THE INTERPLAY OF FAMILY SYSTEMS, SOCIAL NETWORKS AND FERTILITY IN EUROPE COHORTS BORN BETWEEN 1920 AND 1960

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ABSTRACT

Despite important variations in regional family systems, little research has been done to assess the effects of these differences on fertility and thus on families’ economic status. Even less attention has been paid to the effects of deviating from these regionally embedded norms in terms of network compositions. People’s social networks may not conform to the region’s view of the ideal family, while this could have important implications for their fertility behaviour. To fill this knowledge gap, the present paper examines how variations in family systems and social networks across Europe between 1920 and 1960 affected fertility in the following decades. The study uses SHARELIFE release 1, as of November 24th 2010 or SHARE release 2.5.0, as of May 24th 2011. The SHARE data collection has been primarily funded by the European Commission through the 5th framework programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th framework programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5-CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th framework programme (SHARE-PREP, 211909 and SHARE-LEAP, 227822). Additional funding from the US National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, Y1-AG-4553-01 and OGH A04-064, IAG BSR06-11, R21 AG025169) as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).
gap, this paper aims to answer two questions: to what extent do family systems shape family size, and to what extent do deviations from regional family system norms in terms of social network composition result in differences in completed fertility? To answer these questions, we use the first two waves of the ‘Survey of Health, Aging and Retirement’ and derive indicators describing regional family systems and people’s social networks. We test the influence of these covariates on the completed fertility of cohorts born between 1920 and 1960 in 13 European countries. Our results show that family system norms, and deviations from them in terms of specific social networks, play an important role in determining family size.

Keywords: family systems, social networks, fertility, Europe

JEL Codes: J13, J12, Z10, Z13, C36

INTRODUCTION

Persistent regional differences in fertility can be observed across Europe. To explain the differences, researchers have drawn on economic factors (Becker & Barro 1988) and cultural factors (Lesthaeghe & Neels 2002, 349–351; Dalla Zuanna 2007, 442) and also on differences in family systems (Macfarlane 1981; Micheli 2005, 80; Viazzo 2010a, 2010b). Studies of the effects of family systems on fertility are rare and often limited to broad classes of family systems and to specific regions or countries (Davis 1955; Burch & Gendell 1970; Hajnal 1982; Das Gupta 1999, 181; Veleti 2001; Micheli 2005). Some have used households or co-residential units to examine family systems and their influence on behaviour (Todd 1990; Madhaven et al. 2003, 58), while especially more recent studies use indicators of social relatedness that extend beyond the household (Yorburg 1975; Reher 1998; Heady & Kohli 2010, 21; Viazzo 2010b, 144–148; Micheli 2012, 19). In these, and particularly in the influential study by Reher (1998), family systems are framed particularly in terms of geographical variation in strong ties (with family and kin) and weak ties (with friends and relatives).

Recent research on fertility emphasizes social networks containing strong and weak ties that affect demographic behaviour (Chen 2006; Bühler & Fratczak 2007; Bernardi & White 2010, 181; Sear & Coall 2011; Keim 2011; Balbo 2012; Bernardi & Klärner 2014). These studies do not take family systems into account but focus rather on kin relations (for instance sibling ties) or are restricted to one region or country, limiting the possibility of comparing spatial variations in family systems (Ettrich et al. 1999, Kohler et al. 2001; Madhavan et al. 2003; Sear et al. 2003; Bühler 2004; Bühler & Philipov 2005; Bühler & Fratczak 2007; see Balbo 2012, 9).

In this article we combine both strands of research. We examine couples’ social networks, with either weak or strong ties, and look at the extent to which they conform to or deviate from the norms of the family system in their region and how this affects the couples’ fertility. Do the couples have close-knit networks
containing a lot of kin, or looser-knit networks with more friends than relatives, and how does this affect fertility? Do different regional views of the ideal network composition (i.e., different family systems) have different effects on fertility? What are for instance the effects of living the same kind of social network in different family systems on the fertility? The basic research question is: if a couple’s social network composition differs from the organization principles of the family system of their region, what effect does this have on their fertility? Studying the interplay between social networks and family systems and the effect of this interplay on fertility opens up a whole new perspective for understanding fertility differences in Europe.

In this paper we base our analysis on the Survey of Health, Aging and Retirement (SHARE) and derive indicators to chart regional family systems and couples’ social networks and test their influence on the completed fertility of couples born between 1920 and 1960 in 13 European countries. For the purpose of my discussion, we define family systems as the regional culturally embedded norms, values and practices that frame people’s kin relationships (Mason 2001, 160–161), and ‘social network’ as the network of people’s social interactions and relationships with their kin.

THEORETICAL BACKGROUND

Family systems, households and social networks

Family systems have long been studied on the basis of indicators that chart the organization of households and, more recently, social networks (Todd 1990; Reher 1998; Viazzo 2010a). Important variations and changes in family systems in and between European countries have been observed (Höllinger & Haller 1990; Reher 1998; Micheli 2005; Santarelli & Cottone 2009; Viazzo & Zanotelli 2010, 75; Isengard 2013). In Italy, for instance, it has been found that traditional co-residence of parents and children has steadily changed towards parents and children living in close proximity (Viazzo & Zanotelli 2010, 73–75). After leaving the parental home at a comparatively late age, children live not with but near their parents. Such developments mean that the social networks in which individuals of contemporary societies are living partly differ from the traditional notions of family systems that regard only households as being nuclear or extended. It is thus important when studying family systems to include relationships not only within but also beyond the household.

Empirical studies of the effect of social relationships and social networks on fertility show that kin beyond the household are important in structuring people’s demographic behaviour (Bonvalet & Lelièvre 2008, 377–383; Widmer & Jallinoja, 2008, 397; Balbo 2012). Some of these studies also try to grasp the mechanisms by which family relationships may influence people’s fertility, for instance through social learning, social support and social pressure (for an overview see Bernardi & Klärner 2014, 649–652).

‘Social learning’ refers to the way children adapt to family structures, behaviour and living strategies through socialization (Barber 2000, 321–322; Bernardi et al.
Siblings and other family members, especially those of roughly the same age, provide behavioural examples (Axinn et al. 1994, 68; Bühler & Fratczak, 2007; Balbo 2012) and are an important source of knowledge (Finkel & Finkel 1975, 256–257; Montgomery & Casterline 1996, 153–154). Knowledge about fertility will include such matters as gender roles or the preferred number, timing and spacing of children (Newson & Richardson 2009, 9). Some effects that have been shown are a stronger desire for children in people with many nephews and nieces (Axinn et al. 1994, 77), a link between the fertility behaviour of siblings (Lyngstad & Prskawetz 2010), cross-sibling influence on the intention to have a first child (Balbo & Mills 2011), and substantial similarities between parents and their offspring in age of becoming a parent (Steenhof & Liefooghe 2008). Cross-sibling effects and similarities between parents’ and their children’s fertility have been shown to be based partly on social and partly on genetic factors (Kohler et al. 2005; Bras et al. 2013, 118).

