Family Systems and Fertility, Western Europe 1870-1960

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Abstract: *»Familienstrukturen und Fertilität, Westeuropa 1870-1960«*. This paper investigates the associations between fertility decline in Western Europe since the nineteenth century and the most elementary institution through which relationships between kin are defined: the family. Fertility levels in Western Europe declined strongly since the mid-nineteenth century but also show marked regional variations, comparable to developments in sub-Saharan Africa in the world today. Recent explanations of fertility decline point at the role of social relationships with kin and non-kin in the diffusion of family limitation. Based on the classification of family systems by Emmanuel Todd, theoretical connections between family systems and the level and speed of fertility change are made. Non-authoritarian family systems are expected to be more open towards change since non-kin are more likely to enter the social network. Authoritarian family systems on the other hand are expected to maintain higher levels of fertility due to the dense kinship networks. The findings in this paper show no clear association between family systems and reproductive outcomes during the course of the demographic transition. Fertility outcomes are more strongly associated with past fertility levels and the level of fertility in neighbouring regions.

Keywords: Family systems, fertility, spatial dependence, institutions, Europe.

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1. Introduction

Between 1870 and 1930, more than half of all countries in Western Europe experienced a decline in fertility by more than ten percent (Coale and Treadway 1986). This major change had far-reaching consequences for Western societies, as it arguably contributed to the rise of modern democracy and sustained economic development (Dyson 2010; Galor 2012; Greif 2006). But how can we understand the marked regional differences in fertility levels between European regions? There has been considerable debate in the literature on the question whether fertility change is a consequence of changes in structural conditions – for example economic growth or increasing secularism – or ideational change (see Casterline 2001 for a summary of the literature). Previous authors have emphasized the effects of economic and structural factors such as urbanization and industrialization on reproductive outcomes in explaining the explaining the decline in fertility at the turn of the twentieth century (Davis 1945; Thompson 1929; Becker 1981; Becker and Barro 1988; Easterlin 1975). Others have argued that processes of ideational change, such as secularization and individualization, where at the root of the decrease in family size (Coale and Watkins 1986; Lesthaege 1983). However, these explanations, alone or in tandem, have not been able to clarify the large regional differences in the timing of fertility decline between European societies. For instance, while France pioneered in family limitation already in the eighteenth century, the country was still largely agrarian. Conversely, many areas in England retained high levels of fertility until far in the nineteenth century, even though this country is considered a forerunner in industrialization. The Princeton European Fertility Project has shown that language borders provided a better explanation for variations in regional European fertility levels than socio-economic differences. In contrast, European regions which were adjacent and shared a common language but were otherwise heterogeneous in economic characteristics, showed a decline in fertility at similar moments in time. This suggests that fertility decline should not be regarded as only an adaptive response to changing social and economic conditions, but also that it could spread between regions as an innovative social behaviour among people with a common language or cultural understanding (Watkins 1986, 441).

Recent studies explaining European fertility decline have highlighted the role of social interactions with both kin and non-kin in the study of reproductive behaviour (Bongaarts and Watkins 1996; Watkins 1990). By providing resources and support (Turke 1989; Tymicki 2004; Rotering and Bras 2015), or by passing on preferences, attitudes and information on parenthood and childbearing (Axinn et al. 1994; Bernardi 2004; Kohler 2001), family and kin play an important role in influencing people's reproductive behaviour. Regional clusters of such norms, values and practices surrounding kinship and family can be viewed as 'family systems' (Das Gupta 1999; Davis 1955; Hajnal 1982;

Mason 2001; Skinner 1997; Therborn 2004; Todd 1990, 1985, 2011; Reher 1998; Kok 2009). Between family systems, the extent and opportunities for the diffusion of new reproductive norms might vary in highly distinctive ways.

This paper aims to examine whether family systems are associated with the spatial diffusion of fertility decline in Western Europe between 1870 and 1960, using regionally aggregated measures of fertility from the Princeton European Fertility Project. Family systems can be defined as 'a set of beliefs and norms, common practices, and associated sanctions through which kinship and the rights and obligations of particular kin relationships are defined' (Mason 2001), or as the 'cultural mould [that is] shaping behaviour' (Kok 2009).

A large number of studies have explored the connections between family systems and various outcomes, including fertility behaviour (Mönkediek and Bras 2016), extramarital fertility (Kok 2009), disparities in social and economic indicators (Duranton et al. 2009), economic performance (Alesina and Giuliano 2007; Greif 2006; Kick et al. 2000), alternative indicators of wellbeing (Brulé and Veenhoven 2014), gender systems (Bertocchi and Bozzano 2014; Mason 2001), and the origins of political divergence (Mamadouh 1999; Todd 1990; Todd 1985). Several authors have developed typologies of family systems. Emmanuel Todd (1990, 1985, 2011) has organised his system using the degree of parental authority and sibling equality. David Reher (1998) distinguishes between regions with 'weak' and 'strong' ties between family members, with a particular focus on how societies take care of their elderly citizens. Göran Therborn (2004) has defined family systems that are geographically anchored to the major continents. Although there are other typologies of family systems, this paper makes use of Emmanuel Todd's typology of family systems because of the theoretical connections between reproductive outcomes and the organising principles of this classification. Some reflection on the merits of Todd's family systems for this study is however required. Todd's typology originates from his work on political ideologies and while the organising principles of family systems are well-defined, Todd's allocation of family systems to particular regions has left room for interpretation (Moch 1986; Rijpma and Carmichael 2016). An important disadvantage for this study is that Todd's typology of family systems may not be precise or selective enough to differentiate between European regions. However, there are only few typologies of family systems and Todd's scheme is particularly well-developed for Western Europe, displaying considerable regional variation. We will come back to this point in the discussion.

A better understanding of the role that family systems play in the diffusion of fertility decline, may help public policy makers who are concerned with the rapid growth of populations in present-day developing countries. If fertility decline is regarded as a behavioural innovation, regarded in a broad sense as the spread of information, attitudes, values and means of birth control between social groups or regions, then knowledge on whether and how family systems affect the diffusion of such innovations helps policy makers to identify key areas on where to focus

their efforts. This article is organized as follows: the next section describes the classification of family systems by Emmanuel Todd. Then follows a theoretical review of the connection between family systems and fertility decline. In the third section, the data, measurements and methods are described, as well as some limitations of our approach. Finally, the results of the analysis are presented followed by a discussion of how these findings help to better understand the role of family systems in the decline of fertility in Western Europe.

2. Family Systems and Fertility

2.1 Classification of Family Systems

In his book *L'invention de l'Europe*, published in 1990, Emmanuel Todd examines regional variations in the development of modernity, marked by indicators such as industrialization, secularization and literacy in Western Europe since the Middle Ages. He draws connections between the different pathways of development and particular local ideologies, or unconscious, implicit values and norms about the place of the individual in his social group, which manifest themselves in what he describes as pre-modern family systems. Building upon the works of Frédéric le Play, Todd distinguishes two main organising principles for his classification of family systems in Western Europe; parental authority and sibling equality.

