

# POLICIES, INSTITUTIONS AND FERTILITY RATES: A PANEL DATA ANALYSIS FOR OECD COUNTRIES

Anna Cristina D'Addio and Marco Mira d'Ercole

## TABLE OF CONTENTS

Introduction.....	8
Some stylised facts about childbearing in OECD countries.....	9
Lower fertility rates.....	9
Postponement of childbearing.....	10
Higher gaps between desired and observed childbearing.....	11
Determinants of fertility rates.....	12
Income, labour market and demographic factors.....	12
Cultural factors: changes in women's roles and attitudes.....	16
Policy measures affecting the cost of children.....	16
Empirical analysis.....	23
Econometric approach.....	25
Variables.....	26
Results and discussion.....	27
Conclusions.....	32
Bibliography.....	38
<i>Appendix I. Econometric Models for the Analysis of Panel Data.....</i>	<i>43</i>

---

The authors, both from the Social Policy Division of the Directorate for Employment, Labour and Social Affairs (anna.daddio@oecd.org and marco.mira@oecd.org), wish to acknowledge the useful comments on previous drafts of this article provided by J.P. Martin, M. Durand, M. Pearson, P. Swaim and N. Johnstone, OECD; D. del Boca, University of Turin and Department of Economics, New York University; J.-P. Sardon, from the INED; P. Johnson, U.S. Census Bureau; participants at the AEA conference "The Rationale of Parenthood Choices" (Pau, March 2005), at the 12th "International Conference on Panel Data" (Copenhagen, June 2005), at the "International Conference on Low Fertility and Effectiveness of Policy Measures in OECD" (Seoul, December 2005), at a seminar at the OECD/Korea Regional Centre for Health and Social Policy (Seoul, December 2005), at a seminar at the National Institute for Population and Social Security Research (Tokyo, December 2005). The opinions expressed in this article do not necessarily correspond to the views of the OECD or of the governments of its member states. The usual disclaimers apply.

---

## INTRODUCTION

Total fertility rates at, or below, replacement level characterise today 64 countries with populations totalling 44% of that of the world. Many of these countries have total fertility rates below 1.5 and some have recorded below-replacement fertility rates for decades. Low fertility rates contribute to a rapid ageing of the population and to an absolute decline in population size. One direct consequence of low fertility rates is the loss of reproductive potential, measured in terms of women of childbearing ages. Other consequences include a prospective decline in the availability of family carers in old age, growing public spending on pensions and health care, an older and less adaptable workforce and a smaller pool of domestic savings.

Demographers and social scientists have engaged a lively debate on the causes of low fertility rates and on the prospects for further change.<sup>1</sup> To that end, many empirical studies have focused on the links between women's childbearing decisions and their participation in the paid labour market, as well as on the relation between fertility rates and other demographic or societal developments at both macro and micro levels. Fewer studies, however, have specifically examined the relation between fertility rates and the institutions and policies affecting families with children.

For several years, the prevailing attitude of OECD governments with respect to the fall in fertility rates has been to adapt to its consequences. While this attitude can be explained, to a significant extent, by historical and cultural factors,<sup>2</sup> there are indications that this situation is rapidly changing.<sup>3</sup> An increasing number of OECD governments list low fertility rates as one of their top policy concerns; and, even when rejecting explicit pro-natalist goals, they recognise the importance of reducing artificial barriers to having and raising children. At the root of this change in attitudes on the issue of childbearing and reproductive behaviour is the understanding that, whether deliberately or not, policies shape the environment in which childbearing decisions take place: policies may help parents to overcome the obstacles to childrearing that they face in everyday life – or create new constraints that accelerate the fall in fertility rates.

This article aims to explain cross-country and inter-temporal variation in fertility rates due to the interaction of labour market features, social and tax policies, and individual characteristics. It extends the model of Gauthier and Hatzius (1997)

to a wider range of policies and labour market determinants, based on longitudinal data for 16 OECD countries over the period 1980-1999. Two different estimators are used: the GMM-system and the pooled mean group estimators (PMG). The results of the analyses suggest that a broad range of policies (such as transfers to families with children, leave provisions) and institutions (such as characteristics of the labour market) affect childbearing decisions.

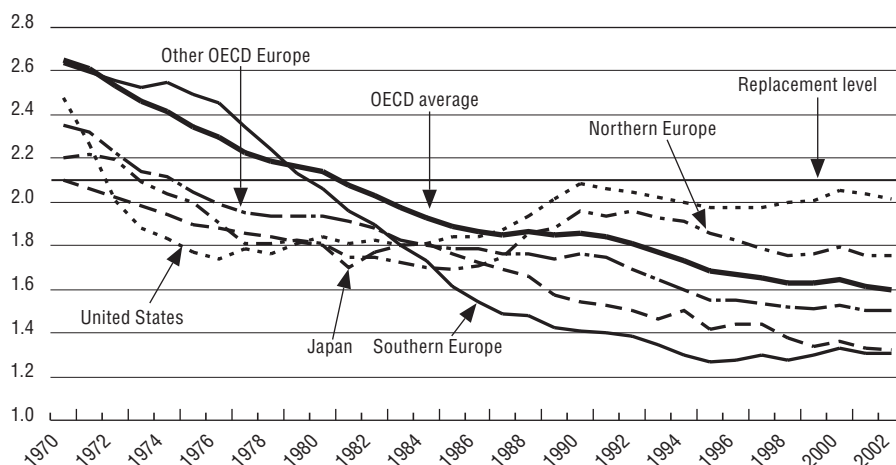
The paper is organised as follows. First, it presents some stylised facts about trends in fertility rates in OECD countries. Second, it discusses some of the determinants of fertility rates that prior research has identified as having contributed to shape these trends. Third, it presents new econometric evidence on the determinants of fertility rates which captures the impacts of a number of policy measures better than have prior studies. The final section concludes.

## SOME STYLISED FACTS ABOUT CHILDBEARING IN OECD COUNTRIES

### *Lower fertility rates*

Total fertility rates declined dramatically over the past few decades, falling on average (across OECD countries) from 2.7 children per women of childbearing age in 1970 to 1.6 in 2002 (Figure 1). By 2003, the total fertility rate was below its “replacement” level – a level of 2.1 would ensure the replacement of the previous generation and therefore population stability, under assumptions of no immigration

Figure 1. Trends in total fertility rates in OECD countries



Note: Data refer to total fertility rates.

Source: For detailed sources see OECD (2005a), *Society at a Glance – OECD Social Indicators*, OECD, Paris.

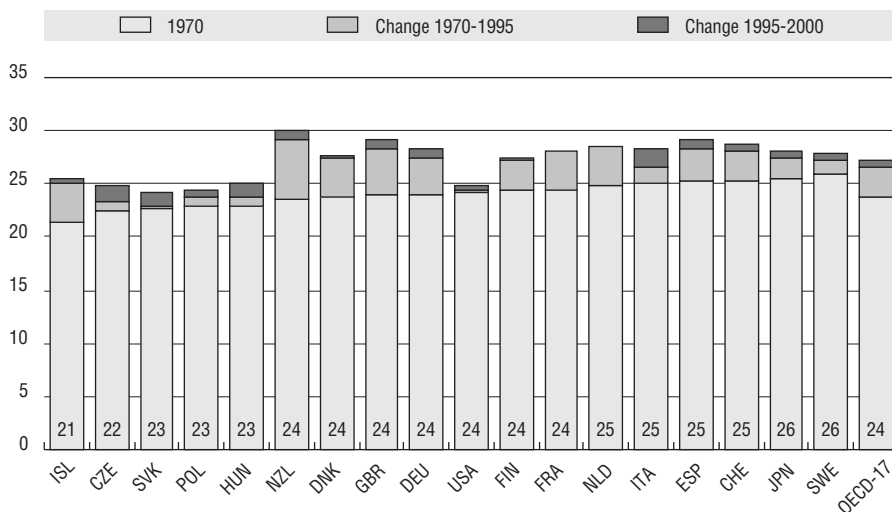
and of no change in mortality rates – in all OECD countries except Mexico and Turkey. The pace of decline, however, varies widely from country to country. Southern European countries, for example, have experienced a more recent decline in fertility rates, but have now reached extremely low levels.

Low fertility rates may be either temporary or persistent. The findings of a companion paper (D’Addio and Mira d’Ercole, 2005) show that the decline in completed fertility rates is likely to continue in the future even for cohorts that have not yet reached the end of their reproductive life. This suggests that the decline of total fertility rates observed over the past three decades is most likely to persist.<sup>4</sup>

### Postponement of childbearing

Postponement of the first childbirth is probably the most important aspect of what has been labelled as the “second demographic transition” that has characterised most OECD countries (van de Kaa, 1987). Postponement is reflected in the rise in the mother’s age at childbirth.<sup>5</sup> An indicator that is often used to describe this phenomenon is the mean age of mothers at the birth of their first child. For the seventeen countries depicted in Figure 2, the mean age of mothers at first childbirth has increased, on average, from 23.8 in 1970 to 27.2 in 2000, an increase of over 1 year per decade.<sup>6</sup>

Figure 2. Mean age of mothers at first childbirth in selected OECD countries



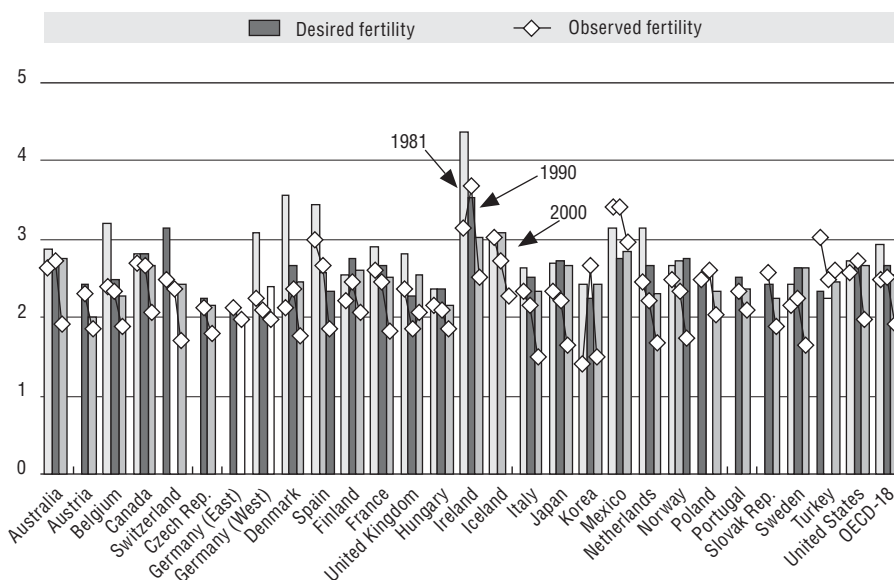
Note: The total height of each bar is the mean age of mothers at first childbirth in the year 2000. Countries are ranked in increasing order of the mean age of mothers at first childbirth in 1970 (shown at the basis of each bar). Source: Computations based on data from OECD (2005a), *Society at a Glance – OECD Social Indicators*, OECD, Paris.

### Higher gaps between desired and observed childbearing

Lower fertility rates can reflect changes in both individuals' life-style preferences and the constraints that they face in everyday life. These constraints may reflect the emergence of new risk factors (*e.g.* labour market insecurity, difficulties in finding suitable housing, unaffordable childcare) and the failure of policies to provide adequate support. Evidence about the potential role of these constraints on women's childbearing decisions can be derived from answers to questions about the "desired" or "ideal" number of children derived from opinion surveys. While interpreting survey data about these questions is not without problems,<sup>7</sup> Figure 3 – which plots the observed and desired number of children of women of all ages in different years – suggests that:

- Women generally have fewer children than they actually want.
- The gap between desired and observed fertility rates is higher in OECD countries where fertility rates are lower.

Figure 3. Desired and observed fertility rates in selected OECD countries



Note: Observed fertility is measured by the number of children that women of different ages declared in the survey. The three bars shown for each country refer to data for 1981, 1990 and 2000, with the exceptions of Austria, the Czech Republic and the eastern länder of Germany, (where data refer to 1990 and 2000), and of Switzerland, Poland and Turkey (where the data refer to 1990, 1995 and 2000). OECD-18 refers to the average of the 18 countries for which data are available in each of the three years.