‘Social support’ refers to the role of families as organizers of solidarity and providers of welfare (Reher 1998, 208–209; Esping-Andersen 1999, 35, 47). By providing or withholding resources and services, families can reduce the risk of life course decisions and influence other family members’ fertility intentions and outcomes (Bühler & Fratczak 2007). The extent to which family can provide certain services is dependent on geographic distance. Some services, such as emotional support, can be provided from a distance with the help of modern communication technologies. However, most services and types of help can only be provided to family members co-residing in the household or living nearby (Litwak & Kulis 1987, 650; Höllinger & Haller 1990, 117). For example, a co-resident grandmother can take care of the grandchildren, prepare food, and help with housework (Reher 1998, 219–17; Sear et al. 2003; Tymicki 2004, 2008). Thereby, co-resident grandmothers can reduce the burden of combining work with family. Especially in social networks, where kin live in close proximity, kin, such as grandmothers, may feel more obligated to help each other, while the family is also more often used as the primary source of support (Caldwell 1978, 557–558; Höllinger & Haller 1990, 117, 120).

‘Social pressure’ refers to families’ ability to control their members’ behaviours, by pointing out norms and values and granting or withholding support. Norms may apply to such things as opportunities to meet with non-kin (Salamon 1977, 815–816), the use of media (Freedman et al. 1964, 27), courting practices (Kok 2009, 15), or women’s roles in the family (Moore 1990, 726–727; Mason 2001, 169, 169–170; Bernardi & Oppo 2008, 199–201). Already the possible reactions of other family members, and the risk of being sanctioned, can influence people’s behaviour and prevent outcomes undesired by the family (Ajzen 1991, 183; Bernardi 2003, 538).

Parents can have a strong influence on their offspring’s fertility. In pre-transitional and transitional societies the motivation for controlling fertility was often...
linked to household economics (Van Bavel 2004, 103–104; Dalla Zuanna 2007, 444, 448–451; Dribe & Scalone 2010; Amialchuck & Dimitrova 2012). Today, parental control over children’s fertility is often linked to ‘status anxiety’, i.e., to maintain one’s position on or climb the social ladder (Dalla Zuanna 2007). A number of studies have demonstrated a negative effect of large family size on children’s educational outcomes and chances of upward social mobility\(^3\) (for an overview see Steelman et al. 2002, 248ff). Among other reasons, this negative effect is explained by dilution of resources (time, material and non-material resources) among children of larger families (Blake 1981, 440; Steelman et al. 2002, 248; Bongaarts 2003; Micheli 2005; Dalla Zuanna 2007, 450). Facing resource constraints, parents reduce fertility to increase the share of resources for each child, thereby improving their chances to move up the social ladder (Becker & Lewis 1974; Becker & Barro 1988).

Resource dilution and reduced opportunities for social upward mobility for children are a problem particularly in regions where public childcare facilities are sparse and children’s welfare is the responsibility of the family (Hilgeman & Butts 2009, 107; Balbo 2012, 100). In these regions, large family size more easily translates into a lower social status for the offspring generation since the burden of raising children is not moderated by the welfare state (Dalla Zuanna 2007, 451). Regions without a well-developed welfare state are also often characterized by strong family systems, with close-knit social networks, through which parents more effectively control their offspring’s fertility (Granovetter 2005, 34, 39–40; Dalla Zuanna 2007, 452–453; Viazzo 2010b; Albertini & Kohli 2013). Although parents may rely on a pool of adult kin who could support and supervise children (Shavit & Pierce 1991, 328), social support is often limited to the co-residential unit (Albertini & Kohli 2013, 836), and is not necessarily linked to higher fertility (Jappens & Van Bavel 2012, 108–109).

**Regional family systems and variance in social networks**

The household organization and the organization of the wider family are associated with family systems (Reher 1998; Micheli 2005; Hank 2007). Since family systems are based on culturally embedded norms, values and practices and thus frame kin relationships and determine social duties and rights (Skinner 1997; Das Gupta 1999; Mason 2001, 160–161; Therborn 2004). They create ideals of the ‘typical’ family to which families may adhere, but from which they may also deviate to a certain degree. Bott (1957, 205–207, 212) demonstrated that the extent to which families were able to name such norms and how far they deviated from them depended on whether respondents lived in loose- or close-knit networks. Close-knit networks are characterized by large numbers of relatives, friends and neighbours who all know each

\(^3\) This effect is more variable in pre-transitional societies or developing countries (Van Bavel et al. 2011; Lawson & Mace 2011, 334).
other (1957, 59). People in close-knit networks more often refer and consent to the norms, values and family ideals shared in their social networks (Bott 1957, 213). In loose-knit networks fewer members know each other, and this increases the variation in social norms in their social networks (1957, 213).

According to Bott (2001, 295–296), relationships to kin are more likely to be close-knit and permanent than relationships to non-kin, which are more easily dissolved. Regions with strong family systems are thus more likely to be characterized by close-knit social networks, dominated by kin relationships, than those with weak family systems (Reher 1998; Micheli 2005; Viazzo 2010b). In strong family regions, family members are more likely to share the same family norms and values and be able to enforce them more easily, which results in more commonly agreed upon family organization principles. In weak family regions, social networks contain a greater variety of relationships with both kin and non-kin (Höllinger & Haller 1990; Mönkediek & Bras 2014) and a greater spatial dispersion between kin is observed (Viazzo 2010b, 147). This greater dispersion is often connected with a more generous welfare state, which allows for greater intergenerational transfers of resources and reduces the need for kin co-residence (Albertini & Kohli 2013). Since social norms are less coherent and less enforced in weak family regions, we expect a greater variety of social networks in these areas. Hence, we expect that variation in families’ social networks is greater in weak than in strong family regions (H1).

In line with hypothesis 1 above, we expect people’s ideas about living strategies and family organization to be more diverse in weak family regions, because their networks contain a greater share of non-kin. We assume that this also results in greater variability in fertility, since non-kin in social networks often link individuals to more distant networks parts, exposing them to different life concepts (as demonstrated by Newson et al. 2005, 2007). Accordingly, we expect that differences in family size are more pronounced in weak family regions than in strong family regions (H2).

Family ideals and experiences that are transmitted from generation to generation will steer people’s attitudes towards family organization and children (Johnson & Stokes 1976, 176). Since social interactions between kin are closer and families are more highly valued in strong family regions, we would expect processes of socialization to raise fertility in these regions. However, empirical research has shown that in societies in which group norms are more easily enforced, social norms ‘overrule’ the effects of socialization (Van Bavel & Kok 2009, 357). In such societies, a positive socialization effect seems to be counteracted by a higher burden of social support and by mismatches between family ideals and realities. This is the case, for example, in many Mediterranean countries. In these countries, public childcare is sparse and the provision of welfare is seen as a family duty (Hilgeman & Butts 2009, 107; Balbo 2012, 100). At the same time, these countries favour family ideals and criteria for starting a family that are more complex and more difficult to conform to (Newson 2009, 470). For the case of Italy, Livi-Bacci (2001, 149) has shown that during the mid-twentieth century certain life-course ideals developed that made setting up one’s own household and acquiring a full-time job a precondition for getting married and having children. Nonetheless, many young Italians
postponed setting up their own households because of the better economic circumstances in the parental household, the emotional closeness to their parents and the limited availability of independent living space on the housing market (Livi-Bacci 2001, 146–148; Dalla Zuanna 2004, 111–115; Vignoli et al. 2013).