The first principle, parental authority, refers to the age at which children become independent and leave the household of their parents. In authoritarian family systems at least some of the children – usually only the first born son – remain living within or in close vicinity of the parental household after marriage, with parents exercising considerable control over their children. In non-authoritarian, or nuclear family systems, children are expected to become economically self-sufficient and leave the parental home to form independent families when they marry or reach adulthood. In order to identify the degree of parental authority, Todd studied regional censuses from the 1950-1960s to determine the proportion of adult children living with their parents. He then compared his findings with historical monographs about these regions to examine whether the pattern that was found matches that of earlier descriptions in the literature. The second principle, sibling equality, refers to the division of parental property among siblings (brothers in particular). In egalitarian family systems, all children receive an equal share of their parents' inheritance, while in non-egalitarian systems inheritance is impartible. In non-egalitarian systems, the parents favour one child – often the oldest son – who inherits the parental property. In order to identify in which regions egalitarian family structures prevail, Todd examined contemporary inheritance laws and practices and also

compared these findings with historical monographs. The combination of these two organising principles results in four family systems (see Table 1).

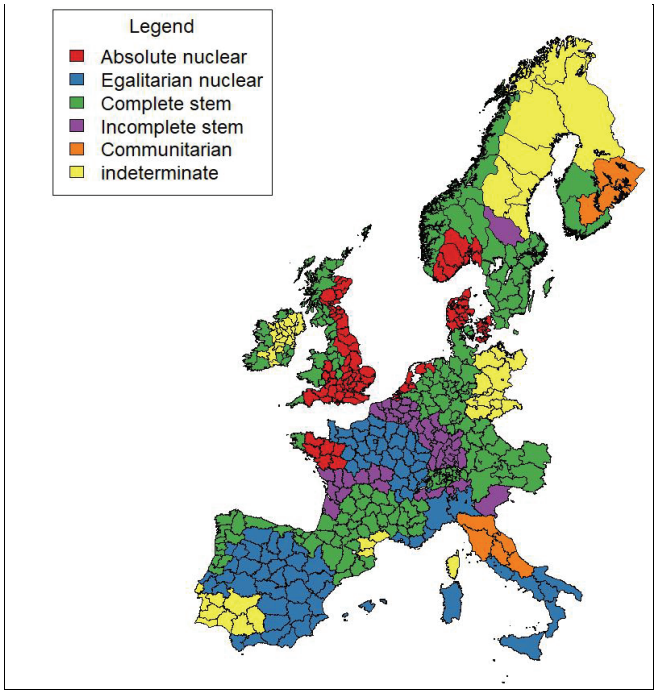
Table 1: Main Characteristics of Emmanuel Todd's Typology of Family Systems in Europe

Family system:	*Absolute nuclear family*
Characteristics:	Weak authority, inegalitarian Neolocal residence of children upon marriage, no clear inheritance rules and frequent use of wills (Todd, 1990, 37, Todd, 1985, 99). Kinship networks dispersed, liberal ties between parents and children (Bras and Van Tilburg, 2007). Le Pay refers to this system as 'unstable' (Todd, 1985).
Principal regions:	England, North-Holland, Denmark
Family system:	*Egalitarian nuclear family*
Characteristics:	Weak authority, egalitarian Neolocal residence of children upon marriage, relatively strong relationships between parents and children (Todd, 1990 p. 37). Bilateral and equal inheritance. No involvement of parents in choice of partners, although endogamous marriage is common in order to prevent dispersal of property. In many areas, such as in southern Italy, daughters receive their share of the inheritance in the form of a dowry.
Principal regions:	Northern France, southern Italy, central and southern Spain, central Portugal
Family system:	*Stem family (also known as authoritarian family)*
Characteristics:	Strong authority, inegalitarian Impartible inheritance and co-residence of heir with parents after marriage. Siblings of the heir can only remain in the household as long as they remain unmarried. Non-inheriting siblings often receive financial compensation, while heir inherits the house and landholdings. Exogamous marriage, often arranged by parents. Married women have a strong position. Kin members form large part of social network, community ties are strong.
Principal regions:	Germany, Austria, southern Sweden, Norway, south and east of the Netherlands, northern Portugal, northern Spain, southern France
Family system:	*Incomplete stem family*
Characteristics:	Strong authority, inegalitarian practices under formal egalitarian laws Same family system as stem family, but inheritance rules are less strict. Formal rule stipulates partible inheritance, although often one heir receives largest share.
Principal regions:	Belgium, north-western Italy, western France (i.e. Maine and Vendée)
Family system:	*Exogamous community family (also known as communitarian family)*
Characteristics:	Strong authority, egalitarian Extended family form wherein several generations live under one roof. Married sons bring their wives into the family home. Household generally split up after death of father and inheriting sons form new households, inducing a new cycle of nuclear, stem and joint phases of co-residence. Women have a relatively weak position. Marriages arranged by parents and inheritance is patrilineal. Equal inheritance among brothers. Kinship networks are cohesive and social interactions are mainly kin-based.
Principal regions:	Northern Italy, Finland

In addition, Todd distinguishes a fifth family system observed in Western Europe where non-egalitarian inheritance practices persist under formal egalitarian laws. He calls this system the incomplete stem family system. Some regions could not be categorized along the organising principles of authority and equality, these regions are categorized as undetermined (Todd 1990). The main characteristics of family systems and the European regions where they are found are summarized in Table 1.

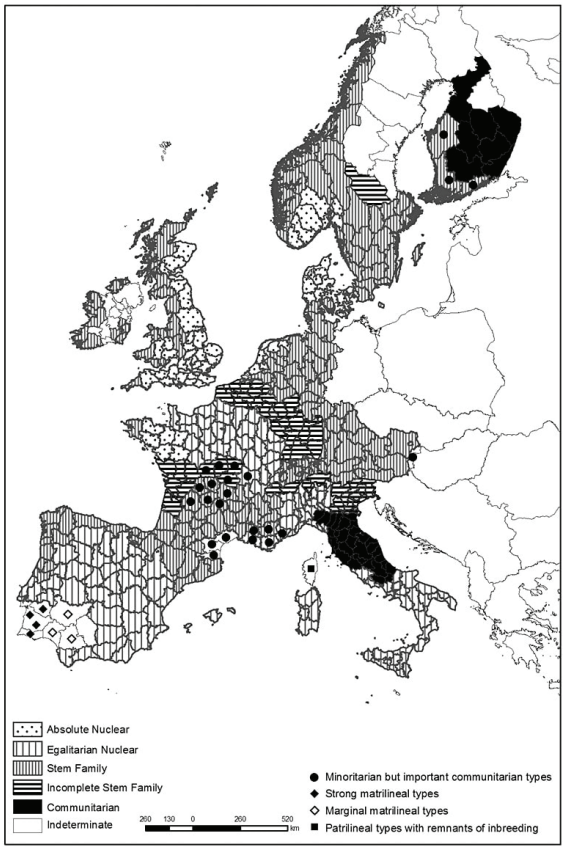
Todd has portrayed his family systems on a map of Western Europe, which has been digitized by Gilles Duranton et al. for a study on the associations between family systems and a series of socioeconomic indicators[1] (Duranton et al. 2009). Todd's original map and the adaptation used in this article are given in Figure 1.

Figure 1: Family Systems in Western Europe



Classification of family systems, based on administrative division around 1900.
Source: Duranton, 2009.

[1] Gilles Duranton kindly provided the digital map of family systems, used in his 2009 article, for this study.



Original classification of family systems in Western Europe by Emmanuel Todd.
Source: Todd 1990, page 7.

