Old Habits Die Hard (Sometimes)

Can *département* heterogeneity tell us something about the French fertility decline?

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Abstract

Unified growth theory suggests the fertility decline was crucial for achieving long-term growth, yet the causes behind that decline are still not entirely clear from an empirical point of view. In particular for France, the first to experience this demographic transition in the European context, the reasons why some areas of the country had lower fertility than others are poorly understood. Using département *level data for the last quarter of the nineteenth century, this paper exploits the French regional variation to study the correlates of fertility estimating a 2SLS fixed-effects model. The findings confirm the importance of some of the forces suggested by standard fertility choice models and unified growth theory. Investment in human capital and the reduction of the educational gender gap, for example, seem to be crucial. Results also highlight the relevance of non-economic factors (such as secularisation), for which I provide new measurements. Spatial dependence is also significant in all specifications of the model, suggesting a diffusion of fertility patterns.*

Keywords: Economic history · Nineteenth-century France · Fertility transition

JEL classification: N33 · J13

1. Introduction

Economists have always considered the study of economic growth important, yet only recently have they given attention to how that growth became more the rule than the exception. For the major part of human history income per capita seems to have remained at subsistence level, with improvements in the standards of living (if any) only marginal or temporary (Clark 2005, p. 507; Ashraf and Galor 2011). Barely two centuries ago this ceased to be the case, and an era of sustained growth began. Economic historians have studied this phenomenon with great interest over the years, yet recently the topic has regained appeal in mainstream economics thanks to the developments of unified growth theory (UGT). Models in this literature put in a single theoretical framework *both* preindustrial stagnation and modern economic growth, *and* the change from one to the other (Galor 2011). In all of them, the demographic transition plays a key role. Via avoiding the dilution of physical capital and land, increasing the in-

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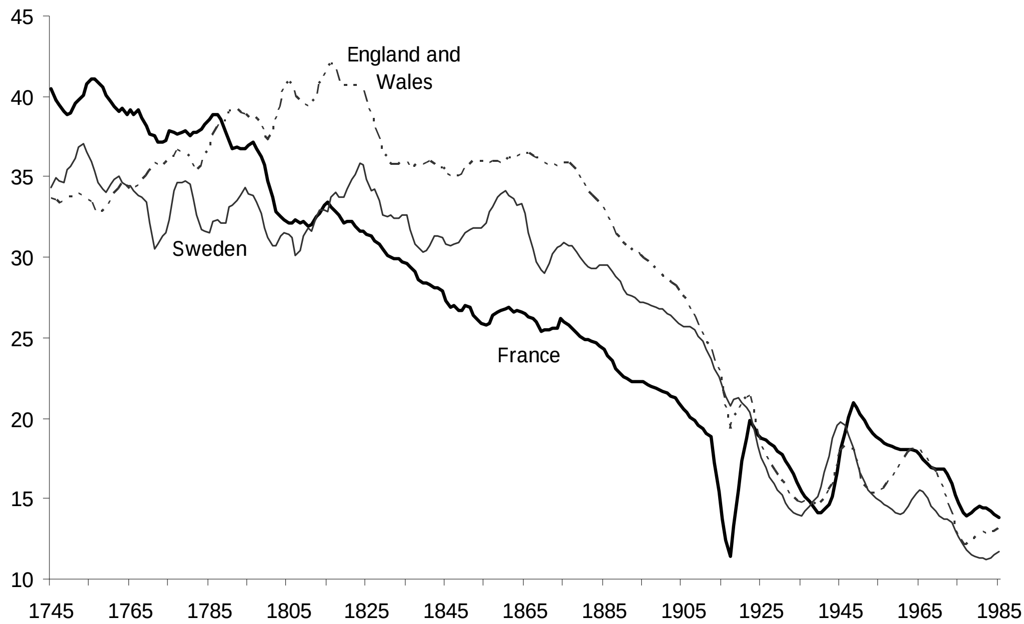
vestment in human capital, and temporarily augmenting the size of the labour force, the systematic fall in birth rates paves the way to economic growth (Galor 2011, p. 46). Yet many studies disagree on *what* drives that decline, potential candidates ranging from biological and environmental conditions to socio-cultural factors to economic motivations (Galor 2011, chapter 4; Guinnane 2011). Identifying the forces that contributed to the fall in fertility, either to validate the internal logic of these models or to think further on the mechanisms at work in them, is of crucial relevance to understand the path taken by Europe into economic growth.

The most iconic case of fertility decline in Europe is without doubt that of France. The evolution of birth rates during the nineteenth century was rather unequal in the various corners of the continent, but even to the bare eye distinct regional patterns are easily identifiable (Flinn 1981, pp. 30-31; Guinnane 2011, pp. 590-592). Downward trends were common, yet timing of the initial fall sometimes differed. A sense of the different experiences can be grasped by looking at Figure 1, which depicts (smoothed) series of crude birth rate for England and Wales, France and Sweden over the long term. The patterns of England and Wales and Sweden are representative of most regions in Europe. Fertility fluctuates around a relatively high mean in pre-industrial times, then there is a decline that begins at some point after the mid-nineteenth century and continues all the way up to the interwar period.

Figure 1. Crude birth rates (births per 1,000 population) in France, England and Wales, and Sweden, 1745-1985



Sources: For France, INED (1977: 332-333) and Chesnais (1992: 518-541); Wrigley and Schofield (1981: 531-535) and Mitchell (1998: 93-116); and, for Sweden, Gille (1949: 63) and *Statistika Centralbyrån* (Statistics Sweden, http://www.scb.se/indexeng.asp). Values are 5-year averages, centred in the year.

Although following the general overall pattern, the French decline arguably began 50 years earlier than in any other part in the continent.[1] Since, in contrast to other places in Northern Europe, France was relatively less urban and industrialised (see e.g. Heywood 1995), this timing has been particularly difficult to reconcile with arguments suggesting the fall in births was driven by economic forces. Instead of following structural changes, the demographic transition in France appears to have taken place *ahead* of them, contributing most likely to counteract the relative industrial retardation and allowing the country to achieve the high standards of living it enjoyed during the nineteenth century (O'Brien 1996, pp. 213-214).

Further, the evidence we have on fertility rates within the country also shows certain peculiarities. Figure 2 plots the widely used I_g index of marital fertility, a measure of the proportion of legitimate births with respect to the maximum biologically attainable (Coale and Watkins 1986) for all *départements* at different dates in the century.[2] In those maps it is easy to identify at least two areas of low fertility, the valley of the Seine (Bassin Parisien) and that of the Garonne (Bassin Aquitaine), and two 'islands' of high fertility, the region of Bretagne in the north-west and the Massif Central in the centre-south-east. Although fertility is decreasing throughout the period, the large differences across regions show certain degree of persistence. As early as 1831 one can find *départements* such as Gironde or Eure with indices below 0.40, evidencing fertility limitation, while as late as 1901 places like Finistère or Côtes-du-Nord still had indices above 0.70, showing little or no limitation at all.

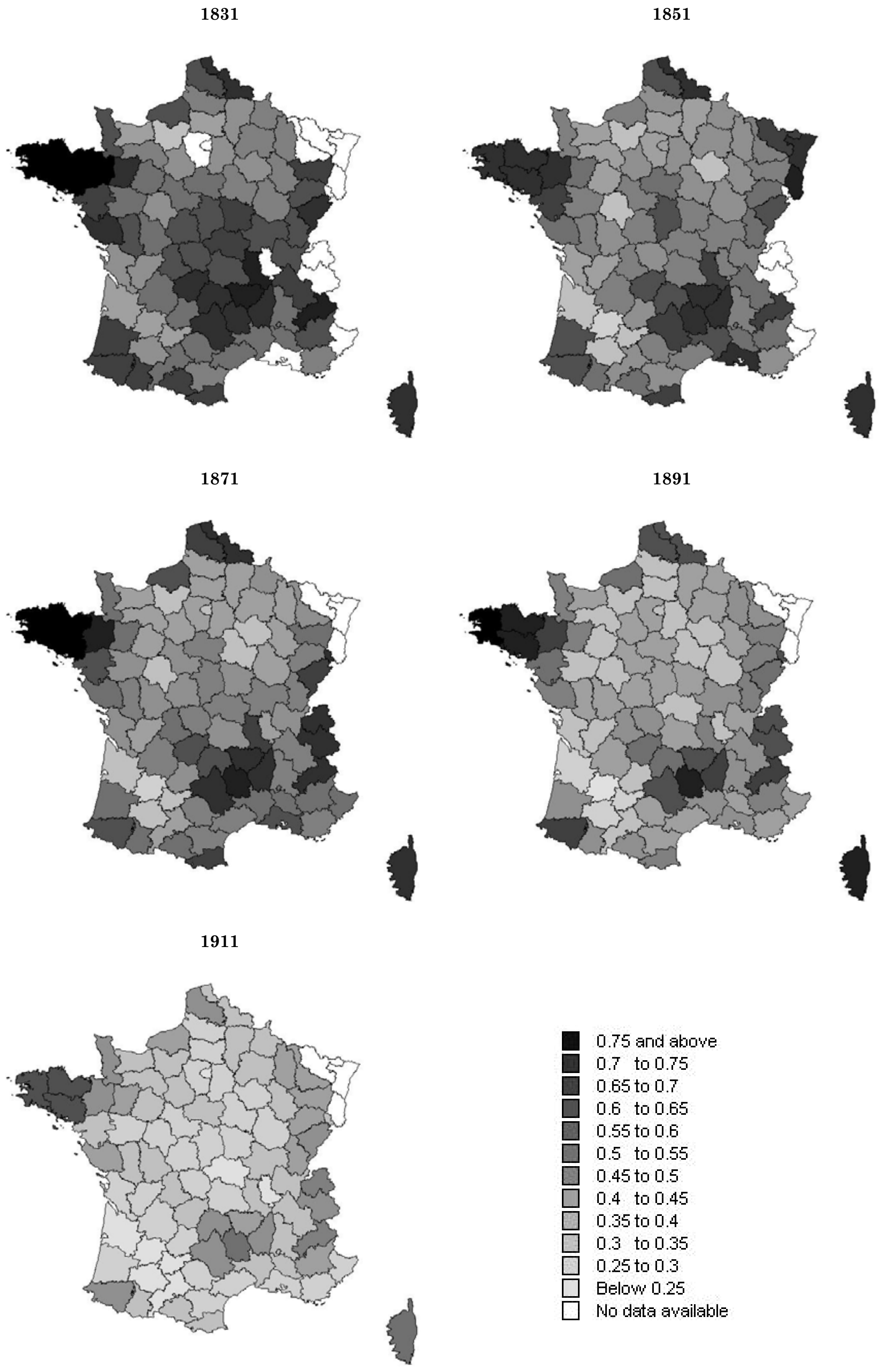
Of course, alternative arguments to explain either feature are not lacking, but only to a limited extent have they been subject to careful empirical scrutiny. The early onset of the French decline has probably received most attention of late, and there recent studies seem to concur that the French Revolution, or events related to it, played a central role in triggering the fall.[3] On the reasons behind the differences across regions, the evidence is patchier. Most of the components that were to shape modern theories of fertility determinants (see van de

[1] Due to various technical matters, dating the beginning of the fertility decline has been a hotly debated issue. See Guinnane *et al.* (1994) for a discussion.

[2] The administrative unit of *département* was adopted during the French Revolution to replace the old 'provinces' that showed considerable heterogeneity among them. The 83 *départements* that were created in 1790 were, in contrast, under a common central administration and had a more or less regular size (it was chosen so that any person within its borders could go and return from its capital by horse in two days). Over time the number increased to 87 in the period I study, and eventually to 100 today.

[3] For example, Weir (1983) proposed the institutional changes brought by the Revolution gave tools to reallocate land and labour, by making bourgeois children superfluous as labourers and costly as consumers. Cummins (2011), after studying the few individual level data available between 1750 and 1850, emphasised the key role of the Revolution in changing inequality, this leading to the decrease in family size. Gonzalez Bailón and Murphy (*forthcoming*), using an agent-based simulation to model French demographic behaviour, hint that certain socio-cultural aspects associated with the dismantlement of the Church led by the revolutionaries are at least partly to blame for the decline.