In strong family regions we expect socialization effects to be counteracted by economic realities, since the welfare state facilities are insufficient to support the current family ideals and desired living styles. In weak family regions, by contrast, such effects may indeed play a role. The extensive public child care and welfare state provision reduces the burden of raising children, which limits the need to control offspring’s fertility. Accordingly, a more generous welfare state allows for socialization effects that increase people’s desire for children. Finally, the more individualized family lifestyle not only fosters greater variety in the composition of families’ social networks but also results in higher fertility. Our hypothesis for testing these assumptions is that couples with close-knit networks have higher levels of completed fertility in weak than in strong family regions (H3).

DATA, MEASURES AND METHODS

Data

We used the first two waves of the Survey of Health, Ageing and Retirement in Europe (SHARE) to answer our research questions and test our hypothesis. The first wave was conducted in 2004/05 in 11 European countries (Austria, Belgium, Denmark, France, Germany, Greece, Italy, Netherlands, Spain, Sweden and Switzerland) and Israel. The second wave, conducted in 2006/07, contained a panel and a replication component, adding three more countries to the survey (Ireland, Poland and the Czech Republic). Together the two waves contain 31,168 respondents who can be identified as anchor persons (APs). Of these cases, 13,678 belong to the panel segment. Apart from the information on APs, the datasets contain information on members of the APs’ households, and also modules that capture respondents’ social relationships (for example, by asking about help relationships). The target population of the survey was 50 years and older, allowing for the study of completed fertility histories.

The following analysis includes APs from only 13 European countries. Persons born before 1920 and after 1960 had to be omitted from the analysis due to low case numbers (1,014 cases), limiting our analysis to cohorts born between 1920 and 1960. To make reliable statements about respondents’ fertility and their location in Europe, we also excluded respondents with missing information on completed fertility (616 cases) or missing NUTS codes (516 cases). Applying these selection criteria reduced

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4 Ireland had to be excluded from the analysis due to missing NUTS codes for some APs.
5 NUTS (Nomenclature of Units for Territorial Statistics) is a hierarchical system dividing the Europe Union into clusters of comparable population size according to the administrative
N from 31,168 to 26,407 cases. In the regression analysis this number is even lower due to variable non-response. Moreover, some NUTS regions had to be excluded from the regression models because of very low case numbers\textsuperscript{6} – leaving 15,252 cases. Table A1 of Appendix 1 shows the number of included cases per NUTS region.

**Measures**

*Dependent variable*

The dependent variable in our analysis is the couple’s completed fertility, which was charted by asking respondents about the number of living children. Table 1 lists the countries and cohorts. It shows that average completed fertility in the SHARE survey was 2.054. Austria, Germany, Italy and Greece lie clearly below this European average, while the Netherlands, Sweden, Spain, France and Denmark have higher values.\textsuperscript{7} Fertility in the overall European cohort decreases over time, from 2.178 (birth cohort 1920–30) to 1.914 (birth cohort 1951–60). Looking at country-specific developments, we see a more complex picture. In France and Austria, for example, cohort fertility fluctuates over birth cohorts. In some other countries, such as Germany and the Netherlands, we see an overall decrease in cohort fertility, while in other countries, such as France and Sweden, fertility even increases.

*Explanatory and control variables*

Our main explanatory variables are two variables that take into account the geographical distance and the intensity of social relationships (frequency of social contact) between respondents and their kin. These variables, which reflect respondents’ kinship networks, are also used to derive indicators of regional family systems.

The strength of kin relationships varies with the spatial and social distance (De Jong Gierveld & Fokkema, 1998, 332; Heady et al. 2010; Dykstra & Fokkema, 2011, 549–550). Close kin relationships are likely to increase the effectiveness of mechanisms of social learning or social control due to increased social interaction and increased social support (Granovetter 2005: 34, 39–40). To differentiate between different social networks, we derive two indicators that divisions laid down by the EU member states. Each country code starts with the international letter code for that country.

Sources: http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction; http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/local_administrative_units (accessed 14 November 2014).

\textsuperscript{6} These were the Spanish regions of Cantabria, La Rioja and Ceuta, the French regions of Midi-Pyrenees and Corse, and the Polish regions of Lodzkie and Lubelskie (altogether 32 cases).

\textsuperscript{7} The result for Spain is not surprising, because fertility decline in Spain started slightly later than in other Mediterranean countries (Pérez & Livi-Bacci 1992).
Table 1: Average completed fertility per country and cohort

| Country     | N (APs) | Average fertility* | Average fertility cohort 1920–30* | Average fertility cohort 1931–40* | Average fertility cohort 1941–50* | Average fertility cohort 1951–60* |
|-------------|---------|--------------------|----------------------------------|----------------------------------|----------------------------------|----------------------------------|
| Austria     | 1351    | 1.907 (0.041)      | 1.876 (0.082)                    | 1.994 (0.075)                    | 1.854 (0.070)                    | 1.916 (0.113)                   |
| Germany     | 2509    | 1.827 (0.031)      | 1.938 (0.078)                    | 1.987 (0.055)                    | 1.746 (0.050)                    | 1.627 (0.067)                   |
| Sweden      | 2370    | 2.251 (0.033)      | 2.113 (0.074)                    | 2.244 (0.063)                    | 2.206 (0.049)                    | 2.448 (0.086)                   |
| Netherlands | 2351    | 2.314 (0.038)      | 2.696 (0.125)                    | 2.589 (0.085)                    | 2.136 (0.053)                    | 2.081 (0.064)                   |
| Spain       | 1896    | 2.213 (0.042)      | 2.366 (0.102)                    | 2.350 (0.083)                    | 2.255 (0.073)                    | 1.835 (0.084)                   |
| Italy       | 2326    | 1.932 (0.036)      | 2.273 (0.113)                    | 2.036 (0.060)                    | 1.768 (0.049)                    | 1.637 (0.070)                   |
| France      | 2507    | 2.233 (0.040)      | 2.142 (0.082)                    | 2.316 (0.081)                    | 2.152 (0.064)                    | 2.366 (0.101)                   |
| Denmark     | 1915    | 2.172 (0.032)      | 2.244 (0.086)                    | 2.314 (0.069)                    | 2.145 (0.051)                    | 2.022 (0.060)                   |
| Greece      | 1840    | 1.841 (0.026)      | 1.962 (0.068)                    | 1.894 (0.048)                    | 1.726 (0.043)                    | 1.818 (0.053)                   |
| Switzerland | 1184    | 2.000 (0.042)      | 2.241 (0.107)                    | 2.064 (0.088)                    | 1.832 (0.067)                    | 1.973 (0.080)                   |
| Belgium     | 2597    | 2.103 (0.032)      | 2.257 (0.087)                    | 2.236 (0.062)                    | 1.954 (0.047)                    | 1.999 (0.061)                   |
| Czech Rep.  | 1852    | 1.916 (0.031)      | 1.818 (0.082)                    | 1.781 (0.052)                    | 2.000 (0.055)                    | 1.955 (0.062)                   |
| Poland      | 1709    | 2.453 (0.043)      | 2.626 (0.117)                    | 2.627 (0.094)                    | 2.518 (0.072)                    | 2.179 (0.073)                   |
| **Total N** | **26,407** | **2.054 (0.014)** | **2.178 (0.037)**               | **2.160 (0.027)**               | **1.980 (0.022)**               | **1.914 (0.031)**               |

Note: *weighted estimates with standard errors in brackets
describe the geographical distance and the intensity of social relationships (frequency of social contact) between respondents and their kin. These indicators measure the social and geographical density of social networks on a continuum. This has the advantage of enabling us to identify a much broader variety of networks, since we do not use categories of predefined types. The indicators range from networks characterized by spatially and socially close relationships between kin (close-knit kinship networks) to networks that consist of very sparse connections between kin (loose-knit kinship networks) (Mönkediek & Bras 2014, 34–35).