2.2 Regional Differences and Persistence of Family Systems

Figure 1 shows Todd's classification of the predominant family systems in Western Europe. National borders do not seem to form a clear separation between family systems and nearly all countries display considerable variation in family systems. In many countries, such as Italy, the Netherlands and France for example, there are regions where cohabitation of parents and married children is observed (stem or communitarian family) and regions where neolocal family structures are predominant (nuclear family).

As mentioned above there are other classifications of family systems, which differ in their organising principles as well as geographical distribution (e.g. Therborn 2004; Reher 1998). Therborn's family systems cover larger geographical areas and Europe in his view contains one single family system – or

geoculture. Reher's (1998) demarcation between the southern and northern European family system is not observable in Todd's classification of family systems. Although Todd's absolute nuclear family system is only found in northern Europe, a clear geographical north-south division between family systems is not visible. Furthermore, within regions, individual families or communities may display very different levels of parental authority and equality than the predominant regional family system. Todd identifies several regions, such as southern Portugal, where smaller communities can be found that have a family system which is markedly different from the regional family system (see bottom Figure 1). Todd's family systems are not necessarily related to the composition of the household or structure of the conjugal unit, but more to the predominant local ideologies of the place of an individual within the group (Todd 1985; Skinner 1997). Recently, Viazzo and Zanotelli (2010) have for example shown that in Italy it has become more common in recent years for adolescents to live in close proximity of their parents instead of cohabiting with their parents. Although variations in household compositions are visible in recent times, family systems still display the same norms, values and practices surrounding the family.

An important assumption about family systems made here is that they are fairly persistent over time, caused by the children's unconscious imitation of their parents. Todd argues that when parents raise their children, their values are reproduced within the family. "[As] a unit of biological and social reproduction, the family needs no sense of history or of life in order to perpetuate its structures" (Todd 1985, 196). In southern European societies, where parental authority is high, children today still leave the parental household at a relatively higher age, compared to northern European societies where parental authority is lower (Reher 1998). Historical census data shows that at least since the nineteenth century joint families (households with two or more co-residing children) have not been common in Western Europe (Ruggles 2010). However, the persistence of family systems over a considerably longer period of time has been questioned by some scholars. For example, Greif, who studies the influence of institutions on economic performance, suggests that the rise of modern corporations has led family systems to evolve towards the nuclear family over time, although not necessarily in a monotonically or geographically uniform manner (Greif 2006). Coleman argues that social capital rather than family systems has become a more important institution over time (Coleman 1994). Social capital identifies the value of relationships and exchanges between family members and as it develops, relationships between family members become less defined by their family system, but more by the social capital of their exchange. Not all researchers however agree with the declining importance and diversity of family systems over time. According to Astone et al. "(…) family formation is among the most important types of investment in social capital made in all societies [and], there is little evidence that the family is withering

away along the lines Coleman suggested" (Astone et al. 1999). Kertzer and Hogan (1988) also observe that demographers since the mid-1960s have regarded family systems as markedly stable elements over long periods of time. In spite of the changing social and economic functions of the family, even throughout periods of industrialization, families systems have retained largely the same structure and geographical distribution.

2.3 Family Systems and Regional Differences in Reproductive Outcomes

Family systems reflect regional norms, values and practices surrounding the family and kinship, such as marriage, birth control, parenthood, or the role of children (Todd 1990; Mason 2001). As such, family systems may have both direct and indirect effects on fertility outcomes, either by specifying 'normal' behaviour or by regulating the diffusion of innovations from one region to another (Bocquet-Appel and Jakobi 1998; Rogers 1995; Weeks et al. 2000).

Direct effects of family systems work through norms and values that are maintained within a particular community or region, such as egalitarian inheritance principles or cohabitation of parents with married children. In a way, family systems can facilitate or constrain particular reproductive behaviours by specifying what is to be considered as 'normal'. For example, Davis (1955) argues that in the joint family system found in East Asian societies, newlywed couples are absorbed into the parental home. Since childbearing was one way for the young couple to establish themselves as adults within the joint household, reproductive outcomes in the joint family system were higher than in nuclear family system regions, explaining in part the association between joint family systems and universal, early marriage (Davis 1955). The utility of children however does not need to relate only to the social status of the couple, but can also be expressed in economic terms. When children are able to provide additional income to the household – i.e. the utility of each additional child is higher than the costs – fertility levels are likely to be higher in regions where it is customary for children to remain living with their parents after marriage, compared to non-authoritarian family system regions where children are more likely to leave the household at younger age (Becker and Barro 1988; Klep 2004, 2010). However, these mechanisms may be too simplistic and household composition does not always reflect power relations within the household. For example, Fertig (2017) argues that within the stem family system, parental authority could be low even in multigenerational households. Since children had alternative options to make a living and their parents were dependent on them for retirement, children had considerable bargaining power over their parents. Historical property transfer contracts from western Germany show that parents for example gave up their property rights or the right to manage the family farm (Fertig 2017).

Family systems may be indirectly be associated with fertility outcomes through the geographical diffusion of knowledge, attitudes, values and norms regarding reproduction (Cleland and Wilson 1987). In this way, family systems do not specify norms concerning 'normal' behaviour but instead reflect an 'openness' to new ideas or behaviours. As such, family systems may not be directly associated with the level of fertility, but with the speed by which behavioural innovations – such as changes in reproductive behaviours – may spread from one geographical area to another. By facilitating or constraining contact with others outside the close-kin group, family systems for example shape opportunities for social learning (Bernardi 2004). Bras and Van Tiburg (2007) have shown that the frequency of contact with kin is affected by the family form. In summary, family systems may have both direct and indirect effects on fertility outcomes either through regional norms, practices and values surrounding the family and kin, or through a certain 'openness' of the kin-network for new ideas or behavioural innovations.

2.4 Hypotheses

This study examines the association between family systems and fertility decline in western Europe. The literature described above suggests that family systems may be associated with fertility outcomes either directly, through norms, values and practices that favour particular reproductive outcomes, or indirectly by shaping the flow of information concerning reproduction from one regions to another. Although these mechanisms are difficult to disentangle, it is important to consider whether fertility outcomes are correlated between regions. First, we examine whether particular family systems are associated with specific fertility outcomes. Next, the notion of 'openness' to change is examined, by including diffusion effects in our analysis.

When local norms, values and practices attribute a relatively large utility to having children, it is likely that fertility outcomes within such systems are higher. The value of children – either economic, or status increasing – is assumed to be higher in authoritarian family systems than non-authoritarian family systems (Klep 2004, 2010; Becker and Barro 1988). David Reher (1998) for example observes that much of the aid provided to vulnerable members of society, such as the elderly, comes from family members and charities instead of public funds and individual insurances in the traditionally authoritarian, Mediterranean societies in southern Europe. It is hypothesized that *fertility levels are likely to be higher in authoritarian family systems than in nuclear family system regions* (H1).

Family systems that are relatively open and show varied networks of both kin and non-kin, are more likely to facilitate the acceptance of new ideas or behaviours, such as family limitation, than family systems that foster closed kin-based networks. The two dimensions of Todd's family systems, the degree

of parental authority and sibling equality, are assumed to be indicators of the openness of family systems to new ideas regarding reproduction. Family systems with low parental authority (nuclear) are relatively open to new ideas because of the relatively young age at which children leave the parental home. Neolocal household formation, customary in nuclear family systems, forms an opportunity for social learning as individuals form networks comprised of both kin and non-kin. In contrast, authoritarian families (stem and communitarian) display a stronger ethic of kinship leading to cohesive kinship networks in which social interactions are highly kin-based (Bras and Van Tilburg 2007). Even when children marry and move out of the household in an authoritarian family system, they still remain bound to the parental home and often live in close vicinity of their parents.