<u>Figure 2</u>. Marital fertility index (Ig) in France for each *département*, 1831-1911



<u>Sources</u>: Maps are mine, constructed using data from Coale and Watkins (1986, pp. 94-107).

Kaa 1996; Guinnane 2011), such as the role played by fluctuations in wealth, the value of children and the costs of rearing them, or the degree of religious faith, to mention a few, were already present in early discussions on the French decline more than a hundred years ago (Spengler 1938, pp. 168-174). Despite the wealth of theoretical ideas, however, only a few have found support or rejection in sound quantitative analysis. Many of the studies on the topic have remained for some time descriptive and conjectural (van de Walle 1974, pp. 6-7). The works of scholars like Etienne van de Walle or David Weir brought a more systematic approach to the subject,[4] and from the late 1970s to the early 1990s several refined the measurements of regional fertility (van de Walle 1974; Bonneuil 1997) and extensively explored their dynamics (e.g. van de Walle 1974; Weir 1983; Wrigley 1985b). A few studies did assess the relevance of some factors in explaining differences across the country, (e.g. van de Walle 1976; McQuillan 1984; Watkins 1991), but the overall picture that emerge from them is far from clear.[5] Moreover, as Brown and Guinnane (2007) have warned us as of late, many of the findings coming from these works might well be flawed. As they argued convincingly, much of the literature on fertility decline, especially that stemming from the European Fertility Project (Coale and Watkins 1986), relied upon highly aggregated data and empirical strategies that ignored relevant aspects of the time dimension, most likely leading to unreliable conclusions. Recent research have dealt with these critiques for other regions of the continent (e.g. Galloway *et al.* 1994 for Prussia; Brown and Guinnane 2002 for Bavaria; Dribe 2009 for Sweden), but the French case remains poorly understood.

Given the particular importance of France in the demographic transition debate, and its consequent relevance for the discussion on UGT, in this paper I assess quantitatively which factors contribute to explain differences *within* the country during the transition. Taking advantage of the persistent heterogeneity in fertility across *départements* in the nineteenth century, I use the standard Easterlin framework (Easterlin and Crimmins 1985) to study the correlates of fertility under various specifications. I assess the effect of factors such as infant

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[4] It is probably fair to say that many economic historians can associate most of our understanding of the French fertility decline over the last thirty years to these two scholars. The late Etienne van de Walle was attached to the Princeton Project and researched on different aspects of the French experience (van de Walle 1974, 1976, 1980, 1992; van de Walle and Muhsam 1995; Lesthaeghe and van de Walle 1976). David Weir, on the other hand, produced an unfortunately never fully published dissertation at Stanford (Weir 1983), and then a series of papers until the mid-1990s (Weir 1984a, 1984b, 1992, 1993a, 1993b, 1994, 1995; Mroz and Weir, 1990).

[5] Van de Walle (1976), for example, suggested that low mortality and high income played a role in decreasing fertility, while urbanisation or industrialisation did not. MacQuillan (1984), however, found that different modes of production were indeed associated with family size, with areas of capitalist production having higher fertility indicators. Watkins (1991), on her side, concluded that variation across *départements* could be largely explained –as van de Walle– by variations in disposable income, but also by migration, size of the State and whether French was or not the main language spoken.

mortality, urbanisation, income, financial development, education, religiosity or political participation on the levels of fertility, introducing departmental and time fixed effects to control for some unobservables, and using climatologic data to instrument infant mortality to produce 2SLS estimates that account for potential endogeneity problems. I also look into spatial dependence to assess the relevance of diffusion. Although good part of debate on fertility decline has been set-up in terms of diffusion versus adaptation hypotheses (Carlsson 1966), and the study of diffusion on fertility dynamics in a sound, quantitative manner has been used already in historical perspective (e.g. Tolnay 1995), this has rarely been integrated in any empirical study of the European fertility decline.[6] By introducing spatial dependence along with other covariates I can assess whether the diffusion *and* adaptation hypotheses can simultaneously contribute to explain fertility.

My results show that wealth was positively correlated with larger families, whereas extended education (child enrolment in primary schools) and the reduction of the educational gender gap (increase in female literacy) was negatively correlated with them. Once I control for other variables, there is no indication that infant mortality, urbanisation, or industrialisation had any effect whatsoever. The level of religiosity (that I measured using two alternative proxies) is consistently relevant to explain fertility and has the expected (positive) sign. All these effects are present despite the fact that I introduce spatially and time-lagged fertility, which also turns out to be strongly significant providing support for the diffusion hypothesis. These results give support to some of the main building blocks of the UGT, namely the link between increased human capital formation and fertility decline. They also hint that the diffusion of cultural factors were partly driving fertility dynamics *along* with economic incentives, and suggest both components should be included in the theoretical models to provide a more comprehensive answer of why and how did the decline occur.

2. Understanding fertility dynamics

Economists, demographers, historians and sociologists, each with their own analytical frameworks, jargon and methodological techniques, have suggested hypotheses to explain the fertility transition, making the literature itself some kind of a puzzle (see, e.g., van de Kaa 1996). Although it is by no means entirely uncontroversial, many participants in this debate agree that fertility transitions are perhaps not different from any other fertility change, so they can be interpreted in terms of a model of fertility determination. Of the many models that have been suggested, Easterlin's synthesis is arguably the one that unites most

[6] To my knowledge, the only exception being a recent working paper that expands the analysis of Galloway *et al.* (1994) on Prussia to incorporate spatial dependence (Goldstein and Klüsener 2010). Another even more recent (and preliminary) manuscript by Guillaume Daudin and co-authors (Daudin *et al.* 2012) also addresses the issue of diffusion in France quantitatively, yet in a different way: by estimating bilateral flows of migrations. I relate my results to theirs later in the paper.

of them and provides a suitable environment to assess alternative hypotheses (Easterlin and Crimmins 1985, pp. 14-20). The model states that the number of children born depends on the interaction of a set of basic determinants: the demand and supply of children, and the regulation costs of controlling fertility. In this very simple formulation, the number of births is determined by two basic factors, level of natural fertility (*N*), and level of fertility control (*FC*), being occasionally affected by a random disturbance (υ):

(1) $$\text{births} = N + \theta FC + \upsilon$$

Natural fertility here refers to the level of fertility associated with no active control, and it is dependent on a range of biological and cultural variables, such as duration of marriage or the nutrition of the mother. The level of fertility control would be typically greater or equal than zero (hence, θ is expected to be negative), and could be thought of as being affected by at least three components (plus, again, a random disturbance):

(2) $$FC = \phi + \varphi\left(Cn - Cd\right) + \eta RC + \nu$$

That is, fertility control depends mainly on the motivation for it and the regulation costs (*RC*). On the one hand, the motivation for contraception is defined in terms of the difference between supply of children (*Cn*), intimately linked to natural fertility, and the demand for them (*Cd*), which is determined by preferences and diverse environmental factors. The regulation costs, on the other hand, include both market costs (RC_m), such as the cost of particular contraceptives or their actual availability, and psychological costs (RC_p), such as the displeasure of abstinence or the moral cost of going against the religious beliefs.

Most models of fertility determination (Guinnane 2011) have a more or less straightforward interpretation in terms of the components laid out in the reduced-form equations (1) and (2). In particular, the sources of change leading to the fall in births can be easily identified. As Ansley Coale put it in a classic paper (Coale 1973, p. 65), a fertility transition will take place if effective techniques of fertility reduction are known and available (i.e. $RC_m < \infty$), if reduced fertility is perceived as advantageous (i.e. $Cn\text{-}Cd > 0$), but also if fertility falls within the calculus of conscious choice (that can well be interpreted as $RC_m < \infty$, or $RC_p < \infty$, or both). In this section I will briefly discuss each of these components in order to motivate the empirical exercise I carry out in the rest of the paper.

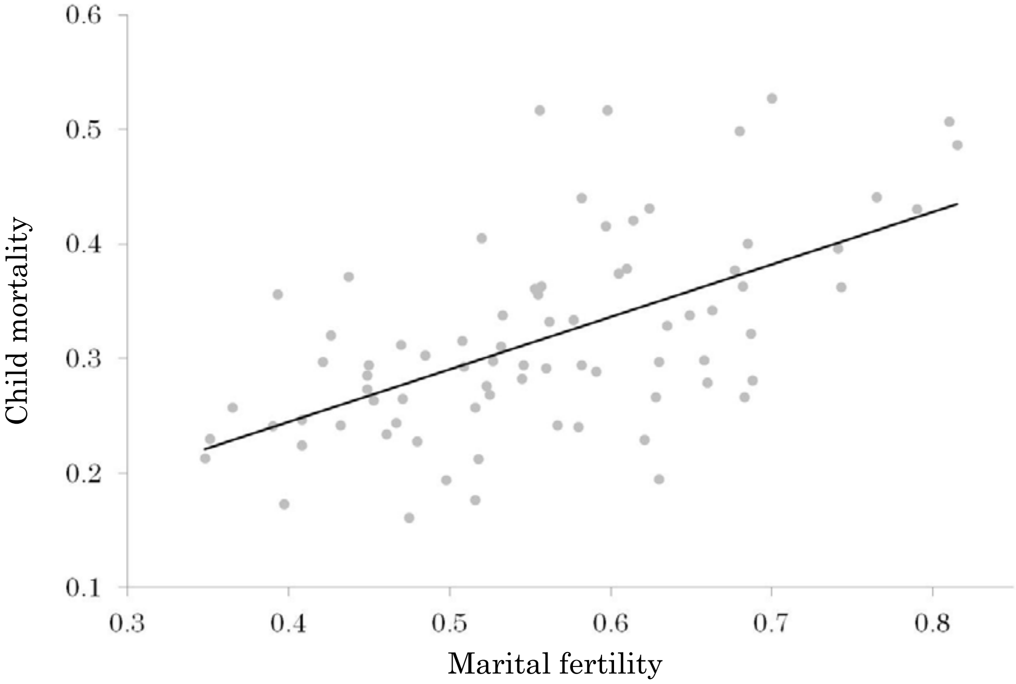
2.1. Means to control

An issue that regularly turns up in discussions about fertility behaviour in the past is that of the availability of means to control it. That is, whether the market costs of regulating fertility were infinite or not. There is little direct evidence showing that the average couple knew how to control fertility, and the consensus up to fifty years ago indeed was that at least in medieval times they did not (Flandrin 1979, p. 194), but there are several reasons suggesting they did know. On the one hand, most cultures across space and time have had some method to control the size of their families: abstinence, *coitus interruptus*, abortion, and infanticide – for example – were generally known. Further, in predominantly rural societies (like early modern France) the breeding of domestic animals is an essential part of the daily activities and knowledge of animal reproductive behaviour must have been widely known then. Details about the peculiarities of human fertility might have been missing, but knowledge about the general dynamics of reproduction must have been common. On the other hand, anecdotal evidence suggests the use of some sort of contraceptives was widespread. Many eighteenth century writers, for example, talked about the 'art of cheating nature' (see e.g. Ariès 1948, 1953; Bergues *et al.* 1960; van de Walle and Muhsam 1995). Little information is available regarding the lower social classes and, when available, it generally refers to extra-marital relationships, but it is known that the nobility and urban bourgeoisie practised some degree of family limitation (van de Walle and Muhsam 1995, pp. 261-265). Although abstinence and changes in the frequency of sexual intercourse might have played a role, what appears to have been frequently used at the time was *coitus interruptus*. Contrary to common belief, this simple tool is relatively efficient (Santow 1995, pp. 29-30), and most of the literature agrees that the 'sin of Onan' was fairly widespread in Europe (and France in particular) at the time and might have been the main mechanism driving the fertility decline (Le Roy Ladurie 1965; Flandrin 1979; van de Walle and Muhsam 1995). Alternative instruments associated with different ways of having intercourse like sodomy, or intercourse without ejaculation (*amplexus reservatus*) appear to have been reserved for prostitution, but were known and perhaps occasionally used among married couples. Other, rather more expensive, contraceptives like condoms or sponges may have played only a minor role (McLaren 1990, pp. 157-158; van de Walle and Muhsam 1995, p. 273), as probably did action after delivery (Bechtold 2001, pp. 167-168). Abortion, nevertheless, was known and increasingly practised, especially among married women (McLaren 1978; Flandrin 1979, pp. 194-195), and most likely acted as an alternative when other means did not provide the expected result.