Source: Data from the World Values Survey (1981, 1990, 2000) and Eurobarometer (2002) as in European Foundation (2004).

- The gap between desired and observed fertility rates has increased over the past twenty years, both on average and in most OECD countries.

The widening of the gap between desired and observed fertility partly reflects the effect of postponement of childbearing on the total fertility rate. However postponement is only part of the story. Figure 4, which plots desired and realised number of children for women of different ages, suggests that the widening of the gap between observed and desired births affects both younger and older women. While for younger women such widening may be reversed in the future, women that are close to the end of their reproductive cycle are unlikely to realise fully their childbearing intentions.

## DETERMINANTS OF FERTILITY RATES

Most analyses of childbearing decisions have their root in the economic model pioneered by Becker (1960) and Leibenstein (1957), where demand for children is a function of their costs and of individuals' preferences, for a given income.<sup>8</sup> Underlying this model is the notion that children are a special type of capital good, *i.e.* a long-lived asset that produces a flow of services that enter the utility function of parents.<sup>9</sup> This model provides a framework for analysing the effects on fertility rates of various economic and social factors, including public policies, even if these effects may differ among individuals and groups because of the heterogeneity of their preferences.

### *Income, labour market and demographic factors*

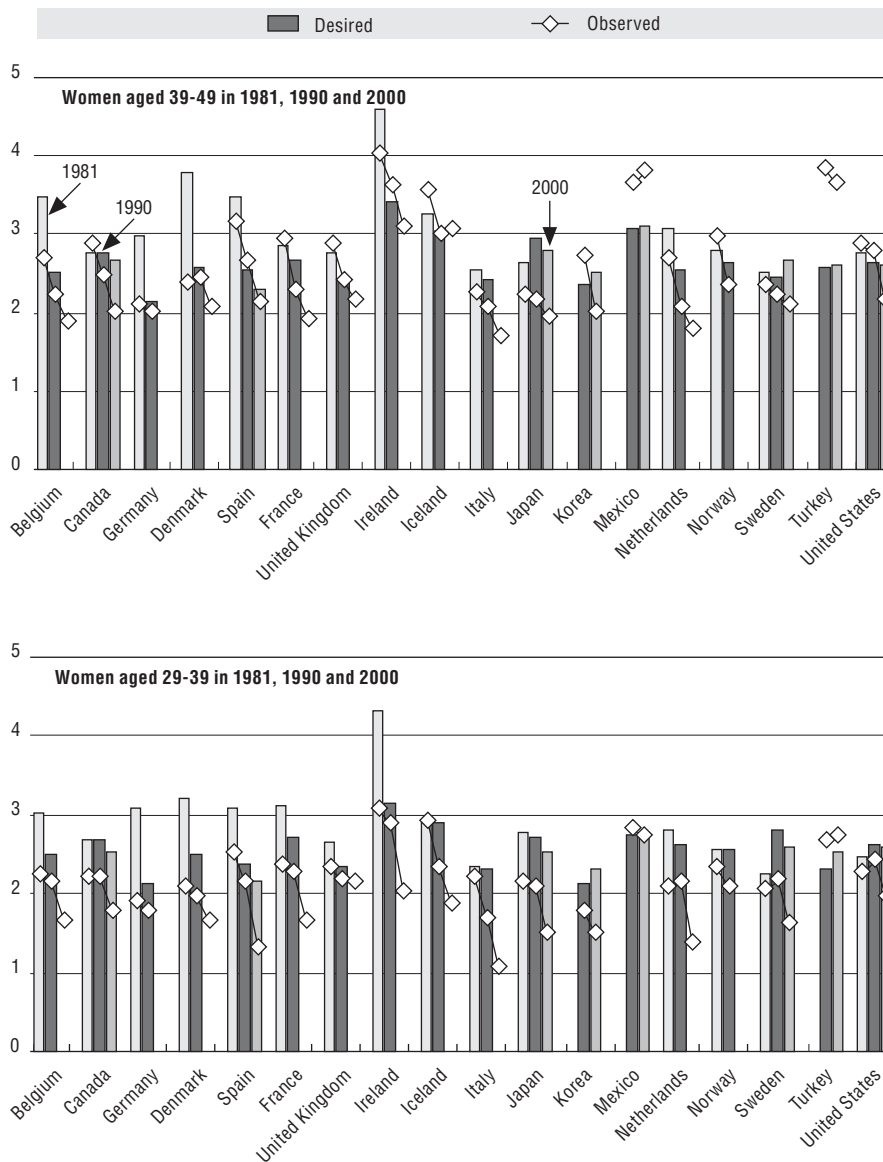
The standard economic model, along with assumptions that children are intensive with respect to mother's time, implies that women's income and earnings are key influences on childbearing. As childrearing competes with paid work for mothers, higher earnings increase the opportunity cost of not working. Similarly, higher educational attainment of women, by increasing their earnings potential, will raise the opportunity costs of childbearing and lower the number of their children.<sup>10</sup>

The relations between childbearing, on one side, and income and education, on the other, is however more complex. At the level of individuals, the evidence does indeed suggest that women have fewer children when they have higher income and higher educational attainment, and that birth rates and labour market participation of women are negatively related.<sup>11</sup> But these relations become more complex when examining empirical associations at the country level, and how these have changed over time.

Looking first at employment, several authors have stressed that the cross-country correlation between female employment rates (or labour force participation) and total fertility rates has changed its sign in recent years (Ahn and Mira, 2002; Del Boca *et al.* 2003). This is confirmed by Figure 5, which plots the cross-country correlation

<sup>12</sup>

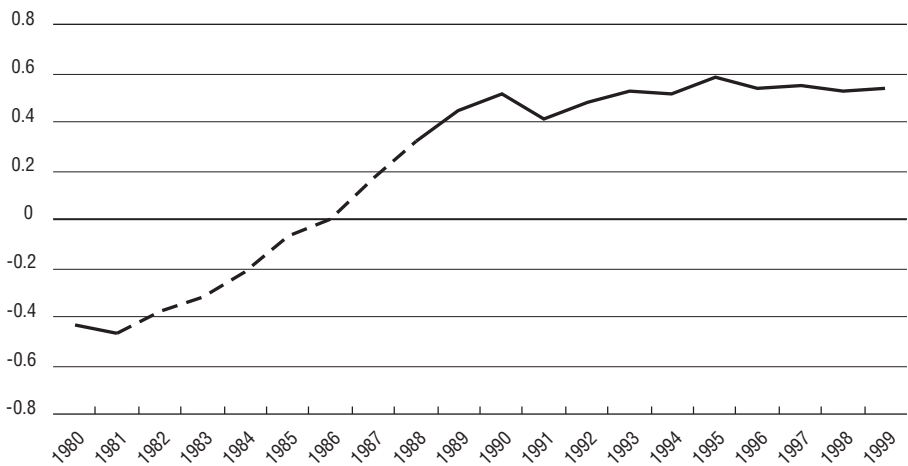
Figure 4. Desired and observed number of children for women of different ages in selected OECD countries



Note: Observed fertility is measured by the number of children that women of different ages declared in the survey. Data for Germany refer to western länder only.

Source: Data from the World Values Survey (1981, 1990, 2000) and Eurobarometer (2002) as in European Foundation (2004).

Figure 5. **Correlation between female employment rates and total fertility rates in OECD countries, 1980-1999**



*Note:* Values shown refer to the cross-section correlation coefficient between the total fertility rate and the employment rate of women aged 15-64 for each year over the period 1980-1999. Data refer to Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. The solid bold line shows correlation coefficients that are statistically significant at the 5% level.

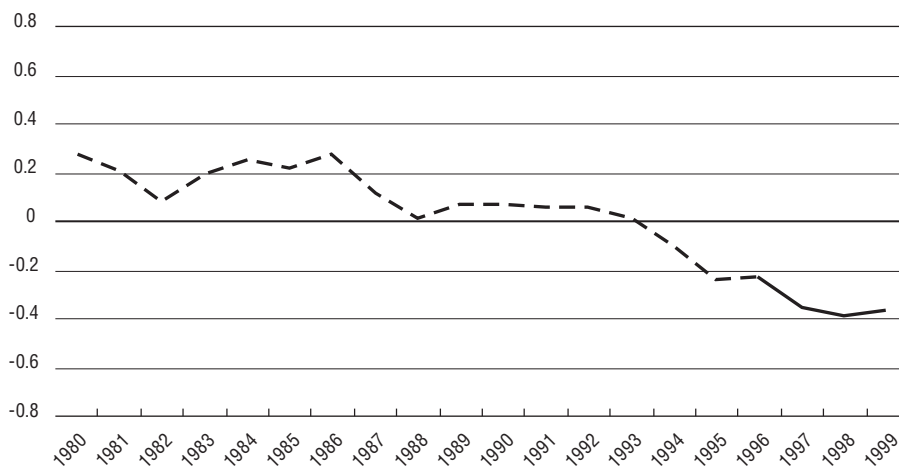
*Source:* Computations based on data from OECD, *Society at a Glance – OECD Social Indicators*, various issues.

between female employment rates and total fertility rates in each year. The change in the sign of the relation between the two variables (positive since the late 1980s) suggests that paid-work and childbearing do not necessarily substitute for each other at the country level. Even at the level of individuals, empirical estimates suggest that the extent to which paid employment and childbearing are negatively related to each other has declined over time in several countries (D'Addio and Mira d'Ercole, 2005).

To the extent that women prefer to establish a foothold in the labour market before having their first child, unemployment is also likely to influence fertility.<sup>12</sup> The effect of unemployment on the timing and number of births is, however, ambiguous. When unemployment is high, youths may decide to remain longer in the parents' home or in schools, both of which contribute to postponing partnership formation and lower childbearing; however, as each woman may also expect a lower probability of finding employment (and lower wages if she is successful), unemployment may also increase childbearing (Gauthier and Hatzius, 1997; Adsera, 2004). Figure 6, which plots the cross-country correlation between unemployment rates (for both men and women) and total fertility rates, also suggests a



Figure 6. **Correlation between total unemployment rates and total fertility rates in OECD countries, 1980-1999**



Note: Values shown refer to the cross-section correlation coefficient between the total fertility rate and the unemployment rates of men and women aged 15-64 for each year over the period 1980-1999. Data refer to Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Korea, the Netherlands, Norway, New Zealand, Portugal, Spain, Sweden, Switzerland, the United Kingdom and the United States. The solid bold line shows correlation coefficients that are statistically significant at the 5% level.

Source: Computations based on data from OECD, *Society at a Glance – OECD Social Indicators*, various issues.

reversal in the sign of the relation between these two variables (from positive to negative since the late 1990s): total fertility rates are today higher in OECD countries where unemployment rates are lower.<sup>13</sup>

While the marital status of mothers does not feature explicitly in the standard model, the information available suggests that in most OECD countries married women have a higher fertility rate than unmarried ones. As the share of women that are unmarried has increased over time, this may be expected to have depressed total fertility rates. However, childbearing patterns of non-married women have also changed significantly over this period. One manifestation of these changes is the increasing importance of birth outside marriage. More than half of all births occur today outside marriages in the Nordic countries, as compared to 1 in 10 in 1960. This share is at present close to 45% in France and to 35% in the United States, while it is much lower in Southern European countries and Japan. As a result of these patterns, OECD countries where the share of out-of-wedlock birth is higher in 2000 also tend to display a higher total fertility rate (D'Addio and Mira d'Ercole, 2005).

### ***Cultural factors: changes in women's roles and attitudes***

While not explicitly considered by the standard model, changes in childbearing are also shaped by fundamental transformations in the roles played by women in society, and in their values and attitudes towards childbearing and gender roles (Gilbert, 2005). Higher educational attainment and labour market participation have fuelled the diffusion of new values – such as autonomy and financial independence – among younger generations of women, and greater awareness of the potential “incompatibility” between professional and family roles.<sup>14</sup> These changes in women's attitudes may be expected to have influenced fertility rates.