To derive these indicators we use the information in the SHARE survey on the frequency of contact in and geographical proximity of respondents’ current

1. co-residential relationships, i.e. individuals living in the respondents’ households,
2. relationships to parents (if alive),
3. relationships to children (if they had any),
4. relationships to (up to three) persons to whom they had provided any kind of help in the past 12 months,
5. relationships to (up to three) persons who provided the respondents with any kind of help during the past 12 months.

In contrast to earlier research on kinship networks based on geographical proximity and frequency of social contact, we include all the above described relationships and do not limit our study to specific family members or subsamples. For the first indicator, average contact, for all kin relationships we add up the frequency of social contact and divided by the sum of all social ties in the network. In this way we create a personal mean value for each respondent, reflecting the density of the kinship network (Mönkediek & Bras 2014, 35). The variables capturing the frequency of contact between respondents and their alter-egos range from (1) ‘daily’ contact to (7) ‘never’ having contact. For co-resident relationships, where no information on the frequency of social contact was provided, we

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8. For relationships to children, ‘frequency of social contact’ was gathered in the survey only for the first four children and information on ‘spatial proximity of parents to their children’ was gathered for all children.
9. Hank (2007, 171) included only the child with the closest spatial or social contact in his analysis. Kohli et al. (2005) mostly did the same. Dykstra and Fokkema (2011) created their typology on the basis of (1) whether parents had a child living within a 5km range, while having contact with at least one of their children every week, (2) whether respondents felt highly responsible for caring for their children or grandchildren and (3) the direction of intergenerational transfers, applying latent-class-analysis (LCA). They also restricted their sample to respondents with at least one child without parent-child co-residence (Dykstra & Fokkema 2011, 551–553).
10. The variables differentiate between the categories: (1) daily, (2) several times a week, (3) about once a week, (4) about every two weeks, (5) about once a month, (6) less than once a month, and (7) never having contact.
assume ‘frequent’ social contact, as the probability of meeting each other every day was rather high. After rescaling our variable, a higher score of our family system indicator reflects on average more frequent social contact between kin. It now ranges from one (‘no contact’ with existing family and kin members) to seven (‘very frequent’ contact).

For the second indicator, average spatial proximity, we count all family relationships, added up the spatial proximity scores, and divide their sum by the number of all family ties in the network, thus creating a mean value reflecting the spatial density of the family network (Mönkediek & Bras 2014, 35–36). The original variables, which contain the information on spatial proximity between kin, range from (1) ‘in the same household’ to (9) ‘more than 500 km away in another country’. Our constructed variable ranges from one to nine, with a higher value indicating closer spatial proximity between couples and their kin.

Aggregating our two network indicators to the regional level (NUTS 2), we derive two parameters of regional family systems. Figure 1 shows the mean values of our network indicators for the European countries – thus showing regional family systems per country. Looking more closely at the two parameters, we identify three clusters of European countries: the first consisting of France, Sweden and Denmark, the second of the Netherlands, Germany, Switzerland, Belgium, Austria and the Czech Republic, and the third of the Mediterranean countries (Greece, Spain and Italy). Poland seems to score in between the

![Figure 1: Average kinship network density in European countries (identifying family systems)](image)

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11 The variables differentiate between the categories: (1) ‘in the same household’, (2) ‘in the same building’, (3) less than 1km away, (4) between 1 and 5km, (5) between 5 and 25km, (6) between 25 and 100km, (7) between 100 and 500km, (8) more than 500km, and (9) more than 500km in another country.
Mediterranean and the central European cluster. As higher values of both indicators reflect networks that are more family-centred, our results confirm other research findings of strong family bonds in the Mediterranean and weak family ties in the Nordic countries (Höllinger & Haller 1990; Reher 1998).

As well as our main explanatory variables, we include several control variables in our analysis (see Table 2).

**Birth cohort** is included to account for changing effects of family networks over time. We differentiate between the following birth cohort groups, with the youngest as the reference category: 1920–30, 1931–40, 1941–50, 1951–60. In the different countries, between 56 and 69% of the respondents were born between 1931 and 1950.

**Country** Country dummies are included to control for national differences in fertility behaviour.

**Degree of urbanization.** Previous research has shown that networks tend to be more familial dense in rural areas (Höllinger & Haller, 1990, 112, 119). To control for this, we construct a dummy variable measuring whether the respondent’s current place of residence is urban or rural.

**Educational level.** Differences in completed fertility may also be the result of socioeconomic status, as has been found in previous research (Danziger & Neumann 1989, 25; Anderton et al. 1987). To control for social status effects we include respondents’ education, measured by the ISCED-97 classification. The categories ‘first stage tertiary’ and ‘second stage tertiary’ are pooled because of low numbers. In our dataset about 30.7% of the respondents have pre-primary or primary education, about 48% have lower or upper secondary education, and 21.3% have tertiary education, reflecting the expected educational distribution for the included birth cohorts. Looking at country averages (weighted), we find differences in education between respondents in Denmark and Germany and those in the Mediterranean countries, with the former having a higher average level of education. This may be partly due to differences in the countrywise distribution of the included birth cohorts.

Finally, variances in the fertility levels of respondents from different European regions may be the result of socioeconomic characteristics of these regions. To control for such differences, we include in my models the regional Purchasing Power Standard per inhabitant (PPS) for the year 2000. These regional values are derived from Eurostat. Although these data do not reflect the socioeconomic characteristics of a region during the reproductive lifespan of the respondents, they are still a valuable indicator of socioeconomic disparities, which appear to be relatively persistent.

12 For more information on ISCED-97 see: http://www.unesco.org/education/information/nfsunesco/doc/isced_1997.htm (accessed 18 February 2015).
13 Source: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=prc_ppp_ind&lang=en (accessed 20 June 2014).
Table 2: Descriptive statistics (control variables)

