j)=m=-a/(n-1)$ for *i* different from *j*.

It is easy to check that $Q=M^{-1}$ is a (*n,n*) matrix such that

$q(i,i)=q_1=(1+(n-2)m)/(1+(n-2m-(n-1)m^2)$,

and $q(i,j)= q_2 =-m/(1+(n-2m-(n-1)m^2)$ for *i* different from *j*.

Hence, Equation (1) can be rewritten,

(1bis) $P=bQS+QU$

which yields,

(2) $VP_i = cVS_i + dS_i + v_i$

where $c= q_1b$ whereas $d=(n-1)bq_2=ab/(1+(n-2m-(n-1)m^2)$

and $v_i=q_1 v_i - a(v_1 +\ldots+v_{i-1} +v_{i+1} +\ldots+v_n )/(1+(n-2m-(n-1)m^2)$

**Table A1** : Distribution of Mothers with two children or more according to the number of other Mothers with two children or more, living in the same *aire*.

| Nb of other Mothers in the *aire* | Nb of Mothers | Proportion in the population of Mothers |
|---|---|---|
| 1 | 4768 | 15.67 |
| 2 | 5172 | 17.00 |
| 3 | 4628 | 15.21 |
| 4 | 3865 | 12.70 |
| 5 | 3054 | 10.04 |
| 6 | 2233 | 7.34 |
| 7 | 1600 | 5.26 |
| 8 | 1323 | 4.35 |
| 9 | 750 | 2.47 |
| 10 or more | 3030 | 9.96 |
| *Total* | *30423* | *100* |

Source: LFS *t*=1991,…2002. Sample: 15-years-old respondents, observed at *t* and *t+1*, who have been living in their neighbourhood for more than one year. Standard deviation in brackets.

**Table A2** : The Effect of a Mother's Demographic Characteristics on her Fertility and Labour Market Participation.

| | Dependent variables : | | | | | |
|---|---|---|---|---|---|---|
| | [3 children or more=1] | | [Participation in the Labour market=1] | | | |
| Two eldest children are same-sex | -.038 (.005) | -.037 (.005) | -.018 (.006) | -.017 (.005) | | |
| Second child was born last quarter of the year | - | - | - | - | -.018 (.006) | -.016 (.006) |
| Mother's educational level | | | | | | |
| No diploma | - | ref | - | ref | - | ref |
| Lower-secondary (*Bepc*) | - | -.16 (.01) | - | .16 (.01) | - | .16 (.01) |
| Vocational (*Cap-Bep*) | - | -.20 (.01) | - | .19 (.01) | - | .19 (.01) |
| High-school grad. (*bac.*) | - | -.27 (.01) | - | .25 (.01) | - | .25 (.01) |
| Some College (*bac.+2*) | - | -.28 (.01) | - | .32 (.01) | - | .32 (.01) |
| College Grad (*>bac.+2*) | - | -.27 (.01) | - | .29 (.01) | - | .29 (.01) |
| Mother's age | - | .026 (.001) | - | .021 (.001) | - | .021 (.001) |
| 12 year dummies | - | yes | - | yes | - | yes |
| N | 30422 | 30422 | 30422 | 30422 | 30422 | 30422 |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more.

**Table A3 :** The Distribution of Neighbourhoods According to the Number of Mothers with Same-sex Eldest Children, by neighbourhood size.

| | n=2 | n=3 | n=4 | n=5 | n=6 |
|---|---|---|---|---|---|
| P(S=1) | 49.79 | 51.31 | 50.91 | 50.12 | 50.46 |
| P(S=0) | 50.21 | 48.68 | 49.09 | 49.88 | 49.54 |
| N | 2384 | 1724 | 1157 | 773 | 509 |
| Nb of S=1 | Observed distribution of neighbourhoods according to number of S=1 *(Predicted distribution under the assumption of random assignment)* | | | | |
| 0 | 25.04 *(25.21)* | 11.25 *(11.53)* | 6.05 *(5.81)* | | |
| 1 | 50.34 *(50.00)* | 36.95 *(36.49)* | 23.94 *(24.09)* | 19.66 *(18.59)* | 11.59 *(10.51)* |
| 2 | 24.62 *(24.79)* | 38.40 *(38.46)* | 37.77 *(37.47)* | 30.92 *(31.17)* | 22.20 *(23.00)* |
| 3 | - | 13.40 *(13.51)* | 24.81 *(25.91)* | 29.88 *(31.32)* | 29.47 *(31.24)* |
| 4 | - | - | 7.43 *(6,72)* | | 25,34 *(23,86)* |
| 5 | - | - | - | 19,53 *(18,89)* | 11,40 *(11,37)* |
| 6 | - | - | - | - | |
| | Test of adequation of observed distribution to random assignment | | | | |
| chi2-stat. | 0.11 | 0.24 | 1.57 | 1.17 | 1.68 |
| (*P-value*) | *.95* | *.95* | *.85* | *.80* | *.85* |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old. two children or more.
Reading: The column n=2 corresponds to neighbourhoods where we observe only two families with two children or more . In these neighbourhoods, the proportion of same-sex families is about 49.79%. If families with same-sex children were randomly distributed across these neighbourhoods, we would observe 25.21% neighbourhoods with two same-sex families, 50.0% with one same-sex families and 24.79% without same-sex families. We actually observe 25.04% with two same-sex, 50.34% with one same-sex and 24.62% without same-sex families. A chi-squared test does not reject the assumption of random assignment. The same result holds true for larger number of families in the neighbourhood. For n=5 and n=6, we have gathered the neighbourhoods with extreme numbers of same-sex siblings to avoid comparing cells with less than 15 observations.