Data from different waves of the *World Values Survey* – on the share of individuals that agree or do not agree with a range of statements pertaining to the role of women within the family and society – allow for a comparative analysis of the values and attitudes of women of different ages, as well as of men and women of the same age. The survey questions considered relate to whether respondents agree that: i) “when jobs are scarce men should have more right to work than women”; ii) “marriage is not an outdated institution”; iii) “women need to have children to be satisfied”; iv) “lone mothers cannot be approved”; v) “working mothers cannot have the same warm and stable relation with children”; vi) “being a housewife is as fulfilling as working in paid job”. Overall, younger cohorts of women have less traditional views on women's roles within families and societies than older cohorts, although changes are small in several countries and for some subject areas (in particular in terms of whether the institution of marriage is becoming more outdated, and the life-satisfaction associated with being a housewife as opposed to a paid worker). Not surprisingly, men have on average more traditional views on gender roles within families and societies than women of the same age, but these gender gaps have narrowed over time in a majority of OECD countries (D'Addio and Mira d'Ercole, 2005). In general, these data also suggest that, while changes in values and beliefs may have contributed to fertility delay in all countries, there is no unique mapping in terms of fertility rates. Other factors have obviously been at work.

### ***Policy measures affecting the cost of children***

The costs of children play a key role in the standard economic model of childbearing decisions (Box 1). As these costs rise, children become less affordable for actual and potential parents. A range of policies may influence these costs. These include tax benefits and cash transfers; childcare arrangements; and leave provisions (OECD 2006). Some of their key features are described below. Unfortunately, longitudinal data that would allow for their inclusion in the empirical analysis of the next section are limited to (some) measures of tax benefits and parental leave provisions.<sup>15</sup>

### Box 1. The cost of children: a short overview

The economic literature on the cost of children distinguishes between:

- *Direct costs*, which refer to the additional “out of pocket” costs incurred by households when children are present (*e.g.* food, clothing, childcare, education and housing).
- *Indirect costs*, which refer to the loss of income incurred by parents when children are present (*e.g.* foregone earnings because mothers drop out of employment, or reduce their working hours to care for children, or experience a decline in their career prospects following the birth of a child).

The economic literature on childbearing decisions has often focused on direct costs. While the assessments of their size raise difficult methodological issues, estimates of the direct costs of children exist in several countries. In general, these estimates suggest that direct costs of children increase with the age of the child and decline with family income, and that economies of scale in consumption reduce the direct costs for second-born (and higher-order) children (D’Addio and Mira d’Ercole, 2005).

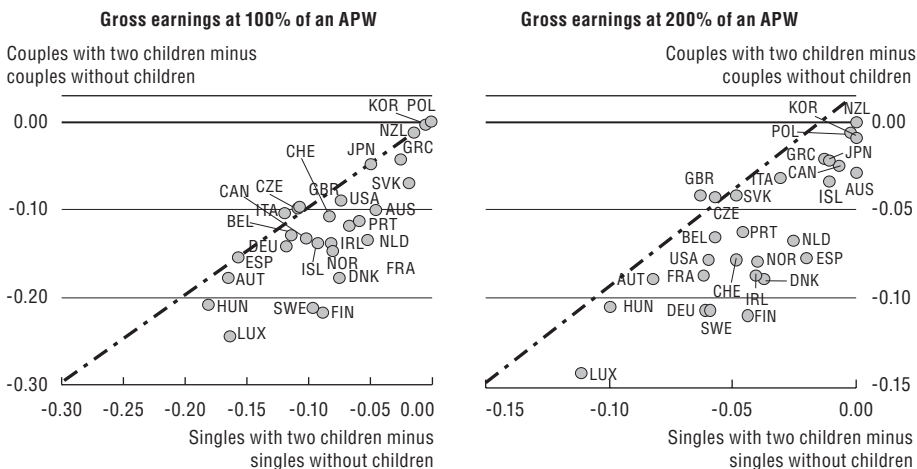
The direct costs of children are shared among parents. This also applies to indirect costs to some extent, but these indirect costs have an additional impact on the financial independence of mothers in the long run. While the immediate impact of the changes in work arrangements that follow childbirth is most often a loss of current earnings, the longer a mother stays out of the labour market the more difficult it becomes for her to re-enter it, with negative consequences for her long-term career prospects. While the difficulties of estimating the size of these indirect costs are even larger than in the case of direct costs, their size is likely to have risen alongside the employment opportunities available to mothers.

Policies can encourage fertility by lowering either direct or indirect costs of children. However, the impact on the extent to which women will combine paid work and childbearing is likely to vary depending on the nature of the policy measures used. For example, cash transfers granted at the birth of each child, if large enough to alter childbearing decisions, may lead mothers to withdraw from (or not to enter) the paid-labour market in order to rear their children instead. Conversely, policies that reduce the labour market penalty associated to having children will generally encourage women both to work more and to have more children.

#### *Tax benefits and cash transfers*

OECD Tax and Benefit models provide information on the financial benefits provided through the combined effect of cash-benefits and tax-expenditures to families with different characteristics. This information is used in Figure 7 to highlight the advantage provided to families with children relative to those without. Within each panel, the vertical axis measures the difference between the “effective” tax rate levied on a two-earner couple with and without children (aged 6 and 4), while

Figure 7. Differences in the average effective tax rates between households with and without children, 2002



Note: Average effective tax rates include income taxes, social security contributions and cash transfers available to a couple with two children aged 4 and 6. The values shown on the vertical axis refer to the difference between the average effective tax rate of a two-earner couple with two children and that of a childless couple (more negative values indicate a more favourable tax treatment for a couple with children). The values shown on the horizontal axis refer to the difference between the average effective tax rate of a single parent with two children and that of a single without children. Values are shown for two levels of gross household income (100% of the earnings of an average production worker, left-hand panel; and 200% of the earnings of an average production worker, right-hand panel).

Source: Data extracted from OECD, *Tax and Benefit models* database.

the horizontal axis measures the difference in tax rates between a sole parent with two children and a single person. Comparisons refer to households with two different levels of income: gross household income equivalent to 100% of the earnings of an “average production worker” (APW), in the left-hand panel; and to 200% of APW earnings in the right-hand panel. Negative values indicate that the average effective tax rates for households with children are lower than for those without children, with this advantage increasing as we move outward along the diagonal line.

Three main features stand out:

- First, there are significant differences across countries in the size of the tax advantage provided to families with children. When household income equals 100% of the earnings of an APW, the advantage provided to couples with two children is highest in Hungary and Luxembourg (above 15%) but also in Spain and Italy, while it is negligible in Greece, Japan, Korea, New Zealand and Poland. Nordic countries and the United States – where fertility rates are relatively high – achieve intermediate levels of “horizontal redistribution”.

- Second, in most countries the advantage granted to households with children is higher in the case of couples than for single parents. With respect to households with gross income of 100% of an APW, this is most evident in Denmark, Finland and Sweden (countries further to the right of the diagonal). Despite these differences, countries that provide higher deductions to couples with children also tend to be more generous with single parents.
- Third, the advantage granted to families with children declines at higher levels of household income. For example, in Luxembourg, couples and singles with children are taxed at rates that are, respectively, 25 and 15 points lower than those without children, for household income at 100% of APW; this advantage declines to 15 and 10 points, respectively, for household income at 200% of the earnings of an APW.

Although the size of this “preferential treatment” granted to families with children is often significant, it is smaller than that implied by most of the elasticities of household needs with respect to household size that are used in comparative research on living standards.<sup>16</sup> Even in countries that provide the greatest advantage to families with children through their tax and benefit systems, these financial advantages cover less than 2/3 of the additional costs incurred by these families.

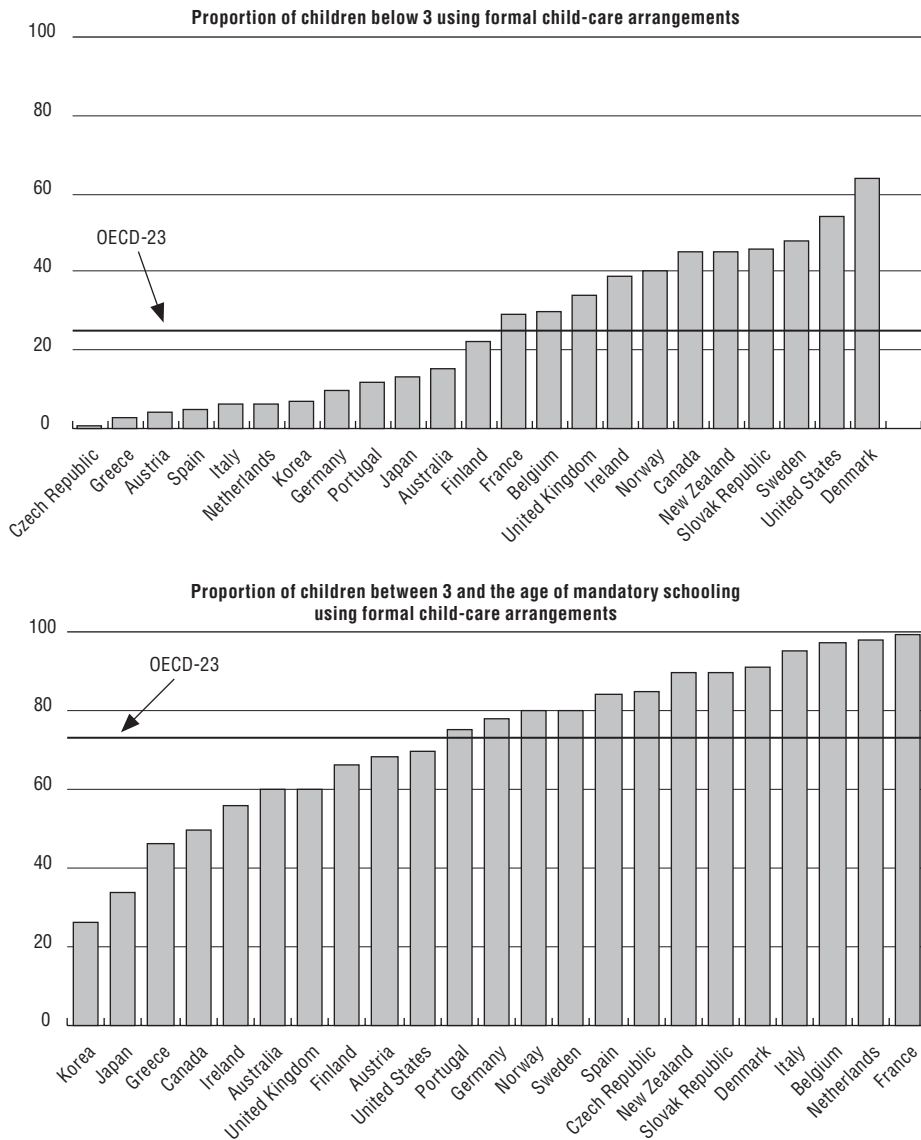
According to the standard model, the effect of these financial benefits on fertility rates will depend on the relative size of “income” and “substitution” effects.<sup>17</sup> Most empirical studies of the relationship between financial benefits and fertility rates report evidence of a positive impact, although they differ on whether these effects are temporary or persistent, and on their size.<sup>18</sup>

### *Childcare*

Affordable and quality childcare is important not only for raising fertility rates, but also in order to ensure that achievement of this goal is compatible with that of encouraging higher female employment and higher levels of investment in children. When childcare is unaffordable, of low-quality, or difficult to access, parents may opt for atypical work schedules in order to share care and work responsibilities, with possibly negative consequences on the stability of the parental unions and on the well-being of children. Mothers’ attachment to the labour market may also decline, as they opt to care for their children at home.

From the perspective of families, two of the most important features of childcare are ease of access and costs. With reference to the first, the share of children aged less than 3 attending formal childcare ranges between more than 60% in Denmark to less than 5% in the Czech Republic, Greece, Austria, Spain and Italy; and between close to 100% in Belgium, the Netherlands and France and a little over 20% in Korea, in the case of children aged between 3 and 6 (Figure 8). A significant proportion of these formal childcare facilities is directly provided by

Figure 8. Share of children of different ages attending formal childcare arrangement



Source: Data collected from national sources. See OECD (2001b), *Society at a Glance – OECD Social Indicators*, Paris.

governments, and translates into significant budgetary costs. In this respect, different indicators of public spending on childcare facilities highlight large differences in public childcare spending per child across OECD countries (with very high levels in the Nordic countries and much lower ones in Southern European countries, Japan and Korea, especially for children below the age of entry into pre-primary education).