| Country       | N    | Mean education (ISCED - 97)* | N birth cohort 1920–1930 | N birth cohort 1931–1940 | N birth cohort 1941–1950 | N birth cohort 1951–1960 | N urban |
|---------------|------|------------------------------|---------------------------|---------------------------|---------------------------|---------------------------|---------|
| Austria       | 1351 | 2.982 (0.038)                | 284 (21.0%)               | 451 (33.4%)               | 467 (34.6%)               | 149 (11.0%)               | 1,205 (89.3%) |
| Germany       | 2509 | 3.322 (0.024)                | 427 (17.0%)               | 754 (30.1%)               | 841 (33.5%)               | 487 (19.4%)               | 1,715 (69.7%) |
| Sweden        | 2370 | 2.706 (0.034)                | 425 (17.9%)               | 668 (28.2%)               | 889 (37.5%)               | 388 (16.4%)               | 1,948 (83.5%) |
| Netherlands   | 2351 | 2.703 (0.032)                | 347 (14.8%)               | 540 (23.0%)               | 910 (38.7%)               | 554 (23.6%)               | 1,834 (79.2%) |
| Spain         | 1896 | 1.651 (0.040)                | 400 (21.1%)               | 550 (29.1%)               | 549 (29.0%)               | 397 (20.9%)               | 1,721 (93.5%) |
| Italy         | 2326 | 1.864 (0.029)                | 353 (15.2%)               | 787 (33.8%)               | 815 (35.0%)               | 371 (16.0%)               | 1,310 (56.8%) |
| France        | 2507 | 2.331 (0.041)                | 524 (20.9%)               | 622 (24.8%)               | 825 (32.9%)               | 536 (21.4%)               | 1,779 (71.8%) |
| Denmark       | 1915 | 3.259 (0.034)                | 337 (17.6%)               | 418 (21.8%)               | 690 (36.0%)               | 470 (24.5%)               | 1,502 (79.6%) |
| Greece        | 1840 | 2.055 (0.038)                | 343 (18.6%)               | 522 (28.4%)               | 606 (32.9%)               | 369 (20.5%)               | 1,585 (86.2%) |
| Switzerland   | 1184 | 2.824 (0.039)                | 205 (17.3%)               | 294 (24.8%)               | 390 (32.9%)               | 295 (24.9%)               | 596 (50.9%) |
| Belgium       | 2597 | 2.787 (0.034)                | 517 (19.9%)               | 659 (25.4%)               | 878 (33.8%)               | 543 (20.9%)               | 2,018 (78.2%) |
| Czech Republic| 1852 | 2.700 (0.037)                | 284 (15.3%)               | 449 (24.2%)               | 700 (37.8%)               | 419 (22.6%)               | 1,235 (67.9%) |
| Poland        | 1709 | 2.240 (0.035)                | 270 (15.8%)               | 396 (23.2%)               | 590 (32.8%)               | 483 (28.3%)               | 912 (53.8%) |
| Total N       | 26,407 | 25,945                       | 4,716 (17.9%)             | 7,110 (26.9%)             | 9,120 (35.5%)             | 5,461 (20.7%)             | 26,072 (74.3%) |

*weighted means, standard deviations in brackets
Methods

Before we could test our hypotheses using regression analysis, we had to solve three problems. The first was the coexistence of different sampling methods in the target countries of the SHARE waves. We solved this problem by weighting our coefficients using the weights included in the SHARE survey (Klevmarker et al. 2005). The second problem was that the respondents’ social relationships and family size were measured at the same point in time, after they had completed their fertility. In addition, respondents’ social networks include relationships to their children. Both aspects lead to a problem possible reversed causality (endogeneity), represented by the form:

\[
fertility = \text{network indicator} \times \gamma_{10} + X'\beta_{10} + \varepsilon_1
\]

\[
\text{network indicator} = fertility \times \gamma_{20} + X'\beta_{20} + \varepsilon_2
\]

Earlier research has reported significant differences in parent-offspring relationships between regions with different family systems (Hank 2007). Parent-offspring relationships can thus be used to identify differences in regional family systems and, related to this, differences in kinship networks. Nevertheless, to deal with both issues we decided to use an instrumental variables (IV) regression, which is applicable when regressors are endogenous or mismeasured and standard inferential methods are invalid (Ebbes et al. 2009, 446; Lewbel 2012, 67). In this study we use Lewbel’s approach (LA) (Lewbel 2012), which can be applied when no instruments or only weak instruments are present. Using information on the heteroscedasticity in the data, instruments are generated out of existing variables by multiplying the heteroscedastic error terms from a first stage regression with the subset of mean-centred exogenous regressors (Z) (Lewbel 2012, 73; Brown 2014, 38). (See Appendix 2 for a more detailed description of Lewbel’s approach (LA) and a test of its assumptions.)

The LA has one drawback: its estimates are less reliable than those of traditional IV models (Lewbel 2012, 67). Following Lewbel’s (2012, 77) suggestion, we therefore augment our approach by including one traditional instrument found in the dataset. This improves the model’s estimation efficiency. In this study we use people’s opinions about the provision of welfare. Respondents were asked to indicate, on a scale of one to five, whether the state, the family, or a mixture of the two should ‘give financial support’, ‘help with household chores’ and ‘provide personal care’ for older persons in need (Cronbach’s alpha = 0.80). The resulting variable ‘welfare orientation’ is nearly normally distributed (mean 3.095, std. err. 0.009), and correlated with the network indicators but not with respondent’s completed fertility. Unfortunately, a lot of values are missing from this variable, reducing the N in our analysis from 24,036 to 15,252 cases.

The third problem was that we had to take the hierarchical structure of the SHARE dataset into account. Individuals are nested in NUTS 2 regions, which
are nested in countries. The LA is based on the specification that the number of instruments (including all exogenous regressors) is not larger than the number of clusters in the dataset – otherwise this would lead to problems in the identification of the model (Baum et al. 2007, 485). In our case, we only have 13 countries, which constitute the highest level of clustering. This number lies below the various rules of thumb for the number of clusters needed to get consistent estimates of the standard errors within multi-level regression models (Stegmueller 2013; Cameron & Miller 2011). In addition, the number of instruments generated from our control variables exceeds the number of countries. To estimate our models successfully and reduce the number of clusters needed for model identification, we first partialed out the effects of the control variables in the regression models. To account for the clustered data structure, we included country fixed effects (Cameron & Miller 2011, 2013, 19). Since these effects do not completely capture all within-country correlation of the error term (Cameron & Miller 2013, 16), we also derived cluster robust error terms at NUTS 2 levels, to further correct the estimates.

RESULTS
Descriptive results

In order to test our first hypothesis (H1), that variation in families’ social networks is greater in weak than in strong family regions, we created a variable to capture the variation (variance) in contact frequency and spatial proximity between kin in each NUTS 2 region. Looking at the averages (see Figure 2), we find little variation in couples’ social networks in Sweden and in strong family countries such as Spain and Italy. There is more variation in spatial proximity between kin in Greece. Interestingly, we also observe large variation in frequency of contact between kin in Denmark, though the average variation in spatial proximity is comparatively low. Apart from that, the variation in network indicators is comparatively high in most central European countries, as represented by their country averages (Austria, Germany, France and Switzerland). Thus, in contrast to our expectation, variation in social networks is not necessarily higher in weak than in strong family countries, which already rejects our first hypothesis (H1).

Intriguingly, we observe strong regional differences within most European countries as described by the boxplots. While the differences in social networks among Swedish regions are rather small, in Italy, Poland, Spain, Greece, France and Germany they are quite large. Comparing regions, we observe many outliers in Germany, Greece and Spain, suggesting important regional differences in family systems. Mapping those differences (see Figure 3 and Figure 4), the

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14 For Germany information was only available on NUTS 1 levels. For Denmark, where the information was available on NUTS3 levels, we aggregated regions into three higher clusters (north, west, south and east Denmark).
divergences between Italian regions seem to follow the standard division of Italy into two Italian family systems, which has also been observed by several other researchers (for an overview see Micheli 2012, 30–31). In northern Italy, where the stem family model prevails (Micheli 2012, 30), we observe very little variation in spatial proximity among kin. At the same time, we observe large variation in proximity among kin in southern Italian regions, where children leave home and establish their own households earlier, but stay in close proximity to their parents (Santarelli & Cottone 2009, 6–8; Micheli 2012, 30). This result is less clear with respect to variations in frequency of contact among kin (see Figure 4). Looking at these two regions and comparing their fertility levels, we observe higher fertility in the southern Italian regions of Calabria (2.480), Campania (2.562) and Sicilia (2.211) and on average smaller family sizes in the northern parts of Italy (Emilia-Romagna: 1.602, Liguria: 1.190, Lombardy: 1.670). Interestingly, these regional differences follow the diverse and persistent pattern of regional fertility decline, observed by Peréz and Livi-Bacci (1992, 164). While the regional pattern in Italy suggests that fertility levels are higher in regions with more variability in social networks, for Spain and Greece this picture is much less clear. For most parts of Spain, the picture is even reversed. Fertility is lower in regions with more variation in social networks (Galicia: 1.886, Castile and León: 1.901, Aragón: 1.850) and higher in regions with less variation (Andalucía: 2.830, Murcia: 2.754, Navarra: 2.537). Only in a few Spanish regions (Catalonia: 2.241, Valencia: 2.016) variability in social networks and fertility levels are high.
Figure 3: Regional variance in families’ social networks based on spatial proximity