The degree of sibling equality, represented by the distribution of parental property between siblings, also determines the openness of family systems to social innovation. Family limitation is more likely to diffuse over time in regions where children have more opportunities to seek contact with others, or when there are fewer incentives to preserve close bonds with kin-members. Family systems where impartible inheritance is custom provide little incentives for siblings to form close bonds between each other and their parents. Non-inheriting siblings have nothing to gain – or cannot risk their share of the inheritance by falling out of favour from the parents, simply because there is no share – and are therefore more likely to seek contact with others compared to children living under a system of partible inheritance. Accordingly, family limitation is more likely to diffuse within the absolute nuclear family system than in the egalitarian nuclear system, while exogamous community family systems may be the least open for social innovation since in these areas kinship networks are dense and information from non-kin members hardly enters these networks. It is hypothesized that *over time, fertility outcomes will be lower in inegalitarian family systems (under impartible inheritance) than in egalitarian family systems* (H2).

3. Data, Measurements, and Methods

3.1 Data and Measures

The fertility indices used in this article are from the Princeton European Fertility Project (Coale and Watkins 1986).[2] Initiated in 1963, the Princeton project aimed to gain insight in the causes of the decline of fertility in Europe since the mid-nineteenth century. The project in particular considered the question

[2] Data available online at <http://opr.princeton.edu/archive/pefp/>.

whether social and economic change set off the demographic transition in Europe, or whether modernization, as defined by urbanization and industrialization, played a more important role by undermining traditional high fertility patterns.[3] Based on a large selection of census materials and population registers, the Princeton project developed an index, I_f, to represent total fertility in a given area at any moment in time. I_f ranges between 0 and 1 and describes the number of births by all women between 15 and 49 years old in a region relative to the fertility schedule of married Hutterite women between 1921 and 1930.The Hutterites were an Anabaptist sect founded in Western Europe in the sixteenth century which in the nineteenth century migrated to the United States and southern Canada. The Hutterites show the largest number of births ever registered for women in each age group. The fertility schedule of the Hutterites was particularly high because contraception methods were strictly forbidden and children were only nursed for a few months after birth. While I_f provides a relative measure of total fertility, the Princeton project also developed indices of marital fertility, I_g, non-marital fertility, I_h and a measure of the contribution of marital status to the overall rate of childbearing, I_m (Coale and Treadway 1986). These four indices are related by the following identity:

$$I_f = \left(I_m \cdot I_g\right) + (1 - I_m) \cdot I_h$$

In this paper, I_f is used to examine the association between family systems and total fertility. While a discussion of marital and extramarital births specifically is beyond the scope of this paper, other researchers have found that extramarital births are connected to family systems, in particular through norms regarding partner choice and age at marriage (Kok 2009). While for example age at marriage in the Netherlands was relatively high around 1900, strong norms objecting cohabitation prevented high extramarital fertility rates.

The fertility indices developed by the Princeton Project have been disputed in the literature. For example, Brown and Guinnane argue that the Princeton Project data underestimated the role of economic and social change (Brown and Guinnane 2003; Guinnane et al. 1994). Also, the high level of aggregation caused the calculated fertility indices for Germany to differ from those uncovered by other studies (Brown and Guinnane 2003). Furthermore, the measures developed by the Princeton Project are sensitive to the age composition of the population (Coale and Treadway 1986, 162). However, the observations provided by the European Fertility Project are at this moment the only available source which provides a European wide coverage of the historical variation in the rate of fertility decline. The extensive geographical coverage and long period of observation make the Princeton project's data a relevant source for

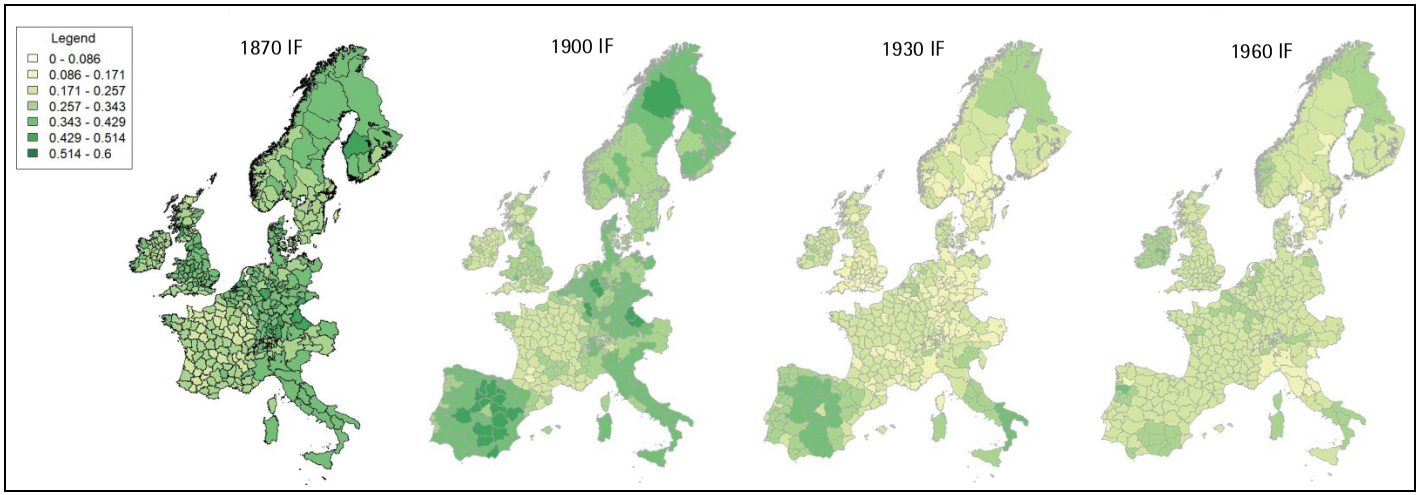
[3] The question whether modernization was the cause of fertility decline was at that time particularly relevant to policymakers, who sought to underpin their family-programmes in developing countries (Coale and Watkins, 1986, 31).

studying the associations between persistent institutions and regional variations in fertility patterns, even in face of the issues mentioned above.

Digital maps of historical administrative boundaries in Europe and the fertility indices of the Princeton project are provided by the Max Planck Institute for Demographic Research (MPDIR, 2013). Historical maps are drawn for the years 1870, 1900, 1930 and 1960.[4] The Princeton I_f indices are used only if the census used to calculate the index did not deviate more than 10 years from the base year of the map. Since the earliest data for Spain is from 1887, no fertility data is available for the earliest period of observation, 1870. A machine-readable map of the distribution of Todd's family systems in Europe is provided by Gilles Duranton et al. (2009). Duranton made two small corrections to Todd's original map, in accordance with the text in *L'invention de l'Europe*. The Languedoc region (France) and the Andalucía regions (Spain) are labelled as undetermined on Todd's original map, whereas in his text Todd describes the Languedoc region as incomplete stem family and Andalucía as egalitarian nuclear (Duranton et al. 2009). The Princeton maps are overlaid with the map of family systems to determine the dominant family system in each region. Changes in the level of fertility are determined by laying the Princeton maps on top of each other and calculating the difference in fertility levels for each region. These procedures allow for tracking fertility over time in individual regions, while changes in administrative boundaries would only lead to small errors in the sample. The spatial distribution of fertility levels is shown in Figure 2.