2.2. Motivation to control

Given that accessibility and knowledge of contraceptive tools seems to have been more or less available at the time, sources of variations should be looked for elsewhere. To have a motivation to control fertility, however, couples must be able to have at least the family size they want. Natural fertility, and consequently the actual supply of children, is determined by several components, many of which are virtually impossible to study in a rigorous way in historical societies. The extent of breastfeeding or the regularity of sexual practices –for example– were most likely relevant factors, yet little record remains of their practices. One crucial element, though, is indeed observable: infant mortality. Even if we assume couples had some degree of control over the size of their families, infant or child mortality in the past was a factor on which they have only a marginal influence. The ways to avoid morbidity and death were poorly understood or simply difficult to deal with. When the number of children one can have is not certain because of a high risk of death at an early age (in some places in France, as many as one child in two would die in the first 5 years of life during the period), couples might increase their fertility only to make up for the expected loss (Brown and Guinnane 2002, p. 41). Indeed, as Figure 3 illustrates, even in the earliest stages of the transition in France (circa 1831) there seems to be a positive correlation between fertility and child mortality. This evidence is indeed suggestive, but one has to take into account the possibility that causality in this case could also go in the other direction, as high fertility might be leading to high mortality. I address this issue later in the empirical implementation.

Figure 3. Marital fertility and child mortality across *départements* , 1831



Sources: Marital fertility corresponds to the *Ig* index for 1831and comes from Coale and Watkins (1986, pp. 94-107). Child mortality is the 4q0 value as estimated by Bonnieul (1997).

The demand for children, in contrast, is determined by income and tastes of the parents, as well as by the prices they face in the market. The literature on this, stemming from the seminal contribution of Becker (1960), conceives children alternatively as consumption or investment goods: they can be seen as a source of satisfaction for the parents or, using the idea of human capital, as assets that yield some return over time (a source of future services, especially labour and old age security). Something that is common to both interpretations is that children consume resources (especially time and money) that could be used in alternative ways, thus imposing some limit on the number of offspring couples want to have. Parents then face an opportunity cost of the time they need to raise children, hence fluctuations in income could have an effect on fertility. Early studies on fertility determinants suggested that increases in income would lead to a fall in fertility because the negative substitution effect on fertility would dominate the positive income effect (Becker 1960; Willis 1973). Evidence on this connection is nevertheless poor and, when available, seems to point to a *positive* link between income and fertility, a thing that had led some authors to raise a series of doubts about the validity of the assumptions underpinning these theories (Galor 2011, p. 116). It could also be the case that what it is relevant is not the income of the family, but that of the mother, as she is the one that normally devotes more time to the raising of children. Part of the literature has been devoted to this, and some theoretical discussions suggest that the reduction in the gender gap could lead to a decline in fertility (Galor and Weil 1996). Although this relationship is pretty well established for current societies (e.g. Lagerlöf 2003, pp. 406-407), little is known for historical societies during the transition.[7]

Changes in these opportunity costs might also come from other aspects of the socio-economic environment. In rural, sometimes self-sufficient communities children can begin to contribute to family income earlier because agricultural labour usually requires less skills than industrial labour, or direct access to food supplies reduces the costs of having additional children. Urbanisation should discourage fertility and, in a similar way, the size of the agricultural sector could encourage it. The evidence on this link between urbanisation or industrialisation and fertility is somewhat unclear for the French case.[8] One possibility is that these modernisation factors influenced fertility not directly but, as UGT suggests, through the increase in the demand for human capital (e.g. Galor and Weil 2000; Galor and Moav 2002).[9] Technological progress arguably increases the requirements of human capital. If children's quality does not come for free, one expects that at some point a substitution might come into play between quality and quantity, incentivising parents to have smaller families. The literature on this has grown considerably as of late, most findings pointing to a considerable

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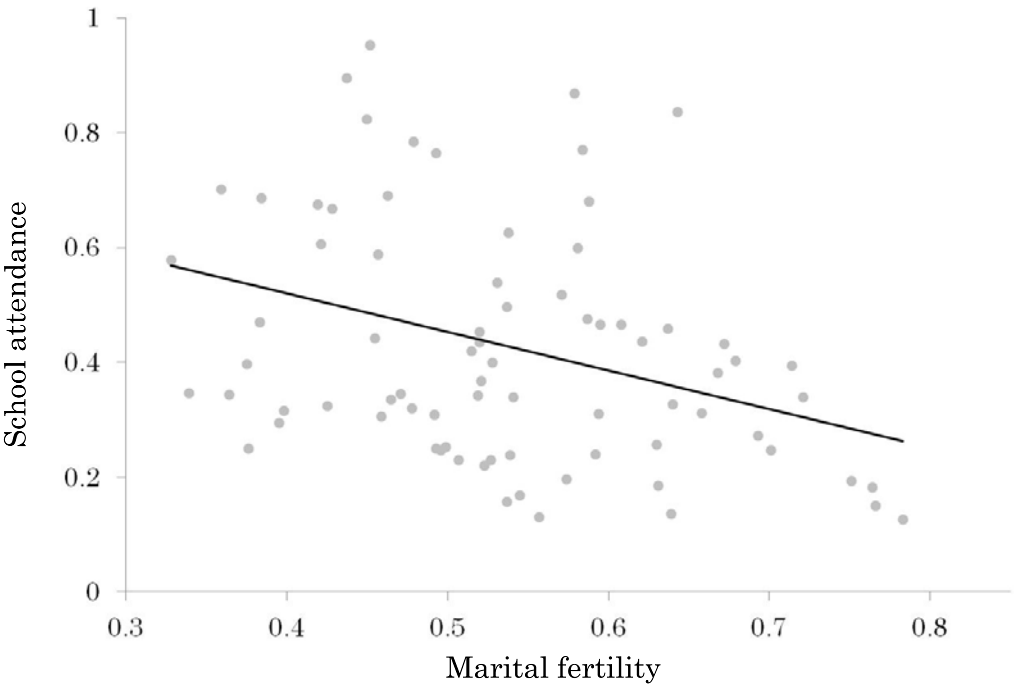
[7] As it is often the case, a Scandinavian country provides an exception. A study of Sweden suggests that indeed increases in the relative wages of women contributed to the fertility decline (Schultz 1985).

[8] Of the five *départements* with the lowest level of marital fertility in 1831, only Gironde had a major city (10,000 inhabitants or more) in 1801. At the same time, *départements* with a considerable population in large urban centres like Bouches-du-Rhône or Loire Inférieure still had Ig indices above 0.60 as late as 1851. Assessing industrial development is more complicated. Some figures for the late eighteenth century show clusters of textile production in the Bassin Parisien, but also in Brittany and the *départements* north of Paris, whereas metallurgic activity was concentrated in the east of the country, where the fertility behaviour was close to average (Léon 1970, pp. 228, 234, 238). The fact that areas leading the decline were located in major valleys is suggestive, but it is difficult to go beyond facile interpretations when thinking on the relevance of physical geography: both areas had large rural sectors, but agricultural activity was concentrated on wheat in one and vines in the other (Rémond 1966, pp. 55-58). And while both had large rivers, integration appears to have differed considerably between those regions (Daudin 2008).

[9] A connected argument is that modernisation in fact fostered the possibility of social mobility (see e.g. Dumont 1890; Cummins 2011) and this led to human capital accumulation as a way to climb up the social ladder, towards higher quality and lower quantity of children.

role of this quantity-quality trade-off in the fertility transition (e.g. Becker et al. 2010; Klemp and Weisdorf 2012). Figure 4 shows suggestive evidence on this: circa 1836 it was indeed the case in France that those *départements* where a larger proportion of the school-age population attended schools fertility was lower.

Figure 4. Marital fertility and education across *départements* , 1836



Sources: Marital fertility corresponds to the *Ig* index for 1836 and comes from Coale and Watkins (1986, pp. 94-107). School attendance is the ratio of students to school-aged population (5 to 15 years) in 1836-37 and the data used to construct that estimation was kindly given to me by Claude Diebolt.

One additional component that sometimes features in discussions about the fertility transition is the role of financial institutions. This stems from one aspect of considering children as investment goods: parents might spend on their offspring when they are young and healthy, expecting children to look after them in sickness and old age. This view provides at least two hypotheses connected to the fertility decline (Guinnane 2011, p. 607). One reinforces the importance of rural-urban transformation: in a context when children begin to migrate to cities, the intergenerational transfer becomes less likely and hence reduces the motivation to have children. The other is associated with the development of financial institutions and welfare state, as the introduction of alternative ways of securing for the old-age could reduce the demand for children. The literature seems to agree that, if this channel played any role, it was probably small (Guinnane 2011, pp. 607-608, Galor 2011, p. 136). Brown and Guinnane (2002), for example, failed to find any sign of this link in Bavaria. Yet Galloway et al. (1994) found for Prussia some evidence that the growth of financial institutions contributed to the decline in fertility, and this effect seems to survive even after the introduction of spatial dependence (Goldstein and Klüsener, 2010).

2.3. Choice to control?

The final point highlighted by Coale (Coale 1973, p. 65) has to do with whether couples actually *consider* deciding on the size of their families. Although it is not really disputed that the transition involved the use of active contraception (see e.g. Flandrin 1979), it is not entirely clear whether before that time contraception was conceived as a possibility at all. For pre-transitional France there is evidence that –in a typical Malthusian fashion– the decision on *when to marry* affected fertility (Weir 1983, chapter II), but only scarce and scattered examples of certain families or small groups actually practicing control within marriage (e.g. Livi-Bacci 1986). Demographers have traditionally suggested that the choice on when to marry *was* indeed the tool used to control procreation in pre-industrial times, via altering women's exposure to the risk of becoming pregnant. If that had been the case, changes in the dynamics of marriage might have generated a motivation for couples to engage in post-marriage fertility regulation. Arguably, the French Revolution brought some of them, as a few normative changes introduced shortly after 1789 made establishing marriage contracts easier in several ways, and some might have even promoted unions.[10] Other accounts instead point directly towards a cultural change triggered by modernisation (e.g. Lesthaeghe 1983), yet, the nature of this modernisation and how it induced the ideational shift is rarely defined in a precise way.[11]

More often than not, however, it is religion that is blamed for the lack of individual self-determination in the pre-transitional period, especially on family life. Free will enjoyed a central role in Catholicism, but in matters of procreation, as in many other areas where the mechanisms of nature were not fully understood, individuals probably felt they had only limited control. 'The Lord gave, and the Lord hath taken away', the saying usually heard at the time by grieving parents that had lost a child, conveys the idea that fertility was largely dependent on the will of God (hence independent from the will of men in general –and parents in particular). This idea was pervasive in medieval and early modern France (Flandrin 1979, p. 179; Ariès 1980, p. 646), as it is right now in many underdeveloped countries (van de Walle 1992, p. 490-496). Some authors have then

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[10] For example, revolutionary laws lowered the age before which parental consent was needed, authorised divorce and, by making civil contract independent of the Church, it avoided the prohibitions of marriage in certain periods such as Advent and Lent (Bergeron 1981, p. 110). Most notably, the Jourdan-Delbrel law in 1798 exempted married men from conscription, which created a clear incentive to marry, *orthogonal* to the decision of having children. Further, a recent body of literature also suggests (more as an empirical regularity than in terms of a theory) that social upheavals have a profound effect on the evolution of birth rates (Binion 2001; Caldwell 2004; Bailey 2009).