**Table A4 :** The Effects of Instruments on the Labour Market Participation of Fathers and on the Labour Market Participation of Women without Children.

| Independent variables | Men aged 21-35 with two children or more [Labour Market Part. =1] | | Women aged 21-35 without children [Labour Market Part. =1] | |
|---|---|---|---|---|
| *Characteristics of other mothers in the neighbourhood* | | | | |
| % [Same Sex=1] | .001<br>(.002) | - | .004<br>(.009) | - |
| % [Second child born during fourth quarter=1] | - | -.002<br>(.002) | - | .005<br>(.011) |
| *Individual Characteristics* | | | | |
| [Same Sex=1] | -.001<br>(.001) | - | - | - |
| [Second child born during fourth quarter=1] | - | -.002<br>(.001) | - | - |
| Nb of Obs. | 20008 | 20008 | 14771 | 14771 |

Source : LFS, t=1991 to 2002, Insee. Sample: Men aged 21-35 with two children or more (2 first columns) and women aged 21-35 years old without children (2 last columns).

**Table A5 :** The Distribution of Neighbourhoods According to the Number of Mothers whose Second Child was born during the Last Quarter of the Year.

| | n=2 | n=3 | n=4 | n=5 | n=6 |
|---|---|---|---|---|---|
| P(Q=1) | 0.260 | 0.250 | 0.231 | 0.258 | 0.260 |
| P(Q=0) | 0.740 | 0.750 | 0.769 | 0.742 | 0.740 |
| N | 2384 | 1724 | 1157 | 773 | 509 |
| Nb of Q=1 | Observed distribution of neighbourhoods according to number of Q=1 *(Predicted distribution under the assumption of random assignment)* | | | | |
| 0 | 54.99 *(54.82)* | 42.58 *(42.25)* | 35.78 *(34.97)* | 23.67 *(22.49)* | 16.50 *(16.46)* |
| 1 | 38.09 *(38.44)* | 41.47 *(42.16)* | 40.71 *(42.01)* | 37.13 *(39.10)* | 35.36 *(34.64)* |
| 2 | 6.92 *(6.74)* | 14.44 *(14.02)* | 19.19 *(18.93)* | 27.55 *(27.19)* | 28.88 *(30.38)* |
| 3 | - | 1.51 *(1.55)* | 3.98 *(3.79)* | 9.96 *(9.46)* | 15.13 *(14.21)* |
| 4 | - | - | 0.35 *(0.284)* | 1.55 *(1.65)* | 3.34 *(3.73)* |
| 5 | - | - | - | 0.13 *(0.11)* | 0.79 *(0.53)* |
| 6 | - | - | - | - | 0 *(0,03)* |
| | Test of adequation of observed distribution to random assignment | | | | |
| $D_0$=chi2(m-1) statistics | 0,205 | 0,475 | 1,01 | 1,52 | 1,48 |
| *P-value* | *.90* | *.90* | *.90* | *.90* | *.95* |

Reading: The column n=2 corresponds to neighbourhoods where we observe only two families with two children or more. In these neighbourhoods, the proportion of second child born during the last quarter of the year is about 26 %. If families whose second child was born during last quarter were randomly distributed across these neighbourhoods, we would observe about 54.82% neighbourhoods without any such family, 38.44% with one such family and 6.74% with two such families. The observed proportions are 54.99 %, 38.09 % and 6.92 %. A chi-squared test does not reject the assumption of random assignment at the 90% level. The same result holds true for larger neighbourhoods.

**Table A6** : The Distribution of Random Fertility Shocks *z* Conditional on Observed Age Difference Between Eldest Siblings.

| Nb Quarters (k) | Distribution of D* | Distribution of z Conditional on Observed Age Difference D | | |
|---|---|---|---|---|
| | P(D*=k) | P(z=0/D=k) | P(z=1/D=k) | P(z=2/D=k) |
| k=3 | 3.5 | 1 | - | - |
| k=4 | 4.3 | 74.7 | 25.2 | - |
| k=5 | 5.2 | 68.0 | 23.9 | 8.0 |
| ***k=6*** | **6.7** | **67.5** | **22.0** | **7.6** |
| ***k=7*** | **7.7** | **64.7** | **23.7** | **7.7** |
| k=8 | 7.0 | 58.3 | 27.0 | 9.8 |
| k=9 | 7.5 | 59.5 | 23.6 | 10.8 |
| k=10 | 8.0 | 60.1 | 23.7 | 9.3 |
| k=11 | 7.2 | 56.3 | 26.2 | 10.2 |

Source : LFS 1990-2002. Sample : Women aged 21-35 years old, two children or more, age difference between eldest siblings comprised between k=3 and 11 quarters.