[4] The following countries are included in the analysis: Austria, Belgium, Denmark, Finland, France, Germany, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

Figure 2: Values of IF



Note: Since observations for Spain are available from 1880 onwards, this country is omitted from the first graph, depicting regional IF levels around 1870.
Data: MPIDR and Princeton Project.

3.2 Methods

In order to examine the association between family systems and fertility levels, we first estimate a simple model where fertility levels are a function of family systems and country fixed effects. Since absolute fertility levels at any point in time are expected to be related to previous fertility levels, we include previous the fertility level for each region as a time-lagged variable. Since the Princeton fertility indices are given with around thirty years between each observation, the OLS model specified has the following form:

$$Y_{i(t)} = \alpha + \beta_1 F_{i(t)} + \beta_2 D_{i(t)} + Y_{i(t-30)} + \varepsilon_{i(t)} \qquad \text{(a)}$$

where $Y_{i(t)}$ denotes the level of fertility in region *i,* F_i are dummy variables for the family system in region i, D_i are national dummy variables used to capture country specific effects and $Y_{i(t-30)}$ is the level of fertility in region i thirty years before. The absolute nuclear family and Austria are used as reference categories for family systems and country level dummies respectively. The choice for the absolute nuclear family as reference category is motivated by the hypothesis that this family system is the most open to change and influence from others outside the kin network.

As can been seen in Figure 2, differences in fertility levels or the rate of fertility change between neighbouring regions are often very small. This suggests that a spatial diffusion process may affect reproductive outcomes; behaviour is adjusted according to processes observed in neighbouring regions (Tolnay 1995; Goldstein and Klüsener 2014). We first examine the presence of spatial autocorrelation to determine whether regions which are adjacent to each other display similar fertility outcomes. Neighbours are identified using k-nearest neighbours analysis, where k is 5, with islands connected to the nearest mainland. This procedure shows similar results as with neighbours lists based on direct connections such as Queen's contiguity. We specify Moran's I as a global measure of spatial autocorrelation (Moran 1950). In addition, in order to control for the diffusion of fertility decline from one region to adjacent regions, we include spatial lag variable to the OLS model specified above. The resulting spatial lag model includes an additional control variable WY_i which captures for each region i the effect of fertility levels or fertility change in surrounding regions.[5] We specify the model both with and without a time-lagged control variable for fertility levels in each region:

[5] The model estimated is a maximum likelihood estimation of spatial simultaneous autoregressive lag. This procedure is in a way similar to controlling for autocorrelation in time-series analysis using a lagged endogenous predictor, except that the model here controls for spatial autocorrelation instead of a time lag. The estimated coefficients are somewhat biased because the independent variable y_2 is not exogenous.

$$Y_{i(t)} = \alpha + \beta_1 F_{i(t)} + \beta_2 D_{i(t)} + \beta_3 WY_{i(t)} + \varepsilon_{i(t)} \quad \text{(b1)}$$

$$Y_{i(t)} = \alpha + \beta_1 F_{i(t)} + \beta_2 D_{i(t)} + \beta_3 WY_{i(t)} + Y_{i(t-30)} + \varepsilon_{i(t)} \quad \text{(b2)}$$

These models, used to examine whether changes in fertility levels are associated with family systems, are estimated for each thirty-year period between 1870 and 1960.

4. Results

A summary of the level of fertility, by family system is given in Table 2. Table 2 shows that total fertility rates declined most strongly between 1900 and 1930, and slightly rose thereafter. The number of observations differs markedly between family systems, there are only a few communitarian family system regions while most regions are a stem family system. Interestingly, the regions marked by Todd as having an 'indeterminate' family system do not stand out by having a particularly large standard deviation in fertility outcomes. Between family systems, Table 2 shows that there are little differences in fertility levels. Based on our hypotheses, fertility levels are likely to be higher in regions where parental authority is high, or where egalitarian inheritance rules are the norm. As such, the communitarian family system is likely to show the highest level of fertility, while regions where the absolute nuclear family systems is dominant are likely to show the lowest levels of fertility. However, the figures given in Table 2 do not confirm these expectations. While the communitarian family system has the highest fertility levels in 1870 and 1900, it shows a stark decline in 1930 and 1960 with levels lower than the absolute nuclear family system. The absolute nuclear family system shows a lower level of fertility on average than the egalitarian nuclear family system, apart from 1870. The stem family system seems to be in between the other family systems regarding the average level of fertility in each period.

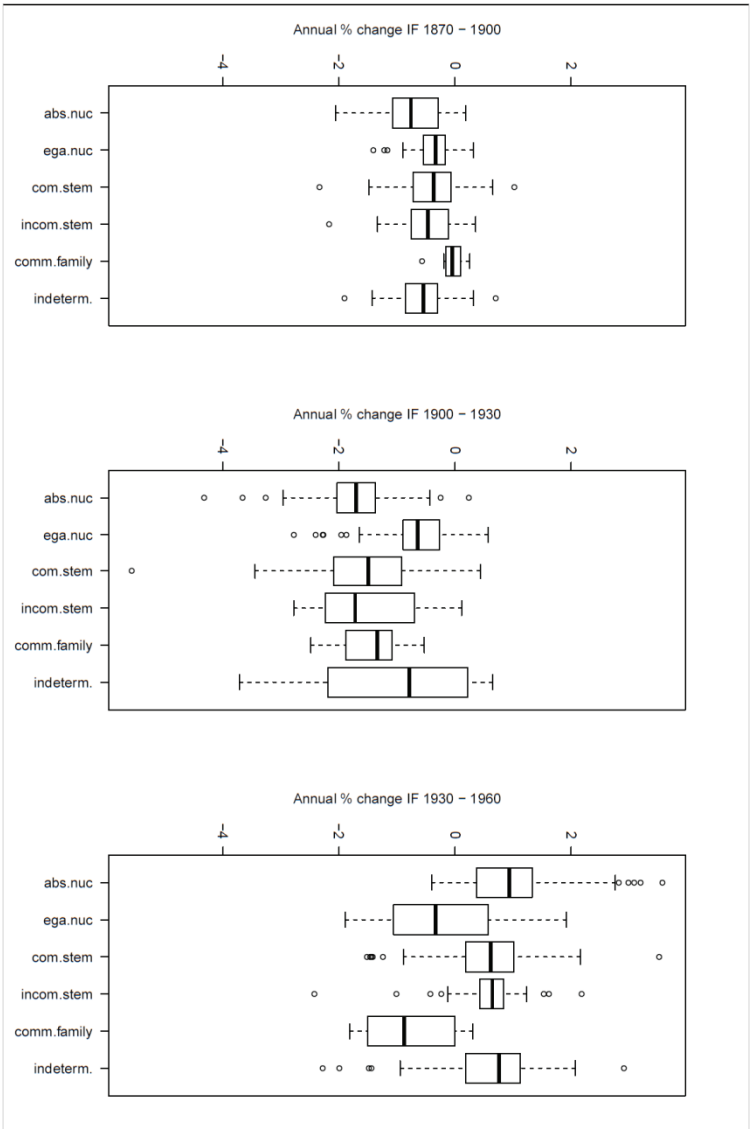
Table 2 also includes Moran's I, the statistical measure designed to represent the correlation between fertility levels across neighbouring regions. The positive value indicates that in all periods there is a significant positive correlation between fertility levels of neighbouring regions.