[11] According to this literature, it was the spread of new ideas – and not the change in material conditions – that accounted for the decline (Cleland and Wilson 1987, p. 27). Lesthaeghe, for example, puts forward that the intellectuals of the Enlightenment provided the raw material that, in the hands of the French revolutionaries, led to the legitimisation of individual freedom of choice in different aspects of life, including fertility (Lesthaeghe 1983, p. 413).

ventured that for the transition to occur this preconception should disappear (van de Walle 1992, p. 490).[12] As de-Christianisation was part of *zeitgeist* of the Revolution,[13] arguments along these lines also place that event as instrumental. Although the early nineteenth century saw a religious revival, the Revolution had shaken the Church to its very foundations; this might have created a window of opportunity for an ideational change, as "(t)he hiatus in clerical control consequent upon the Revolution seems to have enabled at least some French men and women to break free from old constraints" (Gibson 1989, p. 244-245), allowing them to reach a new ideal normative equilibrium in terms of fertility behaviour.[14]

But the National Assembly interfered in the regular functioning of the Church in a more literal way, as the latter suddenly saw many of its liberties curtailed, along with its resources, and its whole apparatus shaken by the purge of its members.[15] An interesting case of this is the Ecclesiastical Oath of 1791. Towards the end of 1790 the revolutionaries imposed a clerical oath of allegiance to the new Constitution that split the clergy into jurors (*constitutionnel*) or non-jurors (*réfractaire*), fuelling confrontations within the clergy and at different levels of society. The nature and consequences of the oath are rather complex (see Tackett 1986), but some authors have ventured the idea that the relaxation of clerical discipline in 'constitutional' regions can partly explain the rapid spread of birth control in those areas (Sutherland 2003, p. 345), where the Church was now lacking a considerable amount of raw material to sustain clerical authority and administer sacraments. This contributed to put an end to a quasi-universal religious practice in France (Gibson 1989, p. 228) and, in particular, perhaps limited the potential ways in which local priest could have influenced birth control practices, facilitating the rise of 'anomalies' in sexual behaviour such as contraceptive practices, illegitimacy, and bridal pregnancies (Le Roy Ladurie 1965; van de Walle and Muhsam 1995).[16] Indeed, as we can see in Figure 5, there is a clear

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[12] Up to the late eighteenth century Catholicism dominated social life (see e.g. Le Bras 1955), conveyed much of the normative framework in France, and had a strong attitude regarding family behaviour and against contraception. In particular, it condemned heavily the 'sin of Onan,' the main technique couples had to control fertility at the time (Flandrin 1979, pp. 194-196).

[13] Already during the eighteenth century there were signs of de-Christianisation. Attendance at mass became less frequent, the number of people joining the clergy diminished, and the proportion of religious books owned by those rich enough to buy them fell considerably (Gibson 1989, p. 3).

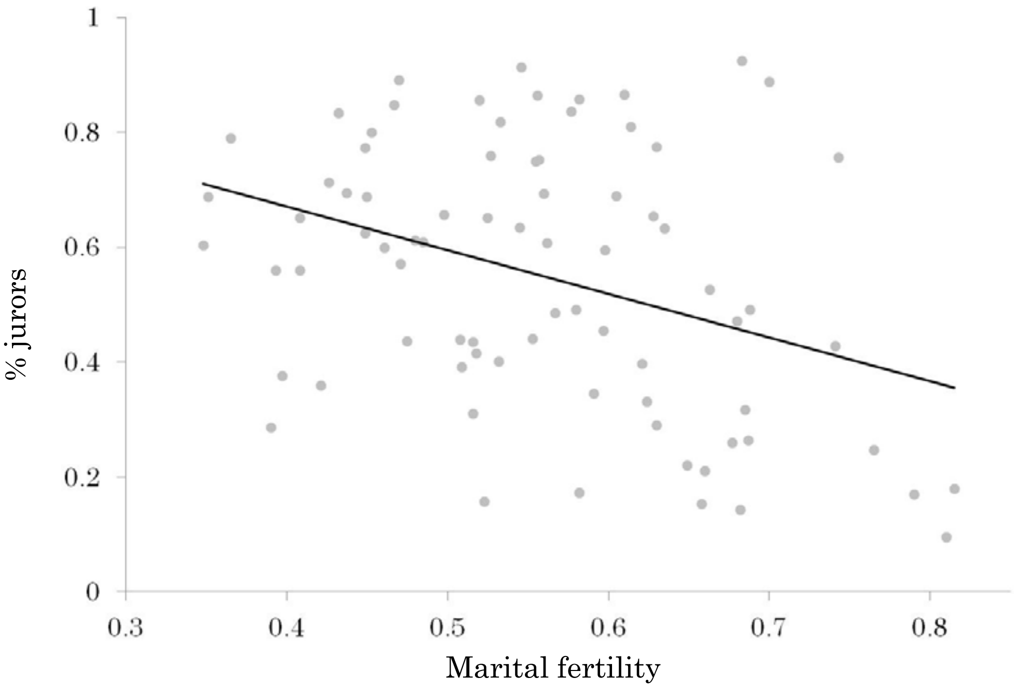
[14] This view can be connected with the recent developments on the role of social networks in fertility choice that suggest that fertility could well be a coordination problem (Kohler 2001, pp. 143-144). For an extensive discussion on this argument, see González-Bailón and Murphy (*forthcoming*).

[15] It is estimated that as many as 3,000 priests were killed (Tackett 2006, p. 549), more than 32,000 were forced to leave the country (Gibson 1989, p. 52), and recruitment of new priests was stopped or seriously curbed.

[16] Arguments not directly related to Catholic views on sexual behaviour are consistent with this story. Given the extent of the influence of the Church it is not unlikely that

negative correlation between the proportion of oath-takers (in 1791) and marital fertility a generation afterwards (in 1831).

Figure 5. Marital fertility (1831) and the Oath (1791)



Sources: Marital fertility corresponds to the *Ig* index in 1831 and comes from Coale and Watkins (1986, pp. 94-107). The proportion of jurors indicate priests taking the oath, and was estimated by me using data from Tackett (1986).

In line with the arguments of other authors (e.g. Weir 1983, p. 39; González-Bailón and Murphy *forthcoming*), the previous discussion suggests the events of 1789 were connected with the fertility decline, partly channelled through their effect on self-determination, or on French Catholicism, or on the organisation of the Church. In any case, there are reasons to believe that factors associated with the French Revolution or the vitality of Catholicism might help explain different levels of fertility.

2.4. On diffusion

One last point to discuss, somewhat connected with the discussion in the previous section, is the role of diffusion via social interaction. Both the presence of clustering and the spatial evolution of rates in Figure 2 point towards diffusion as a way of describing what happened in France (Bocquet-Appel and Jakobi 1998,

weakly religious areas could have been more sensitive to the institutional changes brought by the Revolution and *these* changes could have had an impact on fertility. Inheritance laws provide a clear example. Although supposedly affecting the whole nation simultaneously, it has been suggested these laws were unequally enforced (Brandt 1901), and that, in this, the influence of the Church (by promoting or opposing implementation) could have been instrumental.

p. 190; González-Bailón and Murphy *forthcoming*). Further, a recent unpublished manuscript finds evidence the French decline can be linked to the transmission of fertility norms via migration (Daudin et al. 2012). Hypotheses linking social interaction with fertility can be traced back at least to the late nineteenth century,[17] but they gained special support in the 1970s with the publication of the first results of the European Fertility Project (Coale and Watkins 1986). Some of their findings, specially the fact that fertility patterns were strongly correlated with the distribution of various cultural traits (e.g. language), led to the conclusion that the fertility decline was mainly driven by social interactions and the diffusion of reproductive behaviour (Knodel and van de Walle 1979, p. 239). The importance of social interactions to explain fertility has been nonetheless very controversial, in particular by economists that look at diffusion stories with scepticism because they find hard to picture rational agents unwilling to control fertility on moral grounds (e.g. Brown and Guinnane 2002, p. 40). Of course, social constructs like moral norms are not necessarily outside the calculations of a rational agent (see e.g. Iannaccone 1992, 1998). In fact, recent studies have proposed various micro-founded models where social interaction affects rational, utility maximising couples (e.g. Durlauf and Walker 2001; Kohler 2001) that can be expanded to include the role of fertility norms (González-Bailón and Murphy *forthcoming*). According to these models, fertility choices are seen as coordination problems: the benefits of choosing low or high fertility are dependent on the fertility choices of others. There, agents assess a value function that, along with personal attributes (including tastes, environmental factors, etc.), includes as a key argument the expectations of what others are doing in terms of fertility. Couples then face a cost of deviating from the average behaviour of the other agents.[18] Whereas traditionally economic and diffusion stories have been treated as alternatives (see Carlsson 1966; Brown and Guinnane 2002, p. 40), these recent theoretical development suggest both components should be incorporated together, hence empirical implementation should also partly control for diffusion.

3. Assessing the French experience

3.1. The data

In order to evaluate the hypotheses summarised above, I collected information to create more than twenty different variables and build a novel *département*-level panel dataset spanning the last quarter of the nineteenth century.

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[17] Among the first ideas that appeared to explain the decline some authors attributed the fall in French birth rates to changes in the nature of social dynamics (Dumont 1890) or in the moral order of society (Leroy-Beaulieu 1913).

[18] There are various reasons for this, the most straightforward being social pressure. Another is uncertainty. The decision to reproduce is an important yet relatively infrequent choice in a lifetime; this makes people rely on the experience and judgment of others to make their own assessment, which introduces a particular form of social interaction effects by means of learning. See discussion in e.g. Kohler 2001 or González-Bailón and Murphy *forthcoming*.

The dataset is satisfactory in many senses. First, looking at *département*-level data allows me to strike a reasonable balance between availability of covariates and level of aggregation.[19] The alternative of using household-level data limits in many ways the scope of analysis,[20] while the use of higher levels of aggregation is known to lead to loss of efficiency in estimation (Brown and Guinnane 2007, p. 575). Second, the data cover all *départements* at the time, thus capturing the whole population of France rather than only a few scattered villages. Third, it comprises the years 1876, 1881, 1886, 1891 and 1896, covering the period when the divergence in fertility among *départements* was greatest. It is true that by then the fertility decline was well under way, but the persistence of high fertility in some parts of France illustrated in Figure 2 suggest that, whatever factor was impeding its decline, that factor was probably still present. Also, the period covered by the dataset is characterised not only by great heterogeneity between *départements*, but also by a decreasing mean value of fertility level (González-Bailón and Murphy, *forthcoming*), providing a unique set up for an analysis of temporal and cross-section variation. This leads us to the last, and probably most important aspect of this dataset: that it is specifically built to be a panel. The panel structure, which is virtually impossible to obtain for historic individual data, allows me to deal with the recurrent problem of unobserved confounding factors, now well understood in the literature (see e.g. Brown and Guinanne 2007; Angrist and Pischke 2009, chapter 5) and never addressed in previous studies of the French decline (e.g. McQuillan 1984; Watkins 1991, Chapter 7). Also, it lets me address one of the key criticism recently made to the European Fertility Project, namely the study of fertility transition as a *change* over time (Brown and Guinanne 2007, pp. 585-589).

Table 1 lists the main variables I use, with their definitions and some descriptive statistics, for the whole country and for some selected groups. Definitions are in general self-explanatory, yet some might need further explanations. First, since the main interest was on the behaviour of couples, I decided to use the I_g Princeton index to measure marital fertility. This index is less coarse than others like the crude birth rate, it is more available than the total fertility rate,

[19] Although van de Walle already long ago pointed out that the use *département*-level data had been largely neglected (van de Walle 1974, p. 8), little has been done since then, and the handful of papers that have done so used only few covariates in a simple cross-sectional framework (e.g. McQuillan 1984; Watkins 1991, Chapter 7).

[20] At least so far the use of household-level data has proved limited. Some studies (e.g. Weir 1995; Hadeishi 2003; Cummins 2011) have used this sort of information but had to constrain themselves to relatively small, and most likely special, areas of France. Also they could study the potential influence of only a small number of covariates that is unlikely to grow in the future. Weir took advantage of one of those rare examples where some information could be cross-referenced from other sources for a town (Weir 1995, p. 2), and recently Cummins (2011) has studied another three, but it is uncertain whether much can be done with others due to lack of records to be potentially linked to the demographic data (Cummins 2011, p. 4).