Figure 4: Regional variance in families’ social networks based on frequency of contact
Finally, it is not only fertility that is lower in regions characterized by more variation in social networks; there is a significant negative association between regional variance in spatial proximity among kin and variation in family size (rho: –0.063; P = 0.000). This rejects my second hypothesis (H2), that differences in family size are more pronounced in weak family regions than in strong family regions. The results show that variation in family size is not necessarily greater in weak family regions.

**Regression results**

Tables 3 and 4 present the results of using the LA and the augmented LA (LA+) and also OLS estimates for each model for further comparison. In all models the effects of the control variables were partialed out to reduce the number of excluded variables.

### Table 3: Instrumental variables regression results, explaining regional fertility variation

| Variables                        | Model 3.1 OLS | Model 3.2 LA | Model 3.3 LA+ |
|----------------------------------|---------------|--------------|---------------|
| Individual factors              |               |              |               |
| Contact freq. (mean centred)     | 0.052         | 0.045        | 0.046         |
| Spatial prox. (mean centred)     | -0.191 ***    | -0.177 **    | -0.177 ***    |
| Regional factors                |               |              |               |
| Av. regional contact frequency  | -0.303        | -0.306       | -0.307        |
| Av. regional spatial prox.      | -0.123        | -0.111       | -0.110        |
| Regional variance contact freq. | -0.630        | -0.626       | -0.626        |
| Regional variance spatial pro.  | -0.150        | -0.144       | -0.142        |
| Hansen J                        | 115           | 116          |               |
| jdf                              | 108           | 109          |               |
| jp                               | 0.311         | 0.295        |               |
| N                                | 15,252        | 15,252       | 15,252        |
| F test (P > F)                   | 25.05 ***     | 12.24 ***    | 12.15 ***     |
| Clusters                         | 136           | 136          | 136           |

Note: The effects of the control variables have been partialed out; weighted output.

*p < 0.10, *p < 0.05, **p < 0.01, ***p < 0.001
Table 4: Instrumental variables regression results, explaining completed fertility

| Variables                        | Model 4.1 OLS | Model 4.2 LA | Model 4.3 LA+ | Model 4.4 OLS | Model 4.5 LA | Model 4.6 LA+ |
|----------------------------------|---------------|--------------|--------------|---------------|--------------|--------------|
| Individual factors               |               |              |              |               |              |              |
| Contact freq. (mean centred)     | 0.051 *       | 0.043 ^      | 0.043 ^      | -0.388 *      | -0.483 *     | -0.484 *     |
| Spatial prox. (mean centred)     | -0.191 ***    | -0.185 ***   | -0.185 ***   | -0.365 *      | -0.308 ^     | -0.304 ^     |
| Regional factors                 |               |              |              |               |              |              |
| Av. regional contact frequency   | 0.121         | 0.074        | 0.069        |               |              |              |
| Av. regional spatial prox.       | -0.195        | -0.153       | -0.148       |               |              |              |
| Regional variance contact freq.  |               |              |              | -0.404 *      | -0.389 ^     | -0.390 ^     |
| Regional variance spatial pro.   |               |              |              | -0.044        | -0.042       | -0.043       |
| Interaction terms                |               |              |              |               |              |              |
| Av. reg. contact *               | -0.106 ^      | -0.087       | -0.087       |               |              |              |
| Contact freq. (mean centred)     |               |              |              |               |              |              |
| Av. reg. prox. *                | -0.002        | -0.009       | -0.010       |               |              |              |
| Spatial prox. (mean centred)     |               |              |              |               |              |              |
| Reg. variance contact freq. *    |               |              |              | 0.298 *       | 0.357 *      | 0.357 *      |
| Contact freq.                    |               |              |              |               |              |              |
| Reg. variance spatial prox. *    |               |              |              | 0.115         | 0.084        | 0.082        |
| Spatial prox.                    |               |              |              |               |              |              |
| Hansen J | 120 | 123 | 121 | 122 |
|---------|-----|-----|-----|-----|
| jdf     | 108 | 109 | 108 | 109 |
| jp      | 0.209 | 0.172 | 0.179 | 0.194 |
| N       | 15,252 | 15,252 | 15,252 | 15,252 | 15,252 | 15,252 |
| F test (P > F) | 24.79 *** | 22.12 *** | 22.02 *** | 27.61 *** | 17.73 *** | 17.60 *** |
| Clusters | 136 | 136 | 136 | 136 | 136 | 136 |

Note: The effects of the control variables have been partialed out; weighted output.

^p < 0.10, *p < 0.05, **p < 0.01, ***p< 0.001
instruments. The test of the model assumptions is described in Appendix 2. As reported, all model assumptions are fulfilled.

First of all, the effects of the network indicators on completed fertility (Table 3), suggest that deviations in social networks from the regional means (family systems) have a significant effect on people’s fertility. Individuals whose networks are characterized by closer proximity between kin than the regional averages would suggest, have significantly lower fertility (models 3.2 and 3.3). Interestingly, we find no direct effects of the family systems variables on family size. Yet, as demonstrated by models 3.2 and 3.3, there is an effect of regional variance in social networks on fertility. In regions with more variation in social networks, fertility is lower, thus reducing possible variation in fertility, too. Hence, not only the degree to which individuals deviate from regional family systems matters, but also the regional coherence in social networks is of importance.

To test our third hypothesis (H3), that couples with close-knit networks have higher levels of completed fertility in weak than in strong family regions, we include two interaction terms in our models. These terms link deviations in social network composition with differences in the regional means (reflecting different family systems). The results (models 4.2 and 4.3 in Table 4) show that a network with spatially closer ties to kin than the regional average has a negative effect on couples’ fertility. This effect turns out to be different from what we expected. Since there is the possibility that this general effect is different between weak and strong family systems, we also test how far the effect varies between such regions. Looking at the interaction term suggests no significant changes in the effects. Hypothesis H3 is therefore rejected.

Finally, we test how far there are changes in the effects of deviating from regional family system norms in terms of social network composition between regions with more or less variation in social networks. We therefore include another interaction term. The results show (models 4.5 and 4.6 of Table 4) a positive interaction effect for differences in frequency of contact between kin and the regional variance in social networks. This effect is again significant (p = 0.015), suggesting that the negative direct effect of deviating from regional family system norms is absorbed by contact frequency to kin (p = 0.029) in regions characterized by more variation.