Evidence on childcare costs is sparse. Figure 9 shows estimates of the gross and net childcare costs borne by families with two children (aged 2 and 3), who are cared for on a full-time basis in a public or a publicly recognised day-care facility. These costs are expressed as a proportion of gross household income for couples and single parents at three different earnings levels. Net “effective” childcare costs are calculated as gross out-of-pocket costs adjusted for the various public childcare benefits which are available to parents (Immervoll and Barber, 2005). These cost estimates suggest that:

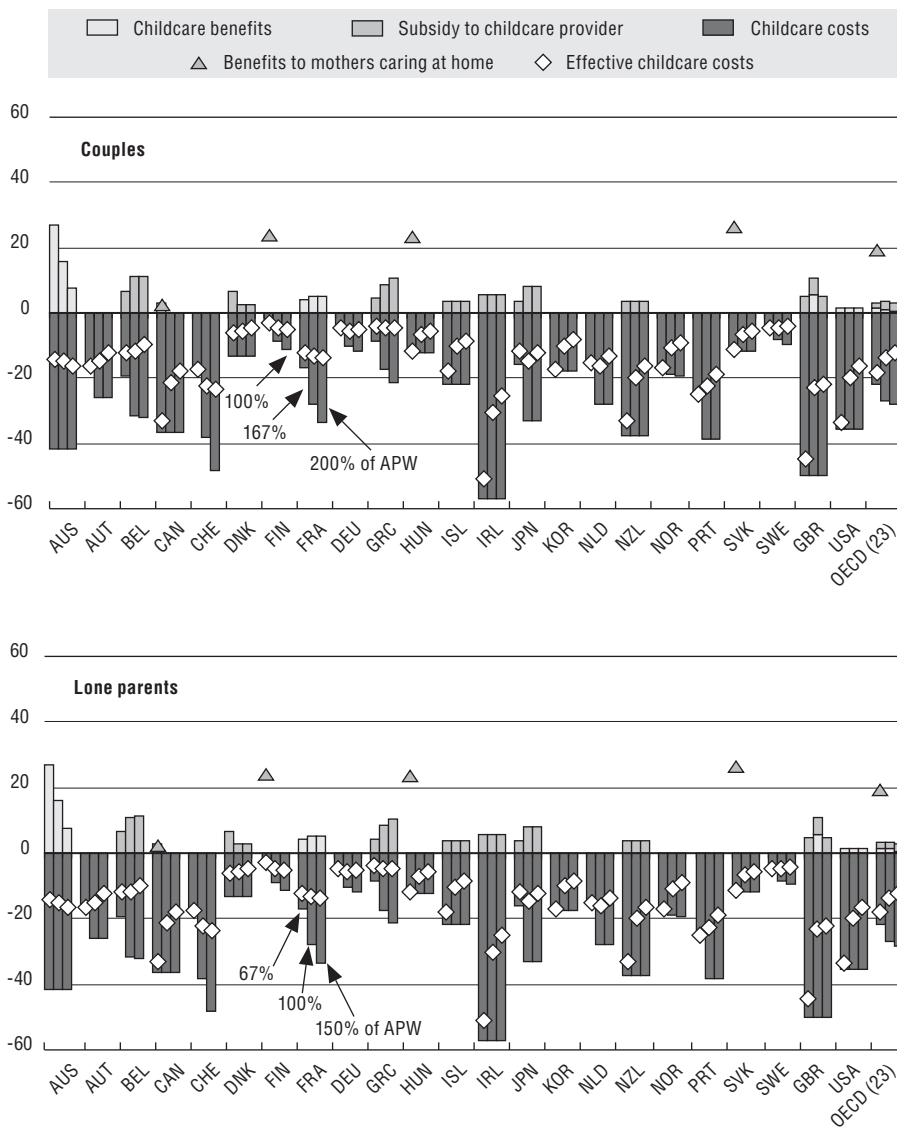
- First, there are important differences in the gross childcare costs borne by families (*i.e.* before taking into account the effect of different public transfers in reducing them) across countries. For families with two pre-school children, these costs range between 50% of gross household income in Ireland and the United Kingdom and 10% or less in Sweden. These differences mainly reflect the importance of in-kind service provision in several OECD countries.
- Second, as a result of different programmes subsidising childcare, the net out-of-pocket childcare costs borne by families are lower, but still vary significantly across countries: at gross income levels of 100% of the earnings of an APW, they range from more than 40% of gross family income in Ireland and the United Kingdom to less than 10% in Denmark, Finland, Germany, Greece and Sweden. Despite these various programmes, childcare costs – as a proportion of household income – are generally higher for low-income families than for higher-income ones.

While comparable data on childcare are very limited, a number of empirical studies have analysed the impact of childcare availability on fertility rates. Most of these studies conclude that good access to childcare is a key element for helping women to combine career and family responsibilities and, in this way, to support fertility rates.<sup>19</sup>

#### *Leave provisions*

The different forms of leave granted to parents play an important role in reducing the indirect costs related to having and rearing children, although their design might undermine mothers' career prospects and financial security. Maternity leave provisions are well-established features of OECD social protection systems. While both their duration and the benefits they provide are important for

Figure 9. **Childcare costs for two children aged two and three in full-time public care, as a share of gross household income, in 2001-2002**



*Note:* The effective childcare costs are calculated as the percentage reduction in gross household income due to childcare cost, childcare benefits and subsidies to childcare provider.

*Source:* Data extracted from the OECD Tax and Benefit models database. Computations based on data reported in Immervoll and Barber (2005).



the well-being of children and families – they secure both employment protection for working mothers and care for infants in a critical phase of their development (OECD, 2001a) – very long periods of maternity leave may lead to detachment from the labour market, reducing the employment and earnings prospects of mothers relative to other women and to men, thereby increasing the indirect costs of childbearing (Leigh, 1983). Indeed, Kamerman (2000) argues that, while maternity leave tends to increase labour market participation of women, it also leads to reductions in their incomes, or to changes in the job situation and in the hours worked relative to their situation before the leave.

Maternity leave is granted to mothers immediately before and after child-birth. Statutory maternity leave, often remunerated, exists today in most OECD countries (exceptions include the United States, Australia and, until recently, New Zealand). Entitlement (to both maternity and childcare leave, where it exists) is however often conditional on meeting minimum requirements for previous work experience (*e.g.* having worked continuously and on a full-time basis for a least a year).<sup>20</sup> In general, the benefit paid during maternity leave is set in relation to previous earnings and is often paid at a full (100%) rate. However, salary support often decreases as the leave lengthens, so that not everybody can afford to use it fully.

Since the early 1980s, most OECD countries have replaced statutory maternity leave with parental leave and now rely on a combination of different types of leave. Duration, the size of benefits to which parents are entitled and legal enforcement of leave policies vary widely among OECD countries (Figure 10) and these differences affect take-up rates. Leave policies reflect socio-cultural attitudes with leave provisions tending to be stronger in countries where childrearing is considered as being largely, or even exclusively, the mother's responsibility.

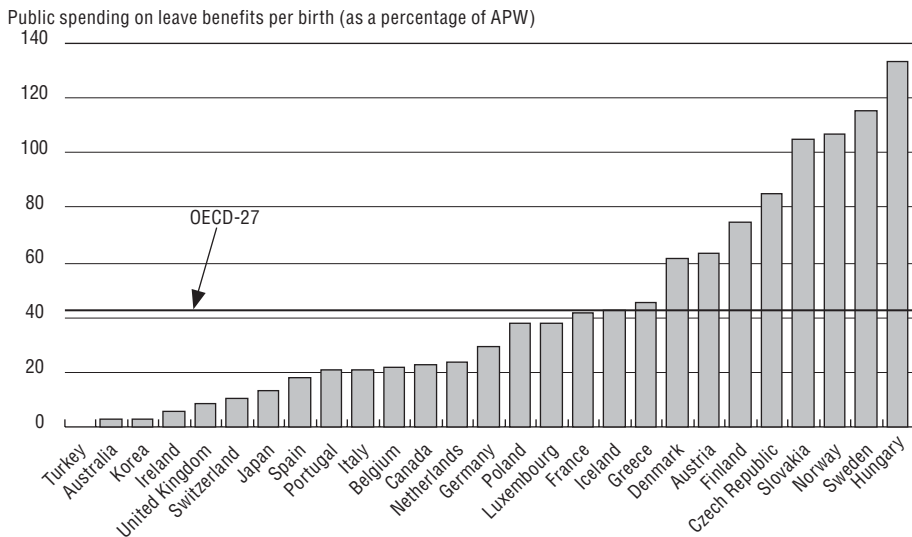
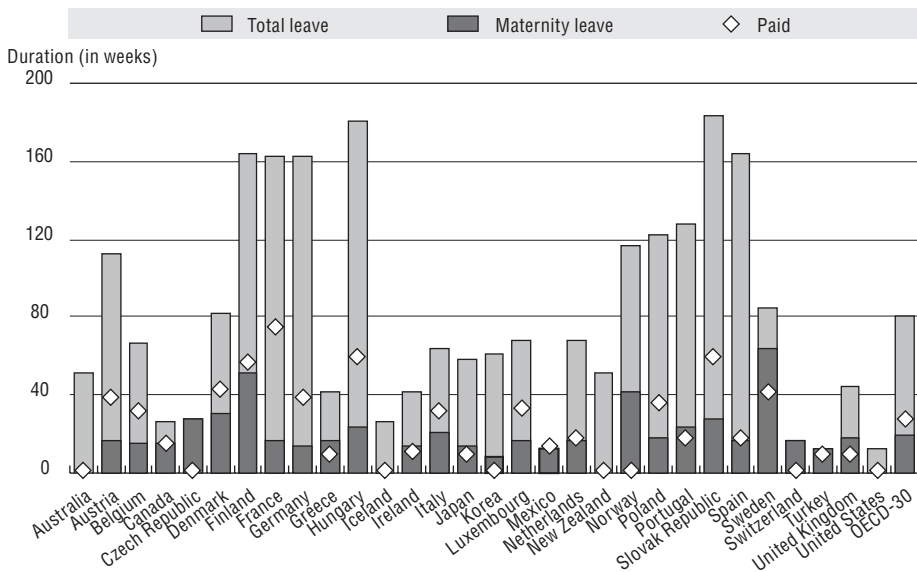
Fewer empirical studies provide estimates of the effects of maternity and parental leave provisions on fertility rates than is the case for other family policies. Those that exist suggest positive effects on the timing of childbearing and ambiguous effects on its size.<sup>21</sup>

## EMPIRICAL ANALYSIS

This section presents new regression-based estimates of the impact of public policies on total fertility rates, while controlling for a number of the other factors affecting childbearing. Cross-country panel models are estimated since fertility rates have shown strong international and intertemporal variation (*cf.* Figure 1), which can be exploited to identify the impacts of different policies. The foregoing analysis has highlighted a number of difficulties that must be confronted in modelling the determinants of fertility rates. These include the following:

- First, the range of policies that can influence fertility rates is broad, including characteristics of the tax and benefit system, educational policies, and

Figure 10. Parental leave provisions in selected OECD countries, 2002



Note: Benefits per birth are computed by dividing public spending on benefits for maternity leave by the number of births in each country. They are subsequently expressed as a percentage of the APW wage.

Source: Data on leave duration are from OECD (2006), *Reconciling Work and Family Life – Social Policies for Working Families*, forthcoming. Data on benefits paid for leaves are from the OECD Social Expenditures Database (SOCX). Data on the number of births are from *World Development Indicators*, The World Bank Group (2004).

measures that influence the labour market opportunities of parents. Even when restricted to “family policies”, the range of instruments covered is wide, and no universal definition of family policies exists.