Table 1. Means and standard deviations of the variables used in the panel regressions, French *départements*, 1876-1896

Variable	Definition	All		High Fertility		Low fertility	
		1876	1896	1876	1896	1876	1896
Marital fertility	Princeton index of marital fertility (Ig)	0.491 (.132)	0.415 (.114)	0.735 (.070)	0.644 (.064)	0.320 (.022)	0.282 (.032)
Infant mortality	Deaths of children younger than 1 year old over births	0.165 (.039)	0.149 (.027)	0.179 (.032)	0.161 (.036)	0.168 (.030)	0.145 (.023)
Net immigration 15/19-20/24	Net immigration of women aged (a)/(a+4)-(a+5)/(a+9) in the last five years	-0.006 (.045)	-0.028 (.078)	-0.044 (.020)	-0.095 (.037)	0.025 (.063)	0.025 (.118)
Net immigration 20/24-25/29		-0.004 (.065)	-0.043 (.063)	-0.021 (.015)	-0.097 (.030)	0.028 (.061)	0.005 (.074)
Net immigration 25/29-30/34		0.006 (.050)	-0.040 (.045)	-0.019 (.012)	-0.073 (.025)	0.018 (.039)	-0.002 (.040)
Foreigners	Change in the amount of foreign born per population in the last five years	0.002 (.006)	-0.001 (.006)	0.001 (.002)	-0.002 (.006)	0.001 (.003)	-0.002 (.003)
Income per capita	National domestic product weighted by direct taxes, per capita, over the price of wheat	570.9 (226)	963.8 (347)	326.0 (86.5)	519.3 (146)	818.9 (303)	1377.0 (436)
Savings per capita	Money in saving accounts, per capita, over the price of wheat	20.2 (14.0)	137.5 (84.6)	8.5 (4.9)	63.3 (31.3)	25.0 (16.8)	176.0 (120)
Urban population	People living in urban areas as a % of total population	0.260 (.157)	0.300 (.169)	0.146 (.054)	0.169 (.060)	0.310 (.249)	0.343 (.246)
Population in industry	People working or depending on someone working in industry as a % of total population	0.216 (.093)	0.221 (.109)	0.118 (.060)	0.132 (.049)	0.258 (.109)	0.255 (.110)
Saving books	Number of saving books per adult	0.096 (.066)	0.229 (.134)	0.041 (.020)	0.112 (.054)	0.125 (.079)	0.282 (.164)
Literacy (female)	% of women signing the marriage contract (not drawing a cross)	0.701 (.183)	0.901 (.100)	0.596 (.199)	0.808 (.175)	0.755 (.147)	0.939 (.039)
Literacy (male)	1 minus the % of conscripts that do not know how to write or read	0.844 (.102)	0.951 (.041)	0.783 (.142)	0.913 (.070)	0.893 (.062)	0.959 (.022)
Children attending	% children in school-age attending school (proxy)	0.887 (.144)	1.076 (.124)	0.811 (.214)	1.062 (.224)	0.949 (.120)	1.095 (.087)
Religion (desservants)	Number of *desservants* per 1,000 population	0.931 (.349)	0.995 (.439)	0.937 (.448)	0.959 (.504)	0.998 (.449)	1.178 (.569)
Religion (religious education)	% Primary school students attending religious institutions	0.375 (.132)	0.284 (.106)	0.444 (.176)	0.353 (.169)	0.322 (.076)	0.241 (.060)
Republican vote	% of votes received by republican parties (as opposed to monarchist parties)	0.543 (.151)	0.681 (.136)	0.510 (.147)	0.642 (.179)	0.509 (.141)	0.646 (.117)
Turnout at the polls	People turning out at the polls as a % of voters inscribed	0.808 (.045)	0.762 (.056)	0.803 (.054)	0.729 (.063)	0.827 (.046)	0.784 (.046)

Notes: Standard deviations in parenthesis. See the appendix A for a detailed account of sources and of how variables were constructed. *Départements* with systematic high fertility are Finistère, Côtes-du-Nord, Morbihan, Lozère, Ille-et-Vilaine, Corsica, Hautes-Alpes, Ardèche, Savoi and Haute-Savoi; those with systematic low ferility are Lot-et-Garonne, Eure, Gironde, Tarn-et-Garonne, Gers, Seine, Aube, Indre-et-Loire, Oise and Yonne.

and it is widely use in the demographic transition literature.[21] Second, due to the lack of data on actual income, I used direct taxes per capita as a proxy, [22] which I made more illustrative by taking the income for the whole country in the relevant years and using the proportion of national contribution to direct taxes as a weight to obtain departmental proxies for income. Third, 'children attending' is really a proxy for school attendance constructed by dividing the number of children at school over twice the population of children aged 1 to 4 years old, which is a relatively good proxy of those aged 5 to 12 (roughly school-age): the proxy is not perfect (its mean is above 1 in some cases), but it is arguably a decent monotonic transformation of the true values, hence useful for the analysis. Lastly, I experimented with several measures of secularisation, two of which I use here. One tentative possibility was to look at the size of the clergy, so I use the number of *desservants* (a class of parish priests who were named by the bishop without the sanction of the Government, but could also be removed at any time by the bishop, i.e. a part of clergy over which the Church still had substantial discretion) per thousand inhabitants, which enjoyed some variability. I also constructed another variable using the proportion of students in religious schools, on the premise that in a more anticlerical region fewer parents would have sent their children to religious schools.

The first two columns give the mean for all *départements* for the years at the beginning and the end of the sample; the other four simply average the values at the two ends of the period for two selections of *départements*: one consisting of the ten with the highest fertility and another of the ten with the lowest fertility. The values describing the temporal dimension for the whole country yield few surprises, as all variables evolve in the expected direction. The other columns, however, already provide some hints about what could explain the variation. *Départements* with high fertility are net senders of migrants, have fewer urban areas, less people working in industry, are poorer, less financially sophisticated (that I proxy here with the number of saving accounts per capita), and less educated. Nevertheless, they tend to be similar among themselves when it comes to infant mortality, and in political terms they are equally 'republican' and politically participative. Since the two measures of religion suggest opposite readings, its role –at this descriptive level– is not entirely clear.

[21] Guinnane et al. (1994) warn us to be cautious when drawing conclusions from Priceton indexes arguing that they do not describe perfectly parity dependence/independence, especially when there is substantial cultural heterogeneity or in the early stages of the transition. Since I am not making statements about parity dependence and looking into a period when the transition is ongoing, those caveats are not particularly relevant in this case.

[22] As done by Weir (1995), and supported by the fact that those taxes were more or less equal across départements and did not change much over the period studied (see Willis 1895, pp. 46-48).

3.2. Econometric model

To study the contribution of these variables to fertility, it is necessary to specify a treatable econometric version of Easterlin's formulation. A general empirical counterpart could take the following form:

$$(3) \qquad \mathrm{f}_i = \mathrm{fertility}_i = \alpha + \sum_{j=1}^{k} \beta_j n_{ji} + \sum_{j=1}^{l} \delta_j cn_{ji} + \sum_{j=1}^{m} \gamma_j cd_{ji} + \sum_{j=1}^{s} \mu_j rc_{ji} + e_i$$

Where, as usual, i indicates the individual unit (*département* in this case), and e_i is a random disturbance. Here, ***n***, ***cn***, ***cd*** and ***rc*** are the vectors of all variables affecting natural fertility, supply of children, demand for children and regulation costs.[23] Recognising that many of the components of these vectors are non-observable and introducing the time dimension the panel dataset allows me to exploit, the model should probably be better specified as:

$$(4) \qquad \mathrm{f}_{it} = \alpha + \sum_{j=1}^{k-d} \beta_j n_{jit} + \sum_{j=1}^{l-f} \delta_j cn_{jit} + \sum_{j=1}^{m-g} \gamma_j cd_{jit} + \sum_{j=1}^{s-k} \mu_j rc_{jit} + u_i + \mathrm{year}_t + \varepsilon_{it}$$

Here t indicates time and the inclusion of year dummies allows us to account for period effects. A crucial element in this specification, however, is the individual term u_i that captures the effect of some unobservables, assuming that those are associated with the characteristics of each *département* and do not change much. If these are indeed constant across time, a fixed effects model will be able to provide appropriate estimates, as coefficients are identified only by variations across periods. This method of course runs into troubles under the presence of time-invariant variables,[24] but as the figures in Table 1 above illustrate, there is variability across time and across *départements*, so the model is well specified in that respect.

Yet another aspect to consider is the role of diffusion. As I pointed out earlier, a good part of the debate on fertility decline has been set up in terms of diffusion versus adaptation hypotheses (Carlson, 1966) without any systematic attempt to assess whether diffusion explains anything *once we account for other*

[23] Clearly, it is sometimes difficult to determine whether a particular factor is affecting fertility through one or more of the channels. For example, women's education could be part of ***n*** (by making healthier, more fecund mothers), ***cn*** (by reducing chances of child mortality), ***cd*** (by increasing mother's opportunity costs), and ***rc*** (by affecting moral costs). Although it is plausible to imagine cases in which these effects could be disentangled, in practice we have to content ourselves with assessing the overall effect of a particular variable.

[24] The random effects approach does not have these problems, but it assumes that individual effects are uncorrelated with the other regressors. This assumption is too strong for my model, as some of the variables we are unable to observe are likely correlated with those we do observe. This can generate inconsistent estimates due to omitted variable bias so, in this context, fixed effects are generally preferred.

covariates. We can address this issue by introducing a spatially- and time-lagged component:

$$(5)\quad \mathrm{f}_{it} = \alpha + \sum_{j=1}^{k-d} \beta_j n_{jit} + \sum_{j=1}^{l-f} \delta_j cn_{jit} + \sum_{j=1}^{m-g} \gamma_j cd_{jit} + \sum_{j=1}^{s-k} \mu_j rc_{jit} + \rho \sum_{j \neq i} w_{ij} \mathrm{f}_{jt-1} + u_i + \mathrm{year}_t + \xi_{it}$$

This is a standard specification for a spatial regression (Upton and Fingleton 1985; Anselin et al. 2008), and similar ones have already been used to study diffusion of fertility (e.g. Casterline 2001, pp. 18-19), including in historical perspective (e.g. Tolnay 1995). Basically, each w_{ij} is the element of a weighting square matrix W that establishes the distances between the different individuals (in this case, *départements*), which has to be pre-specified. This is indeed arbitrary, but not more arbitrary than assuming no spatial dependence (i.e. a matrix of zeros), as it is normally done. There are different ways of establishing those distances, and in this paper I explore the two most commonly used: a neighbouring matrix (this is, one that assigns the value of 1 to adjacent *départements* and 0 to the rest) and distance matrix (that states the inverse of the distance between the centroid of each *département*).

3.3. Pooled OLS versus panel results

Table 2 presents a series of initial estimates that I report as elasticities evaluated at the overall mean.[25] Columns (i)-(ii) correspond to the pooled-OLS model associated with equation (3), whereas (iii)-(iv) correspond to the panel specification as in equation (4). Spatial dependence as presented in (5) is accounted for in columns (ii) and (iv).

Unsurprisingly, the results of the pooled-OLS estimations are not far from previous studies using only cross-sectional data. There I find evidence of marital fertility being positively correlated with infant mortality (as in van de Walle 1976) and urbanisation (as in McQuillan 1984), yet negatively correlated with income (as in van de Walle 1976 and Watkins 1991). Interestingly enough, it also suggest that financial sophistication (increase in saving books per capita) also leads to smaller families. There also seems to be a small role played by migration, where net inflow of women in their mid-twenties has a negative effect on fertility.[26] Results do not change much if we account for spatial dependence,

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[25] This is to ease the assessment of each variable's impact on fertility and make them comparable to other studies (e.g. Brown and Guinnane 2002, Dribe 2009). In Appendix B I report the actual coefficients estimates and additional information on the regressions.