DISCUSSION AND CONCLUSION

The central question of this article was: to what extent does the interplay of regional family systems and social networks shape the fertility behaviour of people born between 1920 and 1960? We measured the structure of social networks using two network indicators which reflect the average frequency of social contact and the average geographical proximity among respondents and their kin. Aggregating these measures on regional levels (NUTS 2) provided us with indicators reflecting regional family systems. Comparing social networks of individuals with the derived regional indicators, we were able to identify the degree to which individuals’ networks
deviated from regional family system norms and how this influenced their fertility. We tested the effects of regional family systems and family network indicators on fertility using the instrument free Lewbel's approach (LA) (Lewbel 2012). This approach is new to demographic studies, but its usefulness has been demonstrated in other disciplines (Rigobon 2003, 77; Rigobon & Roderik 2005, 536; Emran & Shilpi 2012, 1136). The results of our regression models suggest that both regional family systems and couples’ social networks play a role, influencing completed fertility.

Regional family systems play a role in that they lay down the ideals of the ‘normal’ family from which couples’ social networks could differ. While the impact of the indicators (distance from and social contact with kin in social networks) measuring regional family systems on fertility turned out to be insignificant, our results demonstrated that deviations from these regional family system norms in terms of social network composition influenced couple’s fertility significantly. However, contradicting our expectations, closer ties to kin led to lower fertility in all family system regions and not only in strong family systems as we had expected. Although this result seems to confirm the negative effect of closer family bonds on fertility (Livi-Bacci 2001), it is puzzling to see that this effect was the same in weak and strong family regions.

Mapping the variance of the two network indicators in each NUTS region, we observed a greater variability in couples’ social networks according to distance from and contacts with kin) in the central and most southern European regions (Figures 3 and 4). This descriptive result is surprising too, because it was the opposite of what we had expected. We expected to observe a greater variety in social networks, which would result in higher fertility in the weak family regions. Surprisingly, in the weak family northern European regions the coherence in social networks turned out to be comparatively strong. The more individualized life concepts, together with the more generous welfare state of the Scandinavian countries (Reher 1998; Albertini & Kohli 2013), may in fact have reduced the range of family configurations. Together, these factors seem to support the extant norms of living separated from kin, which facilitates networks where kin tend to live outside the household, but in close proximity (Albertini & Kohli 2013).

At the same time, the steady nuclearization of for instance Italian families (Viazzo 2010b, 146), seems to result in less coherence in social networks. For the Mediterranean countries, we observed important regional differences in family systems and coherence in social networks. This corroborates the already observed variations in family organization between, for example, Italian regions (Viazzo 2010b, 146; Viazzo & Zanotelli 2010; Micheli, 2012). The lower fertility in the strong family regions and the greater variety in social networks can be linked again to the welfare state. Especially in the strong family Mediterranean countries, the welfare state increased the differences among regional family ideals and styles of living, leading to fertility postponement (Livi-Bacci 2001, 146–148; Vignoli et al. 2013).

The better fit between family norms and lifestyles in the weak family Nordic countries might explain why we observed a negative effect of stronger family ties on fertility. The better fit leads to higher fertility, while the misfit between family
norms and lifestyles in the strong family Mediterranean countries reduces it. From this point of view, there seems to be no positive effect on fertility of living in close-knit family networks in weak family regions, as long as family in proximity provide practical and emotional support. Yet this could be different again in regions where family system norms allow for a greater variety in networks, such as in the central European ones (Albertini & Kohli 2013, 836).

Thus our results demonstrate that the negative effect of closer bonds (based on contact frequency) on fertility is weaker in regions characterized by less cohesion in social networks. Particularly in central European countries cohesion is rather weak. This result corroborates the idea that closer bonds in weak family regions support fertility when the context is right. This context seems to be the link between regional family norms, the welfare state which frames couples’ socioeconomic context and the actual family organization. In the central European regions, the misfit between family ideals (family systems) and family organization seems to be less pronounced than in the Mediterranean countries. At the same time, familial support does not stop at the household border, as it does in many Mediterranean countries (Albertini & Kohli 2013, 836). Given the traditional welfare state, there is thus still added value in living in close-knit family networks in these parts of Europe, which could increase fertility.

Our research contributes to understanding the persistent regional differences in fertility levels and fertility behaviour across Europe. To understand these spatial differences, our study related people’s fertility decisions to the regional conceptions of family and kin as anchored in family systems and to people’s actual social networks and the role family plays in them. The results show that we can improve on previous research into regional fertility differences by measuring people’s complete social networks and not just their household composition. Our results show that family system norms, and deviations from them in terms of specific social networks, play an important role in determining family size. However, our findings also suggest that in order to better explain the interplay between family systems, social networks and fertility, we need also to take into consideration the national welfare state or organization. This is an important alternative source of welfare which may mediate the interplay among family systems, social networks and fertility in important ways. Hence future research should investigate this issue further by theorizing the possible linkages and testing them by including information on welfare organization.

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## Table A1: Cases per NUTS 2 region*