- Second, sudden policy changes are rare, and long and variable lags in the adjustment of reproductive behaviour make it difficult to capture the specific contribution of reforms.
- Third, some explanatory variables are endogenous. Choices of both working and of having children are jointly determined at the individual's level, since women's childbearing will affect their decision regarding labour supply and *vice versa*.<sup>22</sup>
- Fourth, the difficulties in observing values of certain key variables complicate empirical estimation. For example, direct costs of children cannot be observed directly and (at the margin) they depend upon how many children parents have (Pollak and Wachter, 1975). Similarly, opportunity costs – typically proxied by the woman's (potential) market wage rate – can only be observed for women in paid jobs.<sup>23</sup>

The analysis of the links between policies and fertility rates presented in this article is based on longitudinal data and uses different dynamic specifications. While this modelling approach allows us to overcome some of the problems raised by estimation with cross-country data in a given year (*e.g.* low degrees of freedom, impossibility of controlling for dynamic and county-specific effects) the main “cost” is that no time-series data are available for some of the key variables suggested by the standard model – such as childcare availability and the impact of government taxes and transfers on the direct costs of children (D'Addio and Mira d'Ercole, 2005). The empirical analysis presented in this section is based on repeated observations over the period 1980-1999 for 16 OECD countries (Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Portugal, Spain, Sweden, the United Kingdom and the United States). The approach adopted in this paper extends the model of Gauthier and Hatzius (1997) to a broader range of policy variables, while also allowing for country-heterogeneity in dynamic effects.<sup>24</sup>

### **Econometric approach**

The model used in this article is as follows:

$$y_{i,t} = \lambda y_{i,t-1} + \beta' X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad [1]$$

which is equivalent to:

$$y_{i,t} - y_{i,t-1} = (\lambda - 1)y_{i,t-1} + \beta' X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad [1a]$$

where  $y$  is the logarithm of the total fertility rate,  $X$  is a set of variables accounting for labour market developments, proxies for economic opportunities and policy interventions;  $\mu_t$  is a time-specific effect;  $\eta_i$  is an unobserved country-specific effect and  $\varepsilon$  is the error term, with the subscripts  $i$ ,  $t$  referring to country and time-period effects respectively.

The estimation of equation 1 (or 1a) poses some specific challenges.

- First, given its dynamic specification, the presence of unobserved country-specific effects cannot be treated with a “fixed-effect” estimator: while first-differencing of each variable eliminates country-specific effects, OLS estimates cannot be used in the presence of the lagged dependent variable (which is correlated with the error term).
- Second, some explanatory variables may be endogenous with respect to changes in fertility rates, raising the possibility of simultaneous or reverse causation.
- Third, an important question for estimation is whether the data should be pooled or not, *i.e.* whether the country-specific parameters are restricted to be uniform ( $\lambda = \lambda_i$ ): pooling can produce inconsistent and biased estimates when this restriction is not valid (*i.e.* when the slope coefficients differ across countries, Pesaran and Smith, 1995).

The first and second issues can be addressed by the Generalized Method of Moments (GMM) estimator. The third issue can be addressed by estimating one equation for each country over the time-period considered and then computing the means of the estimated coefficients (“Mean Group” estimator). However, the latter method produces consistent results only if the dimension of the panel tends to infinity (Pesaran and Smith, 1995). An alternative approach for the case of small samples is provided by the “Pooled Mean Group” (PMG) estimator, which constrains the long-term coefficients to be the same but allows for different short-run coefficients. This estimator allows us to distinguish between short and long-term dynamics, while also accounting for country heterogeneity. To address endogeneity and heterogeneity in dynamics, this paper uses both the PMG and GMM-system estimators (see Appendix).<sup>25</sup>

### **Variables**

The dependent variable used in the empirical analysis is the logarithm of the total fertility rate. The specifications used are dynamic and include, among the explanatory variables, the lagged dependent variable (the logarithm of the fertility rate at time  $t-1$ ). Various explanatory variables – policies and institutional

factors discussed in the previous section – have been introduced in the equation to account for their possible impact on childbearing decisions. They are:

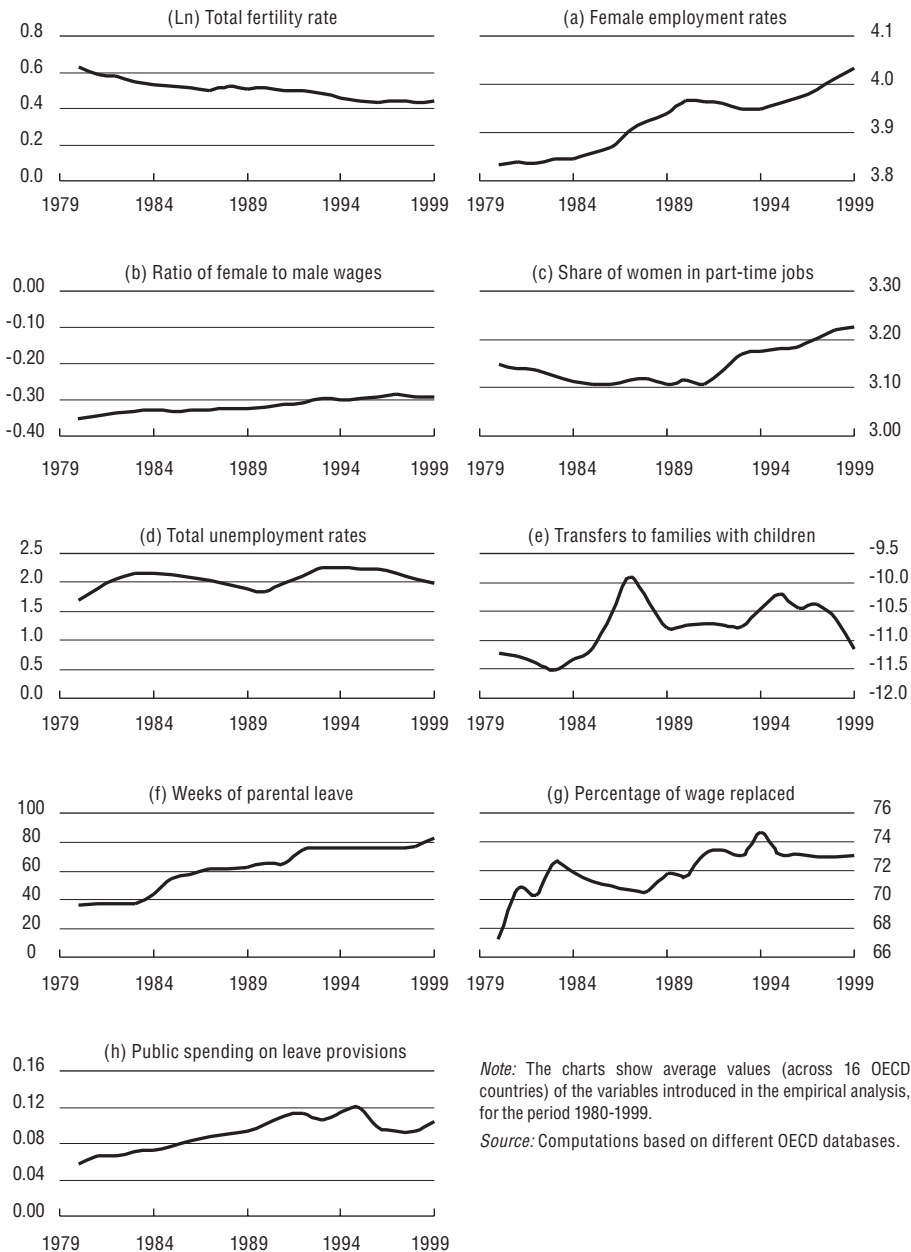
1. The employment to population ratio of women aged 15-64 (in logarithm, derived from OECD Labour Market Indicators).
2. The ratio of female to male hourly earnings in manufacturing (in logarithm, derived from OECD, Labour Market Indicators and from the ILO database on wages). This variable is used as a proxy for opportunity cost (the lower the gap between male and female wages, the higher is the income loss for women deriving from career interruptions linked to maternity).
3. The share of women in part-time jobs (in logarithm, from OECD Labour Market Indicators).
4. The total unemployment rates (in logarithm, from OECD Labour Market Indicators). This variable captures the general conditions of the labour market as they influence both opportunity costs and uncertainty in the income prospects of families.
5. Net transfers to family with children (in levels, from various issues of OECD, *Taxing Wages in OECD countries*) are computed as the difference between the average effective tax rates of a married couple with two children (aged 6 and 4) and that of a single person. Data refer to a couple where one spouse earns 100% of an APW, and to a single earning the same amount. This variable captures the combined financial effect of marriage, having a child and inactivity of the mother on family income (as opposed to the measure in Figure 7, which only relates to the financial benefits associated to the presence of children).
6. The length of parental leave, in weeks (from Jaumotte, 2003; and OECD, 2006).
7. The percentage of the wage replaced during maternity leave (in levels, from Gauthier, 2004).
8. Public spending on maternity leave benefits per birth, as a percentage of the earnings of an APW (from OECD, 2006; and OECD Social Expenditures Database).

Average levels of these variables, for the countries included in the analysis, over the period 1980-1999, are reported in Figure 11. Descriptive statistics for these variables, which distinguish between and within components, are shown in Table 1.

## **Results and discussion**

Table 2 presents results based on a model that include time effects. Estimates are obtained using a system version of the “generalised method of

Figure 11. Average values of the variables included in the panel data analysis



Note: The charts show average values (across 16 OECD countries) of the variables introduced in the empirical analysis, for the period 1980-1999.

Source: Computations based on different OECD databases.

Table 1. Descriptive statistics for the variables included in the empirical model

Variable		Mean	Std. Dev.	Min.	Max.	No. observations
Total fertility rates	overall	0.50	0.16	0.15	1.19	N = 320
	between		0.13	0.29	0.81	n = 16
	within		0.11	0.28	0.92	t = 20
Female employment rates	overall	3.92	0.27	3.23	4.37	N = 320
	between		0.26	3.40	4.30	n = 16
	within		0.09	3.62	4.24	t = 20
Ratio of women to men wages	overall	-0.32	0.17	-0.88	-0.09	N = 320
	between		0.17	-0.84	-0.11	n = 16
	within		0.04	-0.48	-0.13	t = 20
Share of women in part-time jobs	overall	3.15	0.43	2.35	4.02	N = 320
	between		0.42	2.45	3.92	n = 16
	within		0.13	2.72	3.61	t = 20
Total unemployment rates	overall	2.06	0.52	0.47	3.17	N = 320
	between		0.44	0.99	2.90	n = 16
	within		0.30	1.04	2.94	t = 20
Net cash transfers	overall	-10.78	4.42	-22.90	0.51	N = 320
	between		3.66	-19.88	-5.61	n = 16
	within		2.64	-23.94	-2.91	t = 20
Weeks of parental leave	overall	61.71	55.44	0.00	164.00	N = 320
	between		50.56	4.20	163.00	n = 16
	within		25.89	-31.64	132.56	t = 20
Wage replaced	overall	71.97	26.27	0.00	100.00	N = 320
	between		26.27	0.00	100.00	n = 16
	within		6.41	26.77	89.47	t = 20
Public spending on leave benefits	overall	0.09	0.18	0.00	0.91	N = 320
	between		0.18	0.00	0.69	n = 16
	within		0.04	-0.08	0.32	t = 20

Note: For each variable, the line labelled "overall" refers to the whole dataset; the one labelled "between" refers to the variation of the means for each country across time periods; the one labelled "within" refers to the deviation from the respective mean for each country (hence the possibility of negative values). N is the total number of observations; n is the number of countries and t is the number of time periods.

Source: Computations based on different OECD databases.

moments" (GMM system). and a "pooled mean group" (PMG) estimator. For comparative purposes, Table 2 also reports estimates from the pooled ordinary least squares model. In general, estimates of the coefficients from both the GMM system and the PMG models have high stability and are robust to various misspecification tests.<sup>26</sup> Also, coefficients for the time trend are significant, while those for the lagged dependent variable are always large, suggesting that policy changes take a long time to have their full effect on fertility rates.