[26] Other studies of the fertility decline have consider important to incorporate migration, yet none found it to be of any relevance to explain fertility (e.g. Brown and Guinnane, 2002: 43; Dribe, 2009: 80-81). This negative effect I find of net inflow of women in their mid-twenties probably works by increasing the denominator of the I_g index, as mean age of marriage in this period for most *départements* is in the low twenties. It is difficult to draw strong conclusions based upon this outcome, but one way of reading it is that women –at least those migrating– were delaying births rather than spacing them. They could also be learning. It has been suggested lately (Daudin et al. 2012) that migrants

Table 2. Modelling marital fertility in France (1876-1896) using *départements* data, pooled-OLS and fixed effects models

Dependent variable: Ig	*Pooled OLS*		*Panel FE*	
	(i)	*(ii)*	*(iii)*	*(iv)*
Demographic controls				
Infant mortality	0.252***	0.188**	0.003	0.010
Net immigration 15/19-20/24	-0.007	-0.006	0.002	0.004**
Net immigration 20/24-25/29	-0.040***	-0.037***	-0.012***	-0.012***
Net immigration 25/29-30/34	-0.003	-0.005	0.004***	0.003**
Foreigners (% change in pop)	0.000	0.000	0.001	0.001
Economic				
Income per capita	-0.267***	-0.208**	0.069***	0.055**
Urban population	0.152***	0.161***	0.065	0.038
Population in industry	-0.007	0.008	0.035	0.036
Saving books per capita	-0.078**	-0.055**	0.027	0.026
Education				
Literacy (female)	0.180	0.062	-0.129***	-0.078**
Literacy (male)	-0.458	-0.349	-0.024	-0.015
% children attending school	-0.218	-0.250**	-0.080**	-0.079**
Modernisation				
*Religion (*desservants*)*	-0.066	0.019	0.087**	0.076***
% republican vote	-0.051	-0.006	0.011	0.015
Turnout at the polls	-0.186	-0.111	-0.007	-0.011
Spatial dependence				
ρ (neighbour)		0.442**		0.353**
Fixed effects	**No**	**No**	**Yes**	**Yes**
Time dummies	**No**	**No**	**Yes**	**Yes**
R^2:	**0.48**	**0.58**		
within			**0.79**	**0.80**
between			**0.12**	**0.08**
F (df, n)	**37.6**	**34.0**	**33.2**	**33.2**

Notes: Values in this table are elasticities evaluated at the overall mean. See appendix A for a complete description of sources and Appendix B for the regression coefficients. All estimations included 435 observations (5 per each of the 87 *départements*). Estimates are heteroskedasticity robust, and clustered by *département* as suggested by Bertrand *et al.* (2004, pp. 270-272) to correct the potential risks of serial correlation. Asterisks indicate significance levels: * 10%, ** 5%, and *** 1%.

which turns out to be relevant. The only difference is that once this is incorporated the proportion of children attending schools become significant to explain fertility, a first piece of evidence suggesting investment in human capital is negatively associated with marital fertility.[27]

went to *départements* with low fertility (which Table 1 above supports), where they probably adopted the social norm –as suggested by equation (5)– and eventually transmitted it back to their *départements* of origin, fostering the diffusion effect.

[27] As a robustness check, I estimated these same models taking the crude birth rate as the dependent variable. This measure of fertility seems to be more sensitive to industri-

A crucial drawback of pooled-OLS to assess this aspect of the fertility behaviour, however, is that it does not model change over time, a thing that has been shown leads to unreliable estimates (Brown and Guinanne 2007, section III). Panel data allow us to deal with this problem by introducing fixed- and period-effects, and columns (iii)-(iv) show how results change if we use this alternative, more reliable procedure. The first remarkable finding is that, in contrast to the previous results, but in line with quantitative analyses that profit from the panel structure (e.g. Brown and Guinnane 2002), infant mortality at this stage of the transition does not to contribute to explain fertility at all, a result that holds even when experimenting with alternative measures of mortality, such as child (children up to 5 years) or perinatal mortality (not reported). Another substantial change is that income seems to have a positive impact on births, an outcome that is most likely reflecting the role of wealth on fertility in a context where children are considered normal goods.[28] As the discussion earlier in the paper somewhat anticipated, both urbanisation and the number of people in industry are disappointingly unimportant, and the proxy for financial development also ceases to be relevant.

What turns out to be significant in these specifications is female education. As many development theories suggest (see e.g. Schultz 1997), fertility in nineteenth century France was more sensitive to female than to male literacy; in fact, conscripts literacy of was not significant in any specification. This is in line with the idea that the opportunity cost faced by mothers matter the most at the moment of deciding the size of the family, and that the reduction in the (in this case educational) gender gap can lead to a decline in fertility (Galor and Weil 1996). Along with this effect, higher investment in human capital remains associated with lower levels of fertility, with the percentage of children attending school showing a elasticity of about -0.08. This highlights the importance of the trade-off between quantity and quality of children, a feature that has gained considerable support in the recent empirical literature (e.g. Becker et al. 2010, Klemp and Weisdorf 2012). These two results regarding education allows us to venture the hypothesis that the efforts made by the French state during the nineteenth century to organise and enforce primary education, such as with the Guizot law of 1833, and eventually extending it to all boys and –most importantly– girls in the country probably had a reinforcing effect on fertility dynamics.

Although not all 'economic' factors appear to have had an impact on fertility, the results so far support the hypothesis that some economic motives did

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alisation, which showed a positive impact on births, but all other results were virtually the same.

[28] Murtin (forthcoming), using a panel of countries in the long run (1870-2000), and controlling for mortality and education, finds the same positive effect of income on fertility. Other works that have looked into income-related measures have instead relied upon wage data, which arguably are closely connected to the idea of opportunity cost of time than that of wealth and, as expected, they suggest either a negative correlation with fertility (Brown and Guinnane 2002, p. 44; Dribe 2009, p. 85) or no correlation at all (Galloway et al. 1994, p. 152).

matter. What about cultural and social variables? If factors directly associated with the democratic values fostered by the French Revolution were ever important to explain births, they were certainly not relevant in the middle of the transition. Neither republicanism (i.e. the proportion of people voting for parties that were not monarchist) nor political participation seem to be connected with fertility. Religiosity, however, does show significant effects with the expected sign. This confirms one of the clearest results of the Princeton project (Knodel and van de Walle, 1979; Lesthaeghe and Wilson, 1986) and subsequent, more sophisticated studies (e.g. Weir, 1983; Galloway *et al.*, 1994; Brown and Guinnane, 2002): regions (in this case, *départements*) that are more religious had higher fertility. Interestingly, as with education, this aspect also highlights the potential relevant role of the State. If, as suggested in the discussion in section 2.3, the revolutionary government indeed contributed to the debilitate the quasi-universal religious practice in France (Gibson 1989), it might have been instrumental to foster the subsequent fertility decline.[29]

These results hold, again, even when controlling for spatially-, time-lagged fertility, which also turns out to be statistically significant. After controlling for a series of relevant covariates, there is *still* a residual effect for diffusion, as recently found also for Prussia (Goldstein and Klüsener 2010). To my knowledge, these are the first pieces of quantitative evidence that give support to theories that emphasise the role of social interactions in fertility choice (e.g. Durlauf and Walker 2001; Kohler 2001) in the context of the demographic transition. It is hard, however, to say much about the actual mechanisms behind this diffusion from the analysis presented here and further work is needed in this area (see González-Bailón and Murphy *forthcoming*). As a recent literature argues (e.g. Kohler 2001), it is plausible that this had to do with the role of social networks. Indeed, as suggested by Daudin et al. (2012), and supported by some of my results, social networks and migration flows partly explain the fertility patterns we see in France during the nineteenth century. Also, this was perhaps facilitated by an increasingly common language, which might to a degree explain why low fertility was achieved earlier in places where French was more widespread (see e.g. Weber 1976, pp. 498-501, or Watkins 1991). Here we have yet another suggestive argument in which the French State after the Revolution might have played a role in the fertility decline, this time by imposing a common language throughout the country that facilitated social interaction.

3.4. 2SLS estimates and robustness checks

As I show in this section, these results persist even under further refinements of the estimation methodology and a series of robustness checks.

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[29] If this reading is indeed correct, an interesting political economy corollary stems from this argument. Since the revolutionary government had the typical pro-natalistic interest of modern states (that need people to pay taxes and fight wars), its success in dismantling (at least partly) the Church's structure might have been Pyrrhic, as it hampered the institution that was helping to sustain high levels of fertility.

Earlier, in section 2.2, I pointed out that infant mortality is likely to be endogenous. Not only infant mortality and fertility might be simultaneously determined; unobserved factors might affect both, generating spurious correlation (Schultz, 1997: 339). One way of dealing with that is to use instrumental variables estimation. Finding a suitable instrument is not always easy, but for this particular case climate data is at least promising. By its very nature, climate is indeed exogenous. Also, hot summers are likely to affect child mortality, but not fertility, making it a potential good instrument.[30] Hence I used temperature data (deviations of the mean summer temperature in Celsius over the 50-years average per *département*) to instrument infant mortality.[31] In Table 3 below I report the results of a series of models that use this information to generate 2SLS estimates of various versions of the regression equation (5).[32] In all cases the F-tests of the excluded instruments in the first-stage regression (reported at the bottom of the table) rejected the hypothesis of them being zero and post-estimation analyses suggested the instruments were valid.[33]

Column (v) differs from column (iv) in Table 2 only in that it instruments for infant mortality, and the results are almost identical. As a robustness check, in column (vi) I use deviations from July's temperature as an instrument and the estimates are comparable. Column (vii) assesses the same model, but with child mortality (i.e. children under five) in place of infant mortality, with the same general outcome. The following two columns, (viii) and (ix), check the consistence of my measure of income. Since there I relied on a proxy (constructed based upon direct taxes), I experimented here with another proxy: the amounts of savings per capita, which are also likely to be correlated with income. The impact we can see in column (viii) is somewhat smaller yet equivalent and, interestingly enough, when we make the two proxies 'compete' in column (ix) it is savings per capita –arguably the less noisy– that dominates, but without affecting much the other coefficients. Column (x) collapses the two literacy measures to create an indication of the impact of the gender gap, whereas in column (xi) I try an alternative measure of religiosity: the proportion of children attending religious schools. Again, results are persistent. Lastly, in column (xii) I experiment with

[30] The literature on nineteenth century child mortality suggests there are clear seasonal patterns in which particularly hot summers increased the risk of death, specially via diarrheal mortality (e.g. Cheney 1984, Woods et al. 1988: 362). Although the peak varies from year to year and place to place (Cheney 1984: 563), the effect seems to concentrate July, so in the estimations I use this as a robustness check.

[31] Climatologic data comes from Luterbacher et al. (2004). See appendix for details.

[32] Appendix B includes details on the first stage corresponding to each of the models.

[33] We know from Angrist and Imbens (1994) that the usefulness of overidentification tests is limited, yet in none of the estimations the null of the Hansen's J statistic of overidentifying restrictions (the joint null that instruments are uncorrelated with the error term and that the excluded instruments are correctly excluded from the estimated equation) was rejected under the standard significance levels.