Table 2: Summary Statistics of If, by Family System

Year	1870		1900		1930		1960	
Family system	Mean (sd)	N	Mean (sd)	N	Mean (sd)	N	Mean (sd)	N
Absolute nuclear	0.3555	90	0.29	87	0.1741	87	0.218	97
	(0.0446)		(0.052)		(0.0385)		(0.0195)	
Egalitarian nuclear	0.2861	46	0.3231	82	0.2648	83	0.2346	83
	(0.063)		(0.0947)		(0.084)		(0.0376)	
Stem family	0.3343	170	0.3029	185	0.1923	191	0.2221	193
	(0.0523)		(0.061)		(0.0492)		(0.0399)	
Incomplete stem family	0.343	44	0.3058	46	0.189	47	0.2207	43
	(0.0571)		(0.0683)		(0.0366)		(0.029)	
Communitarian	0.3748	8	0.3669	8	0.24	8	0.1886	9
	(0.026)		(0.0147)		(0.0462)		(0.0354)	
Indeterminate	0.3326	44	0.3019	53	0.2176	53	0.2473	58
	(0.0589)		(0.0794)		(0.0609)		(0.0566)	
Total	0.3351	402	0.3054	461	0.2051	469	0.2257	483
	(0.0564)		(0.0701)		(0.0633)		(0.0392)	
Moran's I	0.6429***		0.7181***		0.7424***		0.5859***	
Countries	14		17		19		17	

Figure 3 shows a box plot of the compound annual growth rates for the Princeton fertility indices for each region, by period and by family system. A positive figure indicates an increase in fertility. Although Table 2 shows that there are little differences in fertility levels between family systems, Figure 3 shows that between family systems the change in fertility over time can be considerable. The communitarian family system shows the smallest rate of change between 1900 and 1930, and between 1930 and 1960. However, the absolute nuclear family system does not stand out by showing markedly higher changes in fertility levels than the other family systems, apart from the period between 1930 and 1960 where in fact is shows the highest median increase in fertility.

Figure 3: Change in IF by Family System



The results of the OLS model are given in Table 3. Table 3 shows for each time period the association between the level of fertility (Princeton 'If' index) and family systems. The model also includes country fixed effects dummies and a time-lagged measure of fertility in each region thirty years before. Due to the

inclusion of the time-lagged measure, there are no results for 1870 since this is the earliest point of observation. The results show that family systems do not show a strong association with fertility outcomes, as most coefficients are not significant. Fertility outcomes are significantly higher in communitarian family system regions in 1900 compared to the absolute nuclear family system – which is the reference category. For 1930, egalitarian nuclear family system regions show significantly higher fertility outcomes compared to the absolute nuclear family system. However, for 1960, fertility levels are significantly lower in the communitarian family system than in the absolute nuclear family system regions.

For each time period, the time-lagged independent 'If' index shows that there is significant positive autocorrelation between fertility outcomes of the current and previous period of observation. The values of Moran's I on the residuals of the model show that there is still considerable spatial autocorrelation between the regions. The Lagrange multiplier diagnostics show that a spatial error model is preferred to properly cope with the autocorrelation observed in the residuals, but since we are interested in the effect of neighboring regions we will follow up the OLS model by fitting a spatial lag model. The r-squared measures of the OLS models shows that the models have considerable explanatory power, but this may also be indicative of overfitting the model. Given that for each region fixed-effect dummies for the country level and a time-lagged measure of previous fertility is taken into account, there may be too little variation left to be explained by the family systems.

Fertility levels may be correlated between regions, as indicated by the residuals in Table 3. Figure 4 shows the distribution of spatial autocorrelation for each period, based on a local measure of Moran's I on the Princeton 'If' index. Figure 4 shows that in all time periods there is significant spatial autocorrelations in some region, but not in all regions. When comparing Figure 4 to the distribution of family systems in Figure 1, there are no clear similarities between these maps. In other words, a clear association between family systems and a particular 'openness' to fertility diffusion is not visible.

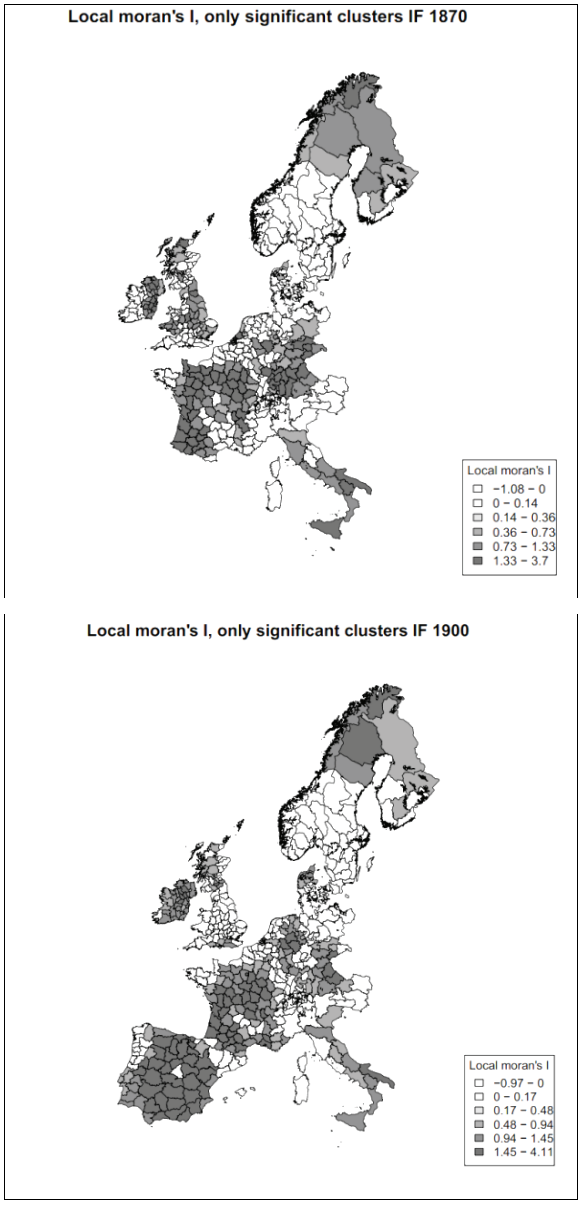
Table 3: Ordinary Least Squares Regression Coefficients of the Princeton 'If' Fertility Index