Table 2. Panel data analysis: estimates for the period 1980-1999

Variable	POLS		GMM-SYS		PMG	
(Ln) Total fertility rate (t-1)	0.898**	[0.021]	0.898**	[0.019]	-0.648**	[0.115]
(Ln) Female Employment rates	0.071**	[0.018]	0.071**	[0.021]	0.307**	[0.088]
(Ln) Ratio of women to men wages	-0.022	[0.024]	-0.022	[0.011]	-0.339**	[0.103]
(Ln) Share of women in part-time jobs	0.019	[0.010]	0.019*	[0.008]	0.161**	[0.024]
(Ln) Total unemployment rates	-0.018*	[0.009]	-0.018	[0.015]	-0.032**	[0.013]
Transfers to families with children	-0.000	[0.000]	-0.002	[0.001]	-0.010**	[0.001]
Total length of parental leave (weeks)	-0.000**	[0.000]	-0.000	[0.000]	-0.003**	[0.000]
Percentage of wage replaced during maternity leave	-0.002	[0.001]	0.000	[0.000]	0.009**	[0.001]
Public spending in leave benefits	0.000	[0.000]	-0.000**	[0.000]	-0.000	[0.000]
Time effect	Yes**		Yes**		Yes**	
R-squared	0.9480					
Sargan test (p-value)			1.000			
m1 test (p-value)			0.035			
m2 test (p-value)			0.161			

Note: The 1st column reports (short run) estimates from the pooled OLS regression model with a common slope and common parameters (POLS); the dependent variable is the logarithm of the total fertility rate. The 2nd column reports (short run) estimates obtained with the GMM system (GMM SYS) estimator that allows for different slopes (which vanish when first differencing the variables); the dependent variable is the logarithm of the total fertility rate. The 3rd column reports (long run) estimates obtained through the pooled mean group (PMG) estimator, which uses the first difference of the total fertility rate as dependent variable. The coefficient associated to the lagged fertility rates shown in column 2 (GMM SYS) corresponds to the parameter  $\lambda$  as specified in the Appendix; that shown in column 3 (PMG) corresponds to the parameter  $\phi$  as specified in the same Appendix [where  $\lambda = -(1 - \phi)$ ]. The intercept is also estimated as part of the short run dynamics in the three models. Robust standard errors are reported in brackets. \*\* and \* denote coefficients that are statistically significant at the 1% and 5% level, respectively.

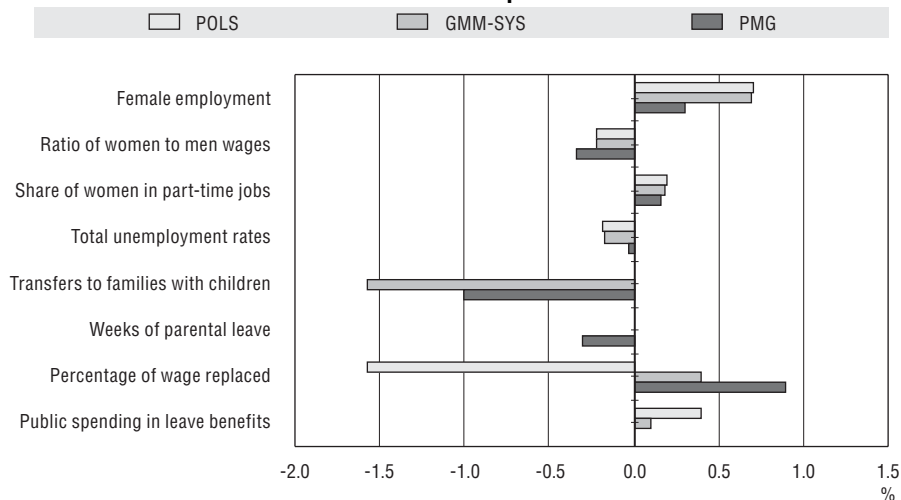
Source: Authors' calculations based on OECD data.

Figure 12 shows the long-term effects for each of the explanatory variables included in the estimated equation, under the three different models. Most of these long-term effects have the same sign, whatever the model used, but they differ in their size. When looking at the PMG estimates (which are all statistically significant with the exception of public spending on leave benefits) several features stand out:

- The positive coefficient on the female employment rate suggests that increasing the financial security of women through their participation in the paid labour market has an important positive effect on their childbearing decisions.
- The greater is the ratio of female to male wages the lower is the fertility rate. This effect may reflect the effect of job segregation, i.e. the concentration of women in “sheltered” jobs and sectors that pay lower wages but grant other advantages to mothers. For example, in the Nordic countries, where fertility rates are relatively high, the high concentration of women in the public sector translates into a low ratio of female to male wages.



Figure 12. Long-term effects of different drivers on total fertility rates under three different specifications



*Note:* Long-term effects of the explanatory variables on fertility rates take into account the coefficient of the lagged dependent variable shown in Table 2. For variable expressed in logarithms, long-term effects reflect the percentage change in total fertility rates associated to a one percent change in the explanatory variable; for variables expressed in levels, long-term effects refer to the percentage change in total fertility rates associated to a unit change in the explanatory variables.

*Source:* Computations based on Table 2.

- The positive coefficient for part time employment suggests that short working hours may allow women to remedy the absence of caring structures. This finding is consistent with results reported by Del Boca (2002), Cette *et al.* (2005) and Zuzanek (2001).
- The negative coefficient of total unemployment rate implies that persistent cross country differences in unemployment matter for fertility rates. This suggests that unemployment is an important concern when couples consider having a child, a result consistent with finding from other studies (*e.g.* Gauthier and Hatzius, 1997; Adsera, 2004; Kravdal, 2002).
- Lower public transfers to families with children, provided by both the tax and benefits systems, decrease fertility rates.<sup>27</sup>
- A longer parental leave lowers fertility rates. This result may appear counter-intuitive, but is consistent with the argument that a longer detachment from the labour market make more difficult for mother to re-enter it. The interpretation of this finding is complicated by the fact that leave provisions are more important in countries with fewer out-of-home caring facilities.<sup>28</sup> Previous studies point to ambiguous results as to the effect of longer parental

leave on fertility rates; however, most of these evaluations – that provide indirect evidence on the opportunity costs of childbearing – have focused on the effects of length of maternity leave on female labour supply, rather than on childbearing *per se*.<sup>29</sup>

- A higher wage replacement rate during maternity leave contributes to higher fertility rates. This positive effect of maternity leave benefits on fertility rates contrasts with the negative one associated to benefit duration. Partly as a result, the coefficient of the expenditure variable, which captures the combined effect of duration and generosity of child related leave, is not statistically significant.<sup>30</sup>

These results are consistent with the view that a range of policies and institutions affect childbearing decisions, and confirm findings from a simple cross-section model referring to 19 OECD countries in 1999 (D’Addio and Mira d’Ercole, 2005).<sup>31</sup> These results should however be treated with caution. First, because of data limitations, some important variables that affect childbearing and fertility rates are excluded from the analysis. Second, the analysis does not address the differential impact of the policies on sub-groups of the population (*e.g.* with different levels of income, or education). Finally, the analysis does not differentiate policy impacts according to birth order.

## CONCLUSIONS

This article has discussed how a range of structural factors have contributed to the decline in fertility rates observed over the past three decades in most OECD countries. With fertility rates now well below replacement in most countries, many OECD countries are paying increasing attention to policies that may lessen the obstacles to childbearing faced by individuals. The focus of this article has been on some of these policies, with special emphasis to those that reduce the costs of children borne by families.

The results of the regression analysis, which makes use of longitudinal data for 16 OECD countries and different econometric approaches to verify the robustness of the key results, confirms that a range of policies influence childbearing decisions. These include transfers to families that reduce the direct cost of children, as well as provisions that allow mothers to better reconcile their family and career responsibilities. OECD countries with very different characteristics such as the United States, France and several Nordic countries have fertility rates that are close to those needed to assure the stability of their population. While the configuration of factors that has led to this positive result differ across countries, these “successes” reflect, at least in part, the presence of policies and arrangements that have contributed to lower the costs of children borne by families. The same range of policies holds the promise of being effective elsewhere.

32

## Notes

1. Some of the main arguments in this discussion are provided by Chesnais (1986, 1996, 1999); Prinz *et al.* (1998); Lesthaeghe and Willems (1999); Ogawa (1997, 2003); Calot and Sardon (2001); Atoh *et al.* (2001); Gauthier (1996, 2001, 2004); Lesthaeghe (2001); Lutz (2000a; 2000b); McDonald (2000a, 2000b, 2000c); Sardon (2002); Goldstein *et al.* (2003); Atoh and Akachi (2003); Neyer (2003); Frejka and Sardon (2004); Ogawa *et al.* (2004); Sobotka (2004); Lutz *et al.* (2005).
2. In the 20th century, explicit pro-natalist policies featured in the experience of several industrialised countries, as a way of assuring strong national populations and expansion abroad (big workforces, big armies). These policies were often associated with measures favouring the deliberate breeding of people for certain selected heritable traits (eugenics).
3. Surveys of governments' views about the levels of fertility rates in their countries (such as those undertaken by the United Nations Population Division) confirm this change. Less than 30 years ago, the overwhelming majority of OECD governments considered the level of the fertility rates prevailing in their country as "satisfactory", with only a few countries considering it as either "too high" or "too low"; today, most OECD countries consider the fertility rate prevailing in their country as "too low", with only two countries regarding it as "too high" and a (sizeable) minority of (12) OECD countries regarding it as "satisfactory". Policy developments have lagged this change in perceptions concerning fertility rates: most (15) OECD governments continue to favour no explicit interventions in this field, even if the number of countries expressing a preference for explicit policies to influence childbearing has increased over time (from 4 in 1976 to 10 in 2003) and includes today one of the countries that in the recent past supported interventions aimed at lowering fertility rates (Korea). See D'Addio and Mira d'Ercole (2005) for a description of these survey results.
4. Continuous low fertility rates may result in a "low fertility trap" for countries that have fertility rates lower (or equal) than 1.5. See on this Lutz *et al.* (2005).
5. On the issue of the postponement of childbirth see for example Sobotka (2004), Frejka and Sardon (2004), Lutz and Goldstein (2005).
6. Besides contributing to the decline of fertility rates (through the reduction in the number of children of parity higher than one and the increase in childlessness), postponement may impair mothers' and children's health and well-being (D'Addio and Mira d'Ercole, 2005).
7. Among these problems are the difficulty in distinguishing between personal desires for their own conditions and societal norms about what is considered to be the "ideal" family size; the dependence of responses on conditions that may change over the life-course of

the individual; the adaptation of fertility intentions to actual experience; and the fact that survey questions may fail to specify the determinants of fertility intentions.

8. Further extensions of this model are provided in Becker and Lewis (1973), Becker (1981) and Cigno (1991; 1994). See also Barmby and Cigno (1990).
9. Demand for children is jointly determined by “substitution” and “income” effects. When the substitution effect prevails on the income effect, quality will be preferred over quantity of children. This theory suggests a negative relation between family size (quantity) and resources devoted to each child (quality). In practice, empirical evidence is more diverse – *e.g.* Black *et al.*, (2004) show that in Norway the negative effect of family size on child education vanishes once the birth order is controlled for. See also Rosenzweig and Wolpin (1980).
10. Higher education of women affects childbearing also through other channels. Longer periods in education imply an increase in the mean age of women at first childbirth and a reduction in the number of years in which they can have additional children. Higher educational achievement may also change women’s desires for children as compared to other goals, providing women with greater autonomy in many spheres of life. Better educated women are also more aware of health problems and contraception technologies, and more capable of avoiding undesired pregnancies. Several studies have provided evidence of a negative association between childbearing and educational attainment of women (Adsera, 2004; Blossfeld *et al.* 1995; Corjin and Klizijng, 2000; Hullén, 2000). One reason for this negative association is that, as education and income are related, the cost of interrupting a career is higher for more educated women than for less educated ones. See also Ringen (1998).
11. A negative relation between paid-employment and childbearing has been empirically documented by Butz and Ward (1979) for the United States and by Mincer (1985) on a cross-country basis.
12. The focus here is on unemployment of both women and men, as both may influence the economic security of couples and, hence, their childbearing decisions.
13. Several other studies find evidence of a negative correlation between fertility rates and either total or female unemployment rates (for example Adsera, 2004; Gauthier and Hatzius, 1997).
14. Liefbroer and Corijn (1999) distinguish between “structural-role” incompatibility, which relates to the actual social opportunities available to women and to the constraints that they face when trying to take advantage of them; and “cultural” incompatibility, which relates to the broad ideologies, values and norms concerning the role of women in the society.
15. Because of the lack of comparable data on some variables (*e.g.* childcare provisions), few studies have investigated the relation between fertility rates and policies across countries, and most of the evidence on the impact of policies relies on research on individuals in specific countries. Despite these differences in approaches, Sleebos (2003), based on a review of the literature, concluded that “most empirical analyses suggest a weak positive relation between reproductive behaviour and a variety of policies; findings are however often inconclusive and contradictory, partly because of methodological differences among studies, and partly because of differences in the range of policies considered”.
16. For example, when the elasticity of household needs is based on the square root of household size, a couple with one child is assumed to incur additional costs of 22% of

its gross household income, of 41% in the case of two children and of 58% in the case of three children.