<u>Table 3</u>. Modelling marital fertility (I_g) in France (1876-1896) using *départements* data, 2SLS with fixed effects

Dependent variable: Ig	***2SLS***							
	(v)	***(vi)***	***(vii)***	***(viii)***	***(ix)***	***(x)***	***(xi)***	***(xii)***
Demographic controls								
Infant mortality	-0.034	-0.050		-0.051	-0.057	-0.030	-0.051	-0.044
Child mortality			-0.040					
Net immigration 15/19-20/24	0.003	0.003	0.003	0.004**	0.004**	0.003**	0.003**	0.003
Net immigration 20/24-25/29	-0.012***	-0.012***	-0.012***	-0.013***	-0.013***	-0.012***	-0.013***	-0.012***
Net immigration 25/29-30/34	0.003**	0.003**	0.003**	0.003**	0.003**	0.003**	0.004***	0.003**
Foreigners (% change in pop)	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Economic								
Income per capita	0.054**	0.053**	0.053**		0.041	0.054**	0.045**	0.046**
Savings per capita				0.040 ***	0.035***			
Urban population	0.039	0.040	0.041	0.015	0.020	0.050	0.027	0.029
Population in industry	0.032	0.031	0.032	0.025	0.027	0.033	0.032	0.031
Saving books per capita	0.024	0.023	0.025	-0.039	-0.035	0.026	0.025	0.019
Education								
Literacy (female)	-0.080**	-0.080**	-0.079**	-0.079**	-0.074**		-0.078**	-0.085**
Literacy (male)	-0.022	-0.025	-0.022	-0.009	-0.011		-0.015	-0.051
Literacy gap (female/male)						-0.062**		
% children attending school	-0.086***	-0.089***	-0.089***	-0.093***	-0.093***	-0.093***	-0.094***	-0.085***
Modernisation								
Religion (desservants)	0.069**	0.067**	0.067**	0.059**	0.063**	0.075***		0.073**
Religion (religious education)							0.082**	
% republican vote	0.013	0.013	0.015	0.009	0.009	0.014	0.011	0.012
Turnout at the polls	-0.015	-0.016	-0.012	-0.020	-0.025	-0.020	-0.025	-0.021
Spatial dependence								
ρ (neighbour)	0.332**	0.325**	0.356***	0.299**	0.265**	0.368***	0.321**	
ρ (distance)								1.021**
<u>Instrument</u>								
Deviation summer temp.	**X**		**X**	**X**	**X**	**X**	**X**	**X**
Deviation July temp.		**X**						
F-test excluded instruments	30.4	13.7	20.2	30.3	29.3	29.9	29.3	28.1
R^2	0.80	0.79	0.79	0.80	0.80	0.79	0.79	0.79
F (df, n)	32.8	32.7	32.5	34.1	33.7	33.5	32.7	31.7

<u>Notes</u>: Values in this table are elasticities evaluated at the overall mean. See appendix A for a complete description of sources and Appendix B for the regression coefficients. All estimations included 435 observations (5 per each of the 87 *départements*) , fixed effects and time dummies. Estimates are heteroskedasticity robust, and clustered by *département* as suggested by Bertrand *et al.* (2004, pp. 270-272) to correct the potential risks of serial correlation. Asterisks indicate significance levels: * 10%, ** 5%, and *** 1%.

an alternative weighting matrix for the spatial dependence, one that incorporate as elements of the matrix the inverse of the distance to the centroid of all other *département*s, which only absorbs part of the explanatory power of the time dummies without having any substantial effect on the level or significance of the other coefficients.

All these estimations provide results that are consistent with the original model I discussed in the previous section. The clear-cut reading of these findings is that, in the case of France, it is a combination of economic factors (mainly associated with the quantity-quality trade-off and the reduction of the gender gap) and cultural elements (such as religion) that contribute to explain different levels of fertility, to some degree mediated by a diffusion process and –at least arguably– reinforced by the particular policies taken by the State following the Revolution in its attempt to build a secular French nation.

4. Conclusion

In this paper I looked into the potential factors driving the fertility decline within France during the fertility transition. The econometric analysis I perform using 2SLS estimation in a fixed-effects panel model finds evidence that confirms the key roles played by *both* economic *and* cultural factors in explaining fertility. Most notably, income is positively correlated with larger families, whereas extended education (child enrolment in primary schools) is negatively correlated with it. These two features make the French story somewhat difficult to reconcile with the traditional account of an income-driven substitution effect leading to fertility decline (Becker 1960), yet still consistent with UGT, where the demand in education comes from complementarities associated with technological change (e.g. Galor 2011). The systematic negative effect of female literacy also resonates with UGT, which puts a special emphasis on the narrowing of the gender gap on driving fertility decline (Galor and Weil 1996). In my results there is no clear indication that infant mortality, urbanisation, or industrialisation had any direct effect whatsoever. Religiosity, measured in two different ways, is consistently relevant to explain fertility. All these effects are present despite the fact that I introduced (in two alternative ways) spatially-, time- lagged fertility, which also turns out to be strongly significant providing support for the diffusion hypothesis. One possible way to read these results points towards the idea that cultural factors were partly driving fertility dynamics, by preventing or allowing the adjustment to economic incentives. This suggests that both components should be included in UGT and related theoretical models to provide a more comprehensive answer of why the decline occurred (and eventually induced Western Europe to achieve modern economic growth). The analysis developed here allows us to be more confident in establishing the link between some cultural traits, economics, and fertility, though it is still rough in determining the precise way in which this took place. As pointed out by many researchers, probably most emphatically by Weir (1983, p. 281), the connection cannot be taken lightly, and more research should be put into the mechanism behind this.

Appendix A: Details on data sources

Official French statistics

The major part of the dataset was constructed using official statistics by the Service de la Statistique Général de la France between 1878 and 1903 and Table A.1 details the references for each variable collected. Data were in general available for all five years, so for only a few cases I had to rely upon an alternative reported year or estimates. To get the missing values for the people working in industry, I calculated the implicit annual rate between 1876 and 1891, and applied it to the known values. To get the 1896 number of women capable of sign their marriage certificate I extrapolated using the average rate of growth of the previous periods. In the remaining variables there were no missing values. The rest of the variables were obtained from diverse publications. Fertility data were available from studies part of the European Fertility Project. In particular, marital fertility (I_g), was obtained from the original core publication of the project (Coale and Watkins 1986, pp. 94-107). Migration came from Bonneuil (1997). The proportion of votes received by the republican parties (as opposed to monarchist parties) in the legislative elections between 1877 and 1893 is from Avenel (1894, p. 65) and the value for 1896 was estimated as the average of the four previous periods.

Temperature data

Climatologic data was kindly given by a group of researchers at the University of Bern that calculated a monthly series spanning five centuries of European climatologic data (Luterbacher et al. 2004).[34] They reconstructed the climatic history of Europe using a large number of homogenised instrumental data series, as well as additional information coming from sea-ice, tree rings and documentary records (Luterbacher et al. 2004, p. 1500), obtaining a grid with a resolution of 0.5° × 0.5° (which in the case of France is equivalent to having a measure each 38 km in the east-west spectrum, and around 55 km in north-south direction) where the value at each point represents the monthly average temperature in the 0.5° radius. About 250 of these data-points lay on French territory. To obtain estimates of the temperature in each *département*, I took the values corresponding to the points laying on that department and averaged them. Following this procedure I calculated for the years of the panel the average temperature for January and July, as well as their deviations from the corresponding 1850-1900 mean.

[34] I have to thank Roman Studer here for letting me know about this study and putting me in contact with the researchers in charge of it.

Table A.1.. Variables obtained from official French statistics

Variable	Reported year PUBLICATION (publication year: pages)				
Population					
Total	1876 ASF (1879: 14-17)	1881 ASF (1884: 12-15)	1886 ASF (1888: 4-5)	1891 ASF (1903: 8-11)	1896 ASF (1903: 8-11)
Women	1876 ASF (1879: 34-37)	1881 ASF (1883: 20-23)	1886 DEN (1888: 84-85)	1891 ASF (1892/4: 24-25)	1896 ASF (1899: 2-5)
By age (< 5 years old)	1876 DEN (1878: 96-99, 120-123)	1881 DEN (1883: 136-139, 160-163)	1886 DEN (1888: 152-155)	1891 DEN (1894: 605-607)	1896 DEN (1899: 356-359)
Births, stillbirths, and number of natural children born	1876 ASF (1879: 44-47)	1881 ASF (1884: 26-29)	1886 ASF (1889: 14-17)	1891 ASF (1899: 2-5)	1896 ASF (1902: 16-19)
Deaths (male < 5 years old)	1876 ASF 1879: 54-57)	1881 ASF (1884: 36-39)	1886 SGF (1889: 64-67)	1891 SGF (1892, 56-59)	1896 SGF (1898, 80-83)
Deaths (female < 5 years old)	1876 ASF (1879: 58-61)	1881 ASF (1884: 40-43)	1886 SGF (1889: 68-71)	1891 SGF (1892, 60-63)	1896 SGF (1898, 84-87)
Foreigners [(a)]	1876 DEN (1878: 88-91)	1881 DEN (1883: 116-119)	1886 DEN (1888: 96-97)	1891 DEN (1894: 506-509)	1896 DEN (1899: 258-261)
Urban	1876 ASF (1879: 14-17)	1881 ASF (1884: 12-15)	1886 ASF (1888: 4-5)	1891 ASF (1892/4: 12)	1896 ASF (1903: 24-27)
In industry	1876 DEN (1878: 212-215)	1881 DEN (1883: 272-275)	1886 DEN (1888: 222-223)	1891 ASF (1892/4: 28-29)	(extrapolated)
Literacy and education					
Women being able to sign	1876 ASF (1879: 18-21)	1881 ASF (1884: 31, 33)	1886 ASF (1889: 18-19)	1892 ASF (1892/4: 50-51)	(extrapolated)
Number of conscripts and their literacy level [(b)]	1876 ASF (1879: 474-477)	1881 ASF (1884: 524-527)	1887 ASF (1888: 414-417)	1893 ASF (1892/4: 684-5)	1897 ASF (1898: 628-629)
Students in lay and congregational primary schools [(c)]	1875-1876 ASF (1878: 240-243)	1880-1881 ASF (1883: 246-249)	1885-1886 ASF (1888: 184-187)	1892-1893 ASF (1892/4: 282-5)	1895-1896 ASF (1897: 442-446)
Others					
Taxes: direct contributions (in francs) [(d)]	1876 ASF (1881: 520-523)	1880 ASF (1885: 546-549)	1886 ASF (1889: 384-387)	1892 ASF (1892/4: 572-75)	1896 ASF (1897: 485)
Number of saving books and amount of francs in them [(e)]	1876 ASF (1879: 218-221)	1881 ASF (1884: 232-235)	1886 ASF (1886: 158-159)	1892 ASF (1892/4: 200)	1896 ASF (1898: 68-71)
Wheat prices	1876 ASF (1879: 14-17)	1881 ASF (1884: 314-316)	1886 ASF (1888: 216-218)	1893 ASF (1892/4: 308-310)	1896 ASF (1898: 94-97)
Number of Desservants	1876 ASF (1879: 68-71)	1881 ASF (1884: 60-63)	1886 ASF (1889: 26-29)	1991 ASF (1891: 34-35)	1996 ASF (1897: 485)
Electors and voters [(f)]	1877 ASF (1879: 458-459)	1881 ASF (1882: 460-461)	1885 ASF (1887: 554-557)	1893 ASF (1892/4: 668-9)	1898 ASF (1898: 521-522)

Sources: All these figures came from publications of the Service de la Statistique Général de la France (1878-1903), either the Annuaire Statistique de la France (ASF), the Statistique Générale de la France - Statistique Annuelle (SGF) or the Résultats Statistiques du Dénombrement (DEN).

Notes: (a) Residents that are not French nationals. Change from 1871 estimated using data for 1872 (DEN 1873, pp. 44-47), as the former was not available; (b) Information corresponding to the original list of conscript, not to those admitted to the army. Cases where the level of education was not known were extracted from the total to get literacy rates; (c) Includes all primary schools, free and public; (d) Includes mainly taxes on land (*foncière*), personal property (*personnel et mobilière*), houses (*des portes et fenètres*), and licenses (*des patentes*). Income estimates built applying the proportions implied by these taxes to the domestic product in Toutain (1987), deflated by the price of wheat; (e) Accounts hold in national *Caisses d'epargne*; (f) Corresponding to legislative elections for the reported years.

Appendix B: Additional econometric output

The tables below detail the econometric output used to construct the elasticity estimates in the text. Table B.1 shows the results of the pooled-OLS and fixed-effects panel regressions that appear in Table 2. Tables B.2 and B.3 present the estimates of the first and second stages in the 2SLS regressions corresponding to Table 3 in the text.