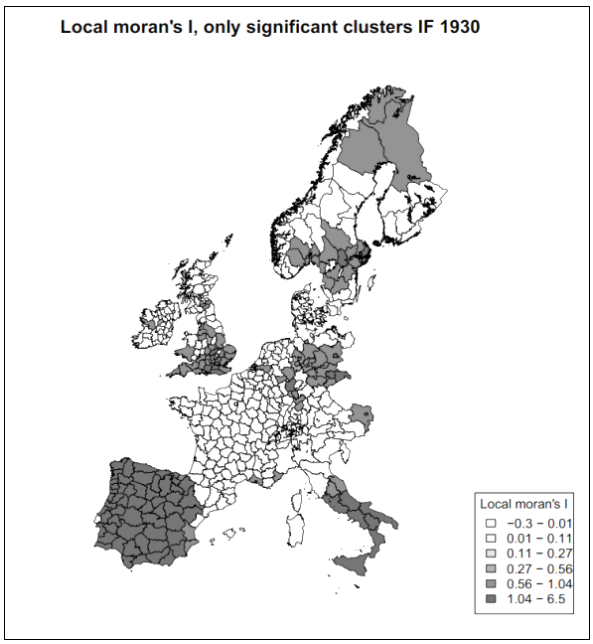
	1900	1930	1960
Egalitarian nuclear	0.012 (0.008)	0.027*** (0.007)	0.006 (0.005)
Stem family	0.008 (0.005)	0.008 (0.005)	0.002 (0.004)
Incomplete stem family	0.0003 (0.008)	0.009 (0.008)	0.008 (0.006)
Communitarian	0.026* (0.015)	0.002 (0.014)	-0.026** (0.01)
Indeterminate	0.003 (0.008)	0.007 (0.007)	0.003 (0.005)
IF (time lagged, t-30)	0.697*** (0.04)	0.548*** (0.033)	0.479*** (0.028)
Country	Included	Included	Included
Constant	0.079*** (0.018)	-0.028* (0.016)	0.155*** (0.009)
Moran's I for spatial autocorrelation in error term	0.159 ***	0.252 ***	0.271 ***
Lagrange multiplier diagnostics			
LMerr	28.691***	85.622***	101.874***
RLMerr	9.26***	9.583***	41.405***
LMlag	20.044***	90.983***	60.479***
RLMlag	0.613	14.944***	0.01
Countries:	17	19	17
Observations	392	465	479
R^2	0.786	0.787	0.682
Adjusted R^2	0.776	0.776	0.667
Residual Std. Error	0.030 (df = 372)	0.030 (df = 440)	0.023 (df = 456)
F Statistic	72.114*** (df = 19; 372)	67.906*** (df = 24; 440)	44.430*** (df = 22; 456)

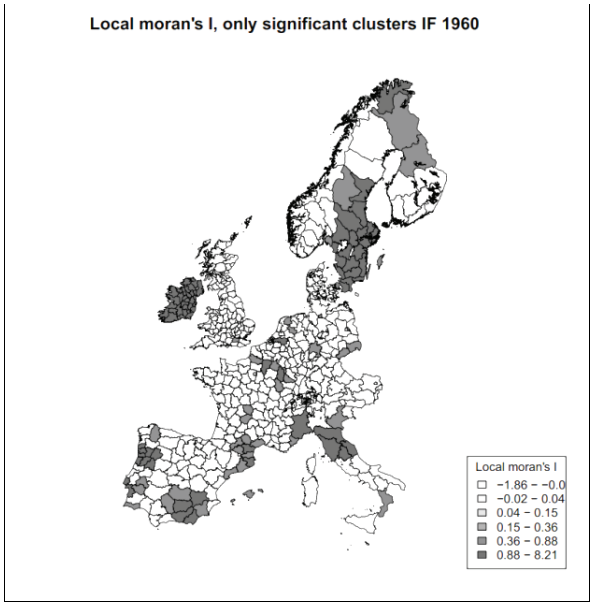
Note: *p<0.1; **p<0.05; ***p<0.01; Standard errors in parentheses

Reference categories are the absolute nuclear family system (for family systems) and Austria (for countries). Sources: See text.

Figure 4: Moran's I: Spatial Autocorrelation in Fertility Levels (Significant Values Only)







The results of the spatial lag models are given in Tables 4 and 5. Table 4 shows the association between fertility levels and family systems, including control

variables for the country (using a fixed effects dummy) and the spatially lagged value of 'If' (denoted by Rho; it represents the average *If* values of neighbouring regions). Table 5 additionally includes a time-lagged observation of fertility in each region thirty years before.

Table 4: Spatial Lag Model of the Princeton ‚If' Index (Maximum Likelihood Estimation)

	1870	1900	1930	1960
Egalitarian nuclear	-0.028*** (0.008)	0.005 (0.009)	0.021*** (0.007)	0.014*** (0.006)
Stem family	-0.006 (0.006)	0.002 (0.007)	0.008 (0.006)	0.006 (0.004)
Incomplete stem family	-0.002 (0.008)	0.006 (0.009)	0.015* (0.008)	0.013** (0.006)
Communitarian	-0.036** (0.016)	0.008 (0.018)	0.01 (0.015)	-0.017 (0.011)
Indeterminate	0.0002 (0.008)	0.003 (0.009)	0.009 (0.008)	0.011* (0.006)
Rho	0.531 ***	0.507 ***	0.559 ***	0.547 ***
Country	Included	Included	Included	Included
Constant	0.147*** (0.022)	0.150*** (0.022)	0.055*** (0.015)	0.106*** (0.014)
LM test for residual autocorrelation	2.917	0.008	0.507	14.34 ***
Observations	402	461	469	483
Log Likelihood	787.858	854.228	928.089	1,079.98
$sigma^2$	0.001	0.001	0.001	0.001
Wald Test (df = 1)	100.480***	100.902***	139.759***	131.058***
LR Test (df = 1)	71.509***	71.301***	101.984***	91.820***

Note: *p<0.1; **p<0.05; ***p<0.01; Standard errors in parentheses.
Reference categories are the absolute nuclear family system (for family systems) and Austria (for countries). Sources: See text.

The results in Table 4 do not seem to support the hypothesis that fertility levels are higher in authoritarian family systems. While the incomplete stem family system shows higher fertility levels in 1930 and 1960 after controlling for national effects and a spatial lag, the overall picture is less clear. Contrary to our hypotheses, communitarian family system regions for example show lower fertility levels in 1870 compared to the absolute nuclear family system. The egalitarian nuclear family system is associated with higher fertility outcomes in 1930 and 1960 as expected, but for 1870 fertility levels in egalitarian nuclear family system areas are lower compared to absolute nuclear family system. The stem family seems not to be significantly associated with fertility outcomes, as

could be expected since overall no strong effects of family systems are observed.

Table 5: Spatial Lag Model of the Princeton 'If' Index, including a Time-Lagged Control Variable (Maximum Likelihood Estimation)

	IF	IF	IF
	1900	1930	1960
Egalitarian nuclear	0.01 (0.008)	0.017*** (0.006)	0.003 (0.005)
Stem family	0.008 (0.005)	0.007 (0.005)	0.003 (0.003)
Incomplete stem family	0.001 (0.007)	0.007 (0.007)	0.007 (0.005)
Communitarian	0.022 (0.014)	0.001 (0.013)	-0.021** (0.009)
Indeterminate	0.0002 (0.007)	0.004 (0.006)	0.004 (0.005)
Rho	0.276 ***	0.433 ***	0.38 ***
IF (time lagged, t-30)	0.642*** (0.041)	0.477*** (0.031)	0.417*** (0.027)
Country	Included	Included	Included
Constant	0.004 (0.022)	-0.077*** (0.015)	0.081*** (0.013)
LM test for residual autocorrelation	9.559 ***	2.826 *	34.534 ***
Observations	392	465	479
Log Likelihood	834.441	1,020.63	1,172.47
$sigma^2$	0.001	0.001	0.0004
Wald Test (df = 1)	24.700***	88.531***	62.878***
LR Test (df = 1)	20.235***	75.993***	52.567***

Note: *p<0.1; **p<0.05; ***p<0.01; Standard errors in parentheses.
Reference categories are the absolute nuclear family system (for family systems) and Austria (for countries). Sources: See text.