17. Higher cash benefits and tax credits to families with children will both reduce the cost of children and increase household income; while the first will increase demand for children, the higher household income may also shift demand towards children of higher “quality”, thereby reducing the number of children demanded by parents.
18. Barmby and Cigno (1990) found that child benefits speed up the onset of motherhood in the United Kingdom. Ermisch (1988a, 1988b) also reports that financial transfers affect the timing of births but not family size. Conversely, Whittington *et al.* (1990) and Whittington (1992) found that a tax relief in the United States had positive effects on family size, and similar results are reported for Canada by Zhang *et al.* (1994). Laroque and Salanié (2004) suggest that the 1994 French reform may have increased births of order 2 by 11%, while reducing births of order three by around 2%; their estimates also suggest that the reform of family benefits in 2004 (*Prestation d’Accueil au Jeune Enfant*), which had explicit pro-natalist objectives, may have increased births by close to 5% (Landais, 2003; Di Prete *et al.*, 2002). The analyses of Gauthier and Hatzius (1997) and Ekert-Jaffé (1995) also report a positive impact of financial transfers on fertility rates.
19. Using data referring to individuals, Blau and Robins (1998; 1989) find that public childcare availability has an important positive effect on fertility rates, while higher childcare costs have a negative one. Similar results for Italian women are reported by Del Boca *et al.* (2003), using a model where women’s decisions to participate in the labour market and to have children are jointly determined. Ermisch (1989) also concludes that availability of market-provided childcare in some OECD countries has lessened the reduction of fertility rates associated to higher labour force participation of women (see also Kamerman, 2000). Castles (2004, based on data for 20 OECD countries in 1998) and D’Addio and Mira d’Ercole (2005, using data for 19 OECD countries in 1999) also confirm that childcare is a key determinant of childbearing.
20. Exceptions include the Scandinavian countries (where most women are covered), the Netherlands (where some temporary and part-time workers are covered) and Germany (where mothers in education or who are unemployed are covered). In Southern European countries, entitlement often depends on having a contract for permanent employment.
21. Andersson (2001) suggests that the introduction of a “speed premium” in the parental-leave system of Sweden accelerated childbearing decisions, by reducing the spacing between the first and second births. Rønsen (2004) concludes that the extension of maternity leave had a positive impact on fertility rates in Norway and Finland (especially in the latter country) and for higher order births.
22. Several authors have addressed the endogeneity of childbearing decisions with respect to labour force participation through the use of instrumental variables (Browning, 1992) but suitable instruments are hard to identify: when both childbearing and labour market participation are the joint result of household’s maximization of their expected lifetime utility – under budget and time constraints, and using an explicit dynamic framework – both variables will depend on the whole sequence of prices and wages (which themselves may be endogenous) and on household preferences (Engelhardt and Prskawetz, 2004; Kögel, 2002; Del Boca, 2002; Del Boca *et al.*, 2003). Endogeneity is also an issue when estimating the impact of transfers to families on birth rates, since countries’ characteristics not included in the model may be correlated with both fertility rates and family transfers’ expenditures.

23. One approach, used by some studies, to proxy the wage rate of non-employed women is to impute them a wage based on their personal and labour market characteristics: this imputed wage is based on the assumption that they could earn the same wage as their employed counterparts with comparable characteristics. However, this assumption has been questioned. For example, because of sample selection or selectivity bias, Heckman (1979) argued that the structure of wages among employed women is different from that for other women. This argument implies that the imputation procedure just described would give biased estimates of the opportunity cost for non-employed women. Heckman and others have developed techniques to adjust for sample selection bias. These techniques typically entail a two-stage or maximum-likelihood estimation procedure in which, first, the likelihood of a woman being in the workforce is determined as a function of her characteristics and, second, this likelihood is used to generate unbiased estimates of the opportunity cost of time for all women.
24. Gauthier and Hatzius (1997) model the dynamic relation between fertility rates and policies for 22 OECD countries over the period 1970-1990. Other studies using country-level data spanning several years include Ekert-Jaffé (1986) and Blanchet and Ekert-Jaffé (1994), which investigate the effect of family benefits using data for 7 and 11 countries, respectively, over the period 1970-1983; and Adsera, (2004), which studies the relation between fertility rates and institutions in 21 OECD countries. In general, all these articles report evidence of a positive relation between fertility rates and a range of policies.
25. An alternative way of addressing the issue of endogeneity would have been to model jointly the fertility and employment decisions of women. This would however require the use of individual data.
26. With respect to the GMM estimator, both the Sargan test for over-identifying restrictions and the m2 test of second-order correlation in first differences of the error term do not reject the validity of this estimator. With respect to the PMG estimators, the Hausman test – which compares the “pooled mean group” and the “mean group” estimates – does not reject the first specification; the Schwartz Bayes criterion (SBC) of search of the lag order pointed at the existence of an ARDL(1,0) – auto-regressive distributed lag process – in most countries (Canada, Denmark, Finland, France, Greece, Italy, Ireland, Japan, Portugal, Spain and Sweden). For data parsimony, the coefficient estimates are therefore obtained using a partial adjustment model.
27. The magnitude of the coefficient shown in Table 2 implies that, for the year 1990, a 25% increase in financial transfers to families with children translates into a long-run increase of 0.05 children per women. This increase is half-way between that of 0.04 children per women (following a 25% increase in the family benefit index) in Ekert-Jaffé (1994) and of 0.07 children per women (associated to a similar increase in the family allowance-earnings ratio) reported in Gauthier and Hatzius (1997).
28. While controlling for childcare availability might have allowed testing for this hypothesis, this was not possible due to the lack of longitudinal data on childcare.
29. Nizalova reports results similar to those in Table 2 (a negative coefficient linking fertility rates and the duration of parental leave); Gauthier and Hatzius (1997) and Adsera (2004), however, both report a positive coefficient linking fertility and parental leave, which is statistically significant only in the second study (which does not allow for dynamic effects).
30. Leave that is unpaid may be a more immediate concern for some families with children. In the longer term, mothers that return to work after childbirth appear to face high wage penalties and worsened earnings prospects in many countries (Ruhm, 1998). For

mothers paid relatively high earnings, those penalties increase the indirect cost of childbearing.

31. Despite the lower degrees of freedom, the cross sectional specification allows distinguishing between direct and indirect costs of children, and controlling for some additional determinants of childbearing decisions (*i.e.* childcare availability and differences in the views with respect to family and gender roles held by men and women of different ages). Based on this specification, total fertility rate appear to be significantly higher in OECD countries with lower direct costs of children, higher provision of childcare, longer parental leaves and a higher share of part-time work in female employment.

## BIBLIOGRAPHY

- Adsera, A. (2004), "Changing Fertility Rates in Developed Markets. The Impact of Labor Market Institutions", *Journal of Population Economics*, 17, pp. 17-43.
- Ahn, N. and P. Mira (2002), "A Note on the Changing Relationship between Fertility and Female Employment Rates in Developed Countries", *Journal of Population Economics* 15(4)4, pp. 667-682.
- Andersson, G. (2001), "The Impact of Labour-Force Participation on Childbearing Behavior: Pro-cyclical Fertility in Sweden during the 1980s and the 1990s", *European Journal of Population*, 16, pp. 293-313.
- Arellano, M. and S. Bond (1991), "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations", *Review of Economic Studies*, Vol. 58, pp. 277-297.
- Arellano, M. and O. Bover (1995), "Another Look at the Instrumental-Variable Estimation of Error-Components Models", *Journal of Econometrics*, 68, pp. 29-52.
- Atoh, M., V. Kandiah and S. Ivanov (2001), "The Second Demographic Transition in Asia", paper presented at the IUSSP Conference "Perspectives on Low Fertility: Trends, Theories and Policies", 21-23 March, Tokyo.
- Atoh, M. and M. Akachi (2003), "Low Fertility and Family Policy in Japan – in an International Comparative Perspective", *Journal of Population and Social Security* (Population), Supplement to Volume 1.
- Barmby, T. and A. Cigno (1990), "A Sequential Probability Model of Fertility Patterns", *Journal of Population Economics*, Vol. 3(1), pp. 31-51.
- Becker, G. (1960), "An Economic Analysis of Fertility", in *Demographic and Economic Change in Developed Countries*, Princeton, NBER.
- Becker, G. (1981), *A Treatise of the Family*, Harvard University Press.
- Becker, G.S. and G.H. Lewis (1973), "On the Interaction between the Quantity and Quality of Children", *Journal of Political Economy*, 81: S279-S288.
- Black, S.E., P.J. Devereux and K.G. Salvanes (2004), "The More the Merrier? The Effect of Family Composition on Children's Education", NBER *Working Paper* No. 10720, National Bureau of Economic Research.
- Blanchet, D. and O. Ekert-Jaffé (1994), "The Demographic Impact of Family Benefits: Evidence from a Micro-Model and from Macro-Data", in John Ermisch and Naohiro Ogawa (eds), *The Family, the Market and the State in Ageing Societies*. Oxford: Clarendon Press, pp. 79-104.
- Blau, D.M. and P.K. Robins (1989), "Fertility, Employment, and Child-Care Costs", *Demography*, 26(2), pp. 287-299.



- Blossfeld, H.-P. (1995), *The New Role of Women: Family Formation in Modern Societies*, ed. by H.-P. Blossfeld, Westview Press, Boulder.
- Blundell, R. and S. Bond (1998), "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *Journal of Econometrics*, 87, pp. 115-43.
- Browning, M. (1992), "Children and Household Economic Behavior", *Journal of Economic Literature*, Vol. XXX, pp. 1434-1475.
- Calot, G. and J.-P. Sardon (2001), "Fécondité, reproduction et remplacement", *Population*, 56(3), pp. 335-394.
- Castles, F. (2004), *The Future of the Welfare State – Crisis Myths and Crisis Realities*, Oxford University Press.
- Cette, G., N. Drome and D. Méda (2005), "Conciliation entre vies professionnelle et familiale et renoncements à l'enfant", *Revue de l'OFCE*, No. 92.
- Chesnais, J.-C. (1986), "La transition démographique. Étapes, formes, implications économiques", *Cahier INED*, No. 113, Paris.
- Chesnais, J.-C. (1996), "Fertility, Family and Social Policy in Contemporary Western Europe", *Population and Development Review*, 22(4), pp. 729-739.
- Chesnais, J.-C. (1999), "The Future of French Fertility: Back to the Past or a New Implosion?", *Population Bulletin of the United Nations*, 40-41, pp. 212-217.
- Cigno, A. (1991), *Economics of the Family*, Oxford: Clarendon Press.
- Corijn, M. and E. Klijzing (2001), "Transition to Adulthood: Conclusions and Discussion" in *Transition to Adulthood*, (*European Studies of Population*) ed. M. Corijn and E. Klijzing, Kluwer, Dordrecht.
- D'Addio, A.C. and Mira d'Ercole (2005), "Fertility Trends and Determinants: the Role of Policies", *Social Employment and Migration Working Papers*, No. 27, Directorate of Employment, Labour and Social Affairs, OECD, Paris.
- Del Boca, D. (2002), "The Effect of Child Care and Part Time on Participation and Fertility of Italian Women", *Journal of Population Economics*, 14.
- Del Boca, D., M. Locatelli, S. Pasqua, C. Pronzato (2003), *Analysing Women's Employment and Fertility Rates in Europe: Differences and Similarities in Northern and Southern Europe*, WP Child, Turin.
- Di Prete, T., H. Engelhardt, P. Morgan and H. Pacalova (2002), "Do Cross-National Differences in the Costs of Children Influence Fertility Behavior?", Discussion Paper 355, DIW, Berlin.
- Engelhardt, H. and A. Prskawetz (2004), "On the Changing Correlation Between Fertility and Female Employment over Space and Time", *European Journal of Population*, Vol. 20, No. 1, pp. 35-62.
- Ekert-Jaffé, O. (1986), "Effets et limites des aides financières aux familles : Une expérience et un modèle", *Population*, Vol. 41, No. 2, pp. 327-348.
- Ermisch, J. (1988a), "Econometric Analysis of Birth Rate Dynamics in Britain", *The Journal of Human Resources*, 23, pp. 563-576.
- Ermisch, J. (1988b), "Economic Influences on Birth Rate" *National Institute Economics Review*, November, pp. 71-81.
- Ermisch, J. (1989), "Purchased Child Care, Optimal Family Size and Mother's Employment: Theory and Econometric Analysis", *Journal of Population Economics*, No. 2, pp. 79-102.