| Code   | Name               | N Incl | Code   | Name               | N Incl | Code   | Name               | N Incl | Code   | Name               | N Incl |
|--------|--------------------|--------|--------|--------------------|--------|--------|--------------------|--------|--------|--------------------|--------|
| AT11   | Burguñánd         | 49 39  | CZ02   | Praha/Prague       | 201 109| FR62   | Midi-Pirénés        | 3 not  | ITF3   | Campania           | 171 100|
| AT12   | Niedersachsen     | 315 266| CZ03   | Strasbur          | 204 110| FR71   | Rhône-Alpes         | 475 191| ITF4   | Puglia             | 173 87  |
| AT13   | Wien              | 261 202| CZ04   | Jihlava/Prague     | 250 153| FR83   | Languedoc-Roussillon| 243 103| ITF5   | Basilicata         | 68 47   |
| AT14   | Kamen             | 66 53  | CZ05   | Olomouc/Prague    | 142 72 | FR82   | Provence-Alpes/Côte d'Azur | 238 180| ITF6   | Calabria           | 94 14   |
| AT15   | Strasbourg        | 176 131| CZ06   | Strasbur         | 272 171| FR83   | Corse               | 5 not  | ITG1   | Sicilia            | 194 81  |
| AT16   | Saarbrücken       | 247 194| CZ07   | Saarbrücken      | 258 138| GR11   | Anatoliki Makedon., Thess. | 68 57  | ITG2   | Sardegna           | 66 44   |
| AT17   | Saarbrücken       | 70 56  | CZ08   | Morigoso/Morav,   | 256 130| GR13   | Dodek Makedon.      | 343 218| NL11   | Groningen          | 102 71  |
| AT18   | Vorarlberg        | 69 56  | ES11   | Galicia           | 100 61 | GR14   | Thessalia           | 150 105| NL13   | Drente             | 84 52   |
| BE10   | Brussels          | 121 48 | ES12   | Principado de Asturias | 54 31  | GR21   | Rías Bajas          | 48 43  | NL23   | Overijssel         | 256 150|
| BE21   | Antwerp           | 485 340| ES33   | Cantabria         | 23 not | GR23   | Asturias            | 30 21  | NL23   | Gelderland         | 132 99  |
| BE22   | Limburg           | 186 117| ES31   | Pais Vasco       | 85 50  | GR23   | Extremadura         | 58 53  | NL23   | Flandria           | 46 26   |
| BE23   | Ost-Vlaanderen    | 229 137| ES22   | Navarra           | 36 20  | GR24   | Sterna Ellad        | 114 74| NL31   | Utrecht            | 221 143|
| BE24   | Vlaams-Brabant    | 261 186| ES23   | La Rioja          | 20 not | GR25   | Peloponnisos        | 88 75  | NL32   | Noord-Holland      | 252 161|
| BE25   | West-Vlaanderen   | 424 246| ES24   | Aragón           | 70 49  | GR30   | Asturias            | 796 406| NL33   | Zuid-Holland       | 505 305|
| BE31   | Brabants-Wallon   | 54 29  | ES30   | Comunidad de Madrid | 209 97| GR41   | Vöriele Algaio       | 30 28  | NL34   | Zeeland            | 75 40   |
| BE32   | Hainaut           | 334 186| ES41   | Castilla y León  | 138 60 | GR42   | Notio Algaio        | 36 32  | NL41   | Noord-Brabant      | 329 209|
| BE33   | Liége            | 268 160| ES42   | Castilla-La Mancha | 108 43| GR51   | Kriol                | 60 51  | NL42   | Limburg (N.L.)      | 184 111|
| BE34   | Luxembourg (b)    | 62 34  | ES43   | Extremadura       | 53 not | ITIC   | Piemonte            | 182 136| PL31   | Lodzkie            | 155 not |
| BE35   | Namur            | 163 105| ES51   | Cataluna          | 200 120| ITIC   | Liguria             | 93 44  | PL32   | Zielona            | 105 177|
| CH10   | Iemenique         | 210 156| ES52   | Comunidad Valenciana | 212 119| ITIC   | Lombarde           | 284 147| PL31   | Małopolska         | 59 42   |
| CH11   | Espace Mittelholland | 264 202| ES55   | Illes Balears     | 32 14  | ITIC   | Trentino - Alto Adige | 41 17  | PL32   | Silesia            | 202 178|
| CH12   | Nordwestschweiz   | 138 97 | ES61   | Andalucía        | 427 250| ITIC   | Veneto             | 196 107| PL31   | Lubuskie           | 62 not  |
| CH13   | Zürich           | 196 137| ES62   | Region de Muñoz | 60 47  | ITIC   | Friuli - Venezia - Giulia | 95 62  | PL32   | Podkarpackie        | 107 97  |
| CH14   | Oostschweiz       | 207 142| ES63   | Ciudad Autonoma de C. | 8 not | ITIC   | Emilia - Romagna    | 153 103| PL33   | SwietołTMPiskie     | 80 62   |
| CH15   | Zentraalschweiz   | 104 84 | ES70   | Canarias         | 101 52 | ITIC   | Toscana            | 151 81  | PL34   | Podlaesko          | 67 59   |
| CH16   | Ticino           | 53 25  | FR10   | Ile de France    | 666 272| ITIC   | Umbria             | 107 61 | PL41   | Wielkopolskie      | 154 145|
| DK     | East              | 799 362| FR30   | Nord - Pas-de-Calais | 331 121| ITIC   | Marche             | 91 59  | PL42   | Zachodniopomorskie | 120 128|
| DK     | South             | 509 201| FR51   | Pays de la Loire | 335 133| ITIC   | Lazio              | 154 93  | PL41   | Lubuskie           | 54 not  |
| DK     | North-West        | 647 285| FR61   | Altopiano       | 361 99 | ITIC   | Abruzzo            | 13 not | PL51   | Dolomia            | 132 89  |

*Note: The first column shows the number of cases per NUTS regions. The second column shows the number of cases included in the regression analysis per NUTS region. For Germany information was only available on NUTS 1 levels. For Denmark, where the information was available on NUTS3 levels, I aggregated regions into three higher clusters (into north-west, south and east Denmark).
APPENDIX 2

Explanation of the applied instrumental variables (IV) approach

Instrumental variables (IV) regression is applicable when regressors are endogenous or mis-measured. So far, several different IV methods have been developed (Ebbes et al. 2009; Park & Gupta 2012, 568; Lewbel 2012, 67). One of these is the instrument free Lewbel’s approach (LA) (Lewbel 1997, 2012). This approach has the advantage that it does not require any variables (instruments) replacing any endogenous covariates. This solves the problem of fulfilling the criteria for instruments (1) being exogenous, (2) having enough explanatory power to explain the endogenous variable, and (3) not being directly related to the dependent variable (Ebbes et al. 2009, 448–449). In the LA, instruments are generated from the data by multiplying the heteroscedastic error terms from a first stage regression with the subset of mean centred exogenous regressors (Z) (Lewbel 2012, 73; Brown 2014, 38). These regressors can be any set of exogenous covariates so that no information outside the model is needed. In this context, the model relies on the assumptions that (Lewbel 2012, 69, 72):

1. $E(X_{e1}) = 0$,  
2. $E(X_{e2}) = 0$,  
3. $cov(Z, e_1e_2) = 0$,
   
while a simultaneous equation system additionally requires that
4. $cov(Z, e_2^2) \neq 0$

for the model to be identified.

In this study we assume that unobserved regional family systems influence people’s fertility and their observed social relationships which form our network indicators. In doing so I reduce the model’s assumptions to an unobserved single factor model, assuming that (1) there are variables which are not correlated with the error terms, (2) the error term is heteroscedastic and (3) the covariance between the subset of regressors (Z) and the heteroscedastic error is zero (Lewbel 2012, 77). While assumption (1) requires the variables to be exogenous, we can test for assumption (2) using the Breusch-Pagan test. Assumption (3) can be tested by testing the exclusion restriction of the generated instruments. If the generated instruments do not satisfy the covariance restriction then they fail the exclusion restriction tests (Emran & Shilpi 2012, 1137). Yet Lewbel (2012) demonstrates that, even if the third assumption is not met, the model can be used to identify the internal bounds of the model parameters for cases in which the covariance is relatively small (compared to the heteroscedasticity in the error terms; Lewbel 2012, 74). Unfortunately, estimates derived from Lewbel’s (2012, 67) approach are less reliable than the results of traditional IV models. But the approach can be augmented by combining it with traditional instruments found in the dataset; this increases its estimation efficiency (2012, 77).

The performance of the LA has been demonstrated by previous research in economics and health economics (Lewbel 1997, 2012; Ebbes et al. 2009; Emran & Shilpi 2012; Denny & Oppedisano 2013; Huang & Xie 2013; for an overview
see Brown 2014, 39). To estimate the LA models and test their underlying assumptions, we use the \textit{ivreg2} Stata-module, developed by Baum and Schaffer (2012). For model estimation we use the LIML estimator, which performs well under finite sample conditions (Baum et al. 2007: 478). Testing the model assumptions, we need to be sure that there is a subset of exogenous variables (Z) in our model. Among other factors, we include country dummies and respondents’ birth cohort to explain respondents’ fertility. These variables are clearly exogenous with respect to people’s fertility and the structure of their social relationships. Moreover, these variables can be assumed to give rise to the heteroscedasticity in the data. Thus, we can accept the first model’s assumption as being fulfilled. Applying the Breusch-Pagan test to a simplified OLS version of our model, which includes only our covariates, suggests that there is enough heteroscedasticity in the error term to fulfil the second model’s requirement (Breusch-Pagan-Test: \(\text{chi}^2 = 1,229.59; \ P = 0.000\)). Finally, to test the exclusion restriction we apply the Hansen J test and report its results for each model at the end of the regression tables. Testing the null-hypothesis that the included instruments are valid, the observed strong rejection of null-hypothesis in most of our models suggests that the covariance restriction is fulfilled and the LA can be applied.