Table 5 further extends the findings presented in Table 4, by including a time-lagged observation of fertility in each region thirty years before. Both the time-lagged and spatial-lag variable show strong positive autocorrelation, although the residuals of the model still show evidence of significant spatial autocorrelation. The findings in Table 5 are in line with Table 3 (the OLS model) and thus not supportive of our hypotheses. The expectation is that fertility outcomes will be the highest in authoritarian and egalitarian family systems. For 1900, no significant association between family systems and fertility is however observed. For 1930, egalitarian nuclear family system regions indeed show fertili-

ty outcomes higher than the absolute nuclear family system, but the communitarian family system (which is also based on egalitarian principles) does not show to be associated with fertility outcomes. In contrast, for 1960 the opposite effect is found; communitarian family system regions show lower fertility outcomes than the reference category, the absolute nuclear family system.

5. Discussion

Fertility levels in Western Europe declined strongly since the mid-nineteenth century, but also show marked regional variations. The aim of this paper is to investigate whether family systems, defined as norms and practices which define relationships between kin, are associated with variations in the level of fertility. Two hypothesis are tested using data from the Princeton European Fertility Project (Coale and Watkins 1986). First, fertility levels are expected to be higher in authoritarian family systems (communitarian and stem) than in non-authoritarian family systems (egalitarian and absolute nuclear). Second, fertility levels are expected to be higher in egalitarian family systems (egalitarian nuclear and communitarian) compared to inegalitarian family systems (absolute nuclear and stem). In order to test these hypotheses, models are estimated including both time- and spatial-lag variables. Since the level of fertility may be associated with past fertility levels or the level of fertility in neighbouring regions, these models aim to uncover and control for these effects.

The findings in this study show no clear association between family systems and reproductive outcomes. Overall, although some findings are in line with our hypotheses, other findings are contradictory or no significant effects are observed. Several aspects of this study may suggest why no clear association is observed. First, Todd's typology of family systems warrants further discussion. As an explanatory variable, Todd's typology may not be precise or selective enough to differentiate between geographical areas with distinctive norms, attitudes and values towards kinship and family, resulting in an underestimation of the actual effect of family systems when measured more accurately. Furthermore, in order to develop his typology, Todd has drawn upon evidence from very different time periods and different social and cultural phenomena, and his methodology for quantifying and aggregating his findings to geographical areas has been questioned (Moch 1986; Rijpma and Carmichael 2016). However, it is difficult to measure family systems accurately – assuming there is consensus on its dimensions and measures. Such an approach would require more detailed information about local communities, preferably including information at the level of the individual and their household, but this information is not available for the time period covered in this study. Finally, although the concept of family systems takes into account the role of others, through local norms, values or practices, it is not specific on the role of non-kin

household members, even though co-residence with non-kin was widespread in parts of Europe into the beginning of the twentieth century. Although there are other typologies of family systems, such as Therborn (2004) or Reher (1998), they too provide only broad categorisations of local clusters of norms, practices and values surrounding kinship and fertility and share the important disadvantages of Todd's typology. Even though having important drawbacks, Todd's typology is chosen primarily because it is well-defined for Western-Europe and because of its theoretical connections with fertility behaviour.

Besides the potential shortcomings of Todd's typology, there are other aspects which future studies could improve on. Some family systems – in particular the communitarian family system – are poorly represented in terms of numbers in our data. The use of aggregated measures over a long time span (1870 to 1960) is not likely to be conducive to this study. Also, the measures are aggregated by region and do not take into account the size of regions or other conditions which may affect fertility. Although national and time or spatially lagged dummy variables are included, particular regional conditions or circumstances favouring higher or lower fertility outcomes are not taken into account. The inclusion of time and spatial lagged effects may have captured too much of the variation within the models, and if family systems would only have weak effects these will not be clearly visible in our models.

A suggestion for a future study would be to examine the fertility behaviour of individuals within well-defined family systems. Such an approach requires information on both fertility outcomes of individuals as well as precise measures of their local family systems, but can ultimately provide a better answer to the question which reproductive outcomes are favoured within a particular family system. Furthermore, and perhaps more insightful, such an approach can show how deviations from regional norms, practices and values lead to alternative fertility outcomes (see e.g. Mönkediek and Bras 2016 as an example of this method). Another alternative direction for future research is to examine whether diffusion effects play a role in fertility decline and whether family systems affect the degree to which new fertility behaviours can spread from one regions to another (Bras 2014; Bras and Van Tilburg 2007). If family systems indeed affect fertility outcomes through diffusion processes, e.g. some family systems are more 'open' to new ideas such as family limitation, future research could focus on the interplay between local spatial autocorrelation and fertility outcomes. However, as a quick glance at Figures 1 and 4 suggests, it is unlikely that this association will be found on the basis of the aggregated Princeton *If* measures.

Perhaps the most elementary reason why family systems are expected to be associated with fertility outcomes is that family systems entail social norms, practices or values which either prevent or facilitate making connections with others outside the kin-network. When these local norms more easily allow people other than direct kin to enter your social network – for example because

you are expected to move out of your parental home when you marry or, or because the absence of an inheritance in the form of a farm forces you to establish an independent living – these other people may bring in new ideas which may not have been introduced when your social network is mainly comprised of kin. When family limitation is seen as an innovation, a learned behaviour, family systems thus facilitate the degree to which the decline of fertility can spread. The fact that fertility levels of neighbouring regions are significantly and positively correlated, provides support for this view. The opposite however may also be true; relatively open family systems may also be more likely to display increases in fertility. Closely-knit kin networks on the other hand are probably more likely to show fertility levels which are more constant over time.

The influence of family systems on regional variations in fertility decline warrants further attention. While both the data and methods used in this paper do not allow to infer causal relationships, the results indicate that further research is warranted to examine the associations between regional changes in fertility outcomes and family systems. A better understanding of the role of family systems may be of value for understanding transitions in fertility in the developing world today. For example, fertility levels in sub-Saharan Africa have been declining since the end of the twentieth century, in tandem with other demographic and social developments. In the 1980s, age at marriage was low, child mortality was high and women had on average 6.7 children. This figure declined to about 5.4 children in 2004, although there are large and persistent differences between countries, similar to the experience of Western Europe (Tabutin and Schoumaker 2004). There are however unique characteristics of African family relationships, which may affect reproductive decision making in highly distinctive ways. Examples of such conducts are the transition of property or services from the groom's family to that of the bride at marriage, or rites surrounding the passage to adulthood, the practise of polygyny and the large variation and influence of religion. When we learn more about the various ways in which family systems, or the relationships between kin, as well as non-kin, affect demographic outcomes, this information can be valuable to policy-makers who implements and judge birth control programmes. However, more research is needed to further understand the mechanisms through which practices and norms surrounding kinship interact with reproductive outcomes, in particular in relation to diffusion processes.

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