- European Foundation (2004), "Fertility and Family Issues in an Enlarged Europe", Final Report, Dublin.
- Frejka, T. and J.-P. Sardon (2004), *Childbearing Prospects in Low-Fertility Countries: A Cohort Analysis*, Dordrecht, Kluwer Academic Publishers.
- Gauthier, A.H. (2004), "Comparative Maternity, Parental, and Childcare Leave and Benefits Database", version 2, A *Comparative Research Project*, University of Calgary.
- Gauthier, A.H. and J. Hatzius (1997), "Family Benefits and Fertility: An Econometric Analysis", *Population Studies*, 51.
- Gilbert, N. (2005), "What Do Women Really Want?", [www.thepublicinterest.com/current/article2.html](http://www.thepublicinterest.com/current/article2.html).
- Goldstein, J., W. Lutz and M.R. Testa (2003), "The Emergence of Sub-Replacement Family Size Ideals in Europe", *European Demographic Research Papers No. 2*, Vienna Institute of Demography of the Austrian Academy of Sciences.
- Goldstein, J. and W. Lutz (2005), "How Long can Postponement Continue?", *International Meeting on Postponement of Childbearing in Europe*, 1-3 December 2005, Vienna.
- Heckman, James J. (1979), "Sample Selection Bias as a Specification Error", *Econometrica*, 47(1), pp. 153-161.
- Immervoll, H. and D. Barber (2005), "Can Parents Afford to Work? Childcare Costs, Benefits and Work Incentives", *OECD Social, Employment and Migration Working Paper*, forthcoming, OECD, Paris.
- Judson, R.A. and A.L. Owen (1997), "Estimating Dynamic Panel Data Models: A Practical Guide for Macroeconomists" *Finance and Economics Discussion Paper 1997-3*, Federal Reserve Board, Washington DC.
- Kiviet, J. (1995), "On Bias, Inconsistency and Efficiency of Various Estimators in Dynamic Panel Data Models", *Journal of Econometrics*, Vol. 68, pp. 53-78.
- Kamerman, S.B. (2000), "Early Childhood Education and Care (EDEC): An Overview of Developments in the OECD Countries", *Institute for Child and Family Policy*, Columbia University, [www.childpolicy.org](http://www.childpolicy.org).
- Kögel, T. (2002), "Did the Association between Fertility and Female Employment Within OECD Countries Really Change its Sign?", *Working Paper WP 2001/034*, Max Planck Institute for Demographic Research, Rostock.
- Landais, C. (2003), "Le quotient familiale a-t-il stimulé la natalité française?" DEA thesis.
- Laroque, G. and B. Salanié (2003), "Fertility and Financial Incentives in France", *CEPR Discussion paper*, DP4064.
- Lesthaeghe, R. (2001), "Postponement and Recuperation: Recent Fertility Trends and Forecasts in Six Western European Countries" paper presented at the conference *International Perspectives on Low Fertility: Trends, Theories and Policies*, Tokyo, 21-23 March.
- Lesthaeghe, R. and P. Willems (1999), "Is Low fertility a Temporary Phenomenon in the European Union?", *Population and Development Review*, Vol. 25, No. 2, pp. 211-228.
- Leibenstein, H. (1957), *Economic Backwardness and Economic Growth*, New York: Wiley & Sons, Inc., pp. 147-175.
- Liefbroer, A.C. and M. Corijn (1999), "Who, What, Where and When? Specifying the Impact of Educational Attainment and Labor Force Participation on Family Formation", *European Journal of Population*, 15, pp. 45-75.

- Lutz, W. (2000a), "Determinants of Low Fertility and Ageing Prospects for Europe", in Sylvia Trnka (ed.), *Family Issues between Gender and Generations*. Seminar Report, produced by the European Observatory on Family Matters at the Austrian Institute for Family Studies, Vienna, Austria. Luxembourg: Office for Official Publications of the European Communities, pp. 49-65.
- Lutz, W. (2000b), "Low Fertility and Population Policy in Europe", in *Low Fertility and Policy Responses to Issues of Ageing and Welfare*, Research Paper 2000-1, Seoul: Korea Institute for Health and Social Affairs and the United Nations Population Fund (UNFPA).
- Lutz, W., V. Skirbekk and M.R. Testa (2005), "The Low Fertility Trap Hypothesis", International Meeting on Postponement of Childbearing in Europe, 1-3 December, Vienna.
- McDonald, P. (2000a), "The 'Toolbox' of Public Policies to Impact on Fertility – a Global View", paper presented at the seminar on Low fertility, families and public policies, organised by the European Observatory on Family Matters in Seville, September 15-16.
- McDonald, P. (2000b), "Gender Equity, Social Institutions and the Future of Fertility", *Journal of Population Research*, 17(1), pp. 1-16.
- McDonald, P. (2000c), "Gender Equity in Theories of Fertility", *Population and Development Review*, 26(3).
- Neyer, G.R. (2003), "Family Policies and Low Fertility in Western Europe", Max Planck Institute for Demographic Research, WP-2003-021.
- Nickell, S. (1981), "Biases in Dynamic Models with Fixed Effects", *Econometrica*, Vol. 49, pp. 1417-1426.
- Nizalova, O. (2000), "Economic and Social Consequences of Maternity Protection: A Cross Country Analysis", URL: [www.gdnet.org/pdf/948\\_Nizalova\\_paper2000-1.pdf](http://www.gdnet.org/pdf/948_Nizalova_paper2000-1.pdf).
- OECD (2001a), *Employment Outlook*. OECD, Paris.
- OECD (2001b), *Society at a Glance – OECD Social Indicators*, OECD, Paris.
- OECD (2005a), *Society at a Glance – OECD Social Indicators*, OECD, Paris.
- OECD (2006), *Reconciling Work and Family Life – Social Policies for Working Families*, forthcoming, OECD, Paris.
- Ogawa, T. (1997), "Demographic Trends and Their Implications for Japan's Future", transcript of a speech delivered on March 7, Japan Information Center in San Francisco.
- Ogawa, T. (2003), "Japan's Changing Fertility Mechanisms and its Policy Responses", *Journal of Population Research*, Vol. 20 (1), pp. 89-106.
- Ogawa, T., C.-F. Ko and K.Y.-M. Oh (2004), "Implications of Population Ageing in East Asia – An Analysis of Social Protection and Social Policy Reforms in Japan, Korea and Taiwan", paper presented at the conference of the International Sociological Association, *Ageing Societies and Ageing Sociology: Diversity and Change in a Global World*, United Kingdom.
- Pesaran, M.H. and R.P. Smith (1995), "Estimating Long-Run Relationships from Dynamic Heterogeneous Panels", *Journal of Econometrics*, 68, pp. 79-113.
- Pesaran, M.H., Y. Shin and R.P. Smith (1999), "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels", *Journal of the American Statistical Association*, Vol. 94, pp. 621-634.
- Pesaran, M.H., Y. Shin and R.J. Smith (2001), "Bounds Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics*, 16, pp. 289-326. [Special Issue in Honour of J.D. Sargan on the theme "Studies in Empirical Macroeconometrics", (eds) D.F. Hendry and M.H. Pesaran.]

- Prinz, C., W. Lutz, V. Nowak and C. Pfeiffer (1998), "Fertility and Family Surveys in Countries of the ECE Region: Standard Country Report", Austria (United Nations, New York).
- Rønsen, M. (2004), "Fertility and Family Policy in Norway – A Reflection on Trends and Possible Connections", *Demographic Research*, Vol. 10, No. 10, Max Planck Institute for Demographic Research.
- Rosenzweig, M.R., and K. Wolpin (1980), "Testing the Quantity-Quality Fertility Model: The Use of Twins as a Natural Experiment", *Econometrica* 48(1), pp. 227-240.
- Ruhm, C.J. (1998), "The Economic Consequences of Parental Leave Mandates: Lessons from Europe", *Quarterly Journal of Economics*, Vol. 43 (1), pp. 285-317.
- Sardon, J-P. (2002), "Évolution démographique récente des pays développés", *Population*, No. 10.
- Sleeboos, J. (2003), "Low Fertility in OECD Countries: Facts and Policy Responses", OECD *Social, Employment and Migration Working Papers*, No. 15, OECD, Paris.
- Sobotka, T. (2004), "Is Lowest-Low Fertility in Europe Explained by the Postponement of Childbearing?", *Population and Development Review*, 30(2), pp. 195-220.
- Ringen, S. (1998), *The Family in Question*, DEMOS, London.
- The World Bank Group (2004), *World Development Indicators*.
- Van de Kaa, D.J. (1987), "Europe's Second Demographic Transition", *Population Bulletin* (Population Reference Bureau), 42.
- Whittington, L.A. (1992), "Taxes and the Family: the Impact of the Tax Exemption for Dependents on Marital Fertility", *Demography*, Vol. 29, No. 2, pp. 215-226.
- Whittington, L.A., J. Alm and H.E. Peter (1990), "The Personal Exemption and Fertility: Implicit Pronatalist Policy in the US", *American Economic Review*, Vol. 80, No. 2, pp. 545-556.
- Willis, R. J. (1973), "A New Approach to the Economic Theory of Fertility Behavior", *Journal of Political Economy*, 81, pp. S14-S64.
- World Values Survey (1981, 1990, 1995, 2000) database, World Values Study Group; [www.worldvaluessurvey.org](http://www.worldvaluessurvey.org). For the last wave see also (2004) *Human Beliefs and Values*, Inglehart, R., M.I. Basanez, J.D. Medrano, L.H. Alman and R. Luijk (eds).
- Zhang, J., J. Quan and P. Van Meerbergen (1994), "The Effect of Tax-Transfer Policies on Fertility in Canada, 1921-1988", *Journal of Human Resources*, 29, pp. 181-201.
- Zuzanek, J. (2001), "Parenting Time: Enough or too Little?", *Canadian Journal of Policy Research*, Vol. 2(2), pp. 133-125.

## Appendix I

## Econometric Models for the Analysis of Panel Data

The results presented in the section “Empirical Analysis” are obtained from the estimation of a linear dynamic model of fertility rates based on panel data. The model extends the specification used by Gauthier and Hatzius (1997) to account for the increase in female labour force participation and other labour market characteristics (incidence of part-time jobs). The specific feature of the formulation used by Gauthier and Hatzius is the introduction of the lagged dependent variable in the fertility rate equation, to account for potential long lags of the effects of policies on fertility rates. In the paper, two estimators are used, GMM-system and PMG, which are described here below.

The equation for fertility rates can be written as:

$$y_{i,t} = \lambda y_{i,t-1} + \beta' X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad [\text{A.1}]$$

which is equivalent to:

$$y_{i,t} - y_{i,t-1} = (\lambda - 1)y_{i,t-1} + \beta' X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \quad [\text{A.2}]$$

where  $y$  is the logarithm of the total fertility rate,  $X$  is a set of variables accounting for labour market developments, policies interventions and proxies for economic opportunities;  $\mu_t$  is a time-specific effect;  $\eta_i$  is an unobserved country-specific effect; and  $\varepsilon$  is the error term. The subscripts  $i$ ,  $t$  refer to country and time-period effects respectively.

## GMM estimators

GMM estimators address problems arising out of the simultaneity bias that is implied by the presence of the lagged dependent variable (Nickell, 1981; Kiviet 1995).<sup>1</sup> To this purpose the GMM-estimator (GMM-SYS) developed by Arellano and Bover (1995) and Blundell and Bond (1998) is applied here. Using the first-difference operator and ignoring the time-specific effect, equation A.2 can be written as:

$$\Delta y_{i,t} = \lambda \Delta y_{i,t-1} + \theta' \Delta X_{i,t} + \Delta \varepsilon_{i,t} \quad [\text{A.3}]$$

where  $\Delta$  is the first-difference operator.

The *system* version of the generalized method of moments (GMM-SYS) estimator combines the moment conditions obtained from the equation in first differences (equation A.3) with the extra moment conditions obtained from the equation in levels (equation A.1). Because it uses the extra information from the untransformed model, the system GMM esti-