Table B.1. Modelling marital fertility in France (1876-1896) using *départements* data, pooled-OLS and fixed-effects

Dependent variable: Ig	***Pooled OLS – β (s.e.)***		***Panel FE – β (s.e.)***	
	(i)	***(ii)***	***(iii)***	***(iv)***
Demographic controls				
Infant mortality	0.703 (0.222)	0.526 (0.258)	0.008 (0.071)	0.028 (0.061)
Net immigration 15/19-20/24	-0.221 (0.252)	-0.179 (0.252)	0.069 (0.054)	0.107 (0.055)
Net immigration 20/24-25/29	-0.679 (0.146)	-0.633 (0.143)	-0.210 (0.059)	-0.206 (0.060)
Net immigration 25/29-30/34	-0.088 (0.154)	-0.148 (0.149)	0.108 (0.040)	0.092 (0.041)
Foreigners (% change in pop)	0.094 (0.452)	0.054 (0.401)	0.165 (0.223)	0.206 (0.238)
Economic				
Income per capita (in '000s)	-0.160 (0.044)	-0.124 (0.056)	0.041 (0.016)	0.033 (0.015)
Urban population	0.245 (0.085)	0.259 (0.088)	0.104 (0.100)	0.061 (0.096)
Population in industry	-0.014 (0.095)	0.016 (0.086)	0.075 (0.061)	0.076 (0.062)
Saving books per capita	-0.294 (0.129)	-0.205 (0.112)	0.100 (0.072)	0.099 (0.067)
Education				
Literacy (female)	0.101 (0.097)	0.035 (0.078)	-0.073 (0.024)	-0.044 (0.025)
Literacy (male)	-0.232 (0.172)	-0.177 (0.144)	-0.012 (0.033)	-0.008 (0.034)
% children attending school	-0.099 (0.071)	-0.114 (0.059)	-0.037 (0.016)	-0.036 (0.016)
Modernisation				
*Religion (*desservants*)*	-0.032 (0.027)	0.009 (0.025)	0.042 (0.017)	0.036 (0.013)
% republican vote	-0.034 (0.044)	-0.004 (0.052)	0.007 (0.011)	0.010 (0.012)
Turnout at the polls	-0.113 (0.097)	-0.067 (0.136)	-0.004 (0.023)	-0.007 (0.022)
Spatial dependence				
ρ (neighbour)		0.443 (0.248)		0.353 (0.136)
Fixed effects	**No**	**No**	**Yes**	**Yes**
Time dummies	**No**	**No**	**Yes**	**Yes**
R^2:	**0.48**	**0.58**		
within			**0.79**	**0.80**
between			**0.12**	**0.08**
F (df, n)	**37.6**	**34.0**	**33.2**	**33.2**

Notes: All estimations included 435 observations (5 per each of the 87 *départements*). Estimates are heteroskedasticity robust, and clustered by *département* as suggested by Bertrand *et al.* (2004, pp. 270-272) to correct the potential risks of serial correlation. Asterisks indicate significance levels: * 10%, ** 5%, and *** 1%.

Table B.2. Modelling marital fertility (I_g) in France (1876-1896) using *départements* data, 2SLS with fixed effects, first stage

Dependent variable:	*2SLS: First stage – β (s.e.)*							
	(v) ***Infant mort.***	***(vi)*** ***Infant mort.***	***(vii)*** ***Child mort.***	***(viii)*** ***Infant mort.***	***(ix)*** ***Infant mort.***	***(x)*** ***Infant mort.***	***(xi)*** ***Infant mort.***	***(xii)*** ***Infant mort.***
Instrument								
Deviation summer temp.	0.024 (0.004)		0.030 (0.007)	0.024 (0.004)	0.024 (0.004)	0.024 (0.004)	0.024 (0.004)	0.024 (0.005)
Deviation July temp.		0.015 (0.004)						
Demographic controls								
Net immigration 15/19-20/24	-0.122 (0.046)	-0.141 (0.049)	-0.149 (0.067)	-0.128 (0.042)	-0.118 (0.048)	-0.120 (0.046)	-0.099 (0.045)	-0.115 (0.045)
Net immigration 20/24-25/29	-0.008 (0.032)	-0.004 (0.034)	-0.038 (0.048)	-0.008 (0.033)	-0.009 (0.032)	-0.007 (0.033)	-0.008 (0.032)	-0.008 (0.032)
Net immigration 25/29-30/34	-0.059 (0.036)	-0.040 (0.034)	-0.086 (0.050)	-0.060 (0.036)	-0.059 (0.035)	-0.058 (0.035)	-0.054 (0.036)	-0.062 (0.033)
Foreigners (% change in pop)	0.037 (0.148)	0.031 (0.163)	0.196 (0.227)	0.038 (0.151)	0.042 (0.149)	0.028 (0.147)	0.072 (0.145)	0.043 (0.166)
Economic								
Income per capita (in '000s)	-0.012 (0.018)	-0.004 (0.019)	-0.025 (0.019)		-0.013 (0.018)	-0.012 (0.018)	-0.012 (0.017)	-0.009 (0.018)
Savings per capita				0.008 (0.067)	0.023 (0.066)			
Urban population	-0.021 (0.073)	0.014 (0.074)	0.008 (0.101)	-0.020 (0.073)	-0.025 (0.071)	-0.011 (0.072)	0.023 (0.074)	-0.011 (0.067)
Population in industry	-0.041 (0.024)	-0.035 (0.024)	-0.068 (0.041)	-0.040 (0.025)	-0.042 (0.024)	-0.041 (0.024)	-0.029 (0.026)	-0.040 (0.024)
Saving books per capita	-0.071 (0.054)	-0.058 (0.054)	-0.050 (0.070)	-0.088 (0.083)	-0.096 (0.084)	-0.065 (0.052)	-0.081 (0.058)	-0.062 (0.054)
Education								
Literacy (female)	0.006 (0.021)	-0.006 (0.022)	0.015 (0.025)	0.008 (0.021)	0.006 (0.021)		0.009 (0.021)	0.008 (0.023)
Literacy (male)	-0.033 (0.029)	-0.032 (0.029)	-0.039 (0.044)	-0.033 (0.029)	-0.033 (0.030)		-0.020 (0.029)	-0.025 (0.029)
Literacy gap (female/male)						0.002 (0.017)		
% children attending school	-0.024 (0.012)	-0.019 (0.011)	-0.045 (0.023)	-0.024 (0.012)	-0.024 (0.012)	-0.026 (0.012)	-0.020 (0.012)	-0.024 (0.012)
Modernisation								
*Religion (*desservants*)*	-0.022 (0.014)	-0.023 (0.013)	-0.042 (0.021)	-0.021 (0.014)	-0.023 (0.014)	-0.021 (0.014)		-0.024 (0.014)
Religion (religious education)							0.062 (0.047)	
% republican vote	-0.016 (0.011)	-0.008 (0.011)	-0.008 (0.014)	-0.016 (0.011)	-0.016 (0.011)	-0.016 (0.011)	-0.018 (0.011)	-0.016 (0.010)
Turnout at the polls	0.002 (0.019)	0.003 (0.019)	0.026 (0.027)	0.000 (0.020)	0.001 (0.019)	0.000 (0.019)	-0.009 (0.020)	0.004 (0.019)
Spatial dependence								
ρ (neighbour)	-0.210 (0.134)	-0.192 (0.136)	0.052 (0.187)	-0.231 (0.130)	-0.216 (0.140)	-0.203 (0.136)	-0.245 (0.125)	
ρ (distance)								-0.639 (0.318)
R^2	0.34	0.31	0.49	0.34	0.35	0.34	0.34	0.34
F (df, n)	11.8	9.31	29.4	10.9	11.4	12.2	11.7	11.1
F-test excluded instruments	30.4	13.7	20.2	30.3	29.3	29.9	29.3	28.1

Notes: All estimations included 435 observations (5 per each of the 87 *départements*), fixed effects and time dummies. Estimates are heteroskedasticity robust, and clustered by *département* as suggested by Bertrand *et al.* (2004, pp. 270-272) to correct the potential risks of serial correlation. Asterisks indicate significance levels: * 10%, ** 5%, and *** 1%.

Table B.3. **Modelling marital fertility (I_g) in France (1876-1896) using *départements* data, 2SLS with fixed effects, second stage**

Dependent variable: Ig	*2SLS: Second stage – β (s.e.)*							
	(v)	*(vi)*	*(vii)*	*(viii)*	*(ix)*	*(x)*	*(xi)*	*(xii)*
Demographic controls								
Infant mortality	-0.096 (0.131)	-0.141 (0.220)		-0.144 (0.139)	-0.160 (0.135)	-0.085 (0.129)	-0.144 (0.140)	-0.123 (0.126)
Child mortality			-0.077 (0.107)					
Net immigration 15/19-20/24	0.092 (0.058)	0.087 (0.061)	0.092 (0.058)	0.134 (0.057)	0.113 (0.058)	0.097 (0.056)	0.092 (0.051)	0.078 (0.055)
Net immigration 20/24-25/29	-0.208 (0.056)	-0.209 (0.055)	-0.210 (0.057)	-0.213 (0.054)	-0.213 (0.052)	-0.203 (0.057)	-0.217 (0.056)	-0.210 (0.056)
Net immigration 25/29-30/34	0.088 (0.041)	0.086 (0.041)	0.087 (0.041)	0.083 (0.038)	0.080 (0.039)	0.088 (0.040)	0.103 (0.040)	0.091 (0.042)
Foreigners (% change in pop)	0.228 (0.237)	0.237 (0.249)	0.240 (0.242)	0.277 (0.247)	0.269 (0.249)	0.208 (0.237)	0.193 (0.231)	0.221 (0.225)
Economic								
Income per capita (in '000s)	0.032 (0.015)	0.032 (0.016)	0.032 (0.016)		0.024 (0.015)	0.033 (0.015)	0.027 (0.015)	0.027 (0.015)
Savings per capita (in '000s)				0.230 (0.068)	0.202 (0.071)			
Urban population	0.064 (0.093)	0.065 (0.093)	0.066 (0.092)	0.025 (0.091)	0.032 (0.094)	0.080 (0.091)	0.044 (0.097)	0.046 (0.092)
Population in industry	0.068 (0.059)	0.065 (0.063)	0.067 (0.059)	0.054 (0.058)	0.057 (0.059)	0.070 (0.059)	0.068 (0.057)	0.067 (0.058)
Saving books per capita	0.089 (0.062)	0.086 (0.061)	0.092 (0.063)	-0.146 (0.100)	-0.131 (0.102)	0.099 (0.060)	0.093 (0.061)	0.073 (0.066)
Education								
Literacy (female)	-0.045 (0.024)	-0.045 (0.025)	-0.044 (0.025)	-0.045 (0.025)	-0.042 (0.025)		-0.044 (0.026)	-0.048 (0.024)
Literacy (male)	-0.011 (0.034)	-0.013 (0.034)	-0.011 (0.034)	-0.004 (0.034)	-0.006 (0.033)		-0.008 (0.035)	-0.026 (0.033)
Literacy gap (female/male)						-0.031 (0.017)		
% children attending school	-0.039 (0.015)	-0.040 (0.015)	-0.040 (0.016)	-0.042 (0.015)	-0.042 (0.015)	-0.042 (0.016)	-0.043 (0.015)	-0.039 (0.014)
Modernisation								
*Religion (*desservants*)*	0.033 (0.014)	0.032 (0.014)	0.032 (0.014)	0.028 (0.014)	0.030 (0.014)	0.036 (0.013)		0.035 (0.014)
Religion (religious education)							0.118 (0.051)	
% republican vote	0.009 (0.011)	0.009 (0.011)	0.010 (0.011)	0.006 (0.011)	0.006 (0.011)	0.010 (0.011)	0.007 (0.011)	0.008 (0.011)
Turnout at the polls	-0.009 (0.021)	-0.010 (0.021)	-0.007 (0.021)	-0.012 (0.022)	-0.015 (0.021)	-0.012 (0.021)	-0.015 (0.023)	-0.013 (0.021)
Spatial dependence								
ρ (neighbour)	0.333 (0.136)	0.326 (0.140)	0.357 (0.129)	0.300 (0.136)	0.266 (0.136)	0.369 (0.125)	0.321 (0.141)	
ρ (distance)								1.004 (0.467)
R^2	0.80	0.79	0.79	0.80	0.80	0.79	0.79	0.79
F (df, n)	32.8	32.7	32.5	34.1	33.7	33.5	32.7	31.7

Notes: All estimations included 435 observations (5 per each of the 87 *départements*) , fixed effects and time dummies. Estimates are heteroskedasticity robust, and clustered by *département* as suggested by Bertrand *et al.* (2004, pp. 270-272) to correct the potential risks of serial correlation. Asterisks indicate significance levels: * 10%, ** 5%, and *** 1%.

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