Remarkable Regularities in the Association of Maternal and Paternal Ages at Childbirth: Evidence from 15 High-Income Countries

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Contemporary family changes have brought about shifting patterns of union formation, such as rising cohabitation, declining educational hypergamy (Esteve, García-Román and Permanyer 2012), and later and fewer marriages and childbearing (Lesthaeghe 2014). Among these family behaviors, assortative mating patterns by education, race/ethnicity, and social status have been studied quite thoroughly in many societies because of their implications for social inequalities and mobility (Blossfeld 2009, Blossfeld and Buchholz 2009, Kalmijn 2013, Nitsche et al. 2018, Qian and Lichter 2007, RD 1991). In contrast, the age patterns of mating behaviors are relatively less studied in sociological and demographic research, despite their social meanings in couple dynamics. That is, a large age difference between partners, particularly when the husband is much older than the wife, is often considered an indicator of gender inequality in power relations (Presser 1975, Pyke and Adams 2010). With the rise of women's socioeconomic status in many contemporary societies, it is likely that strong age hypergamy (where the husband is much older than his wife) is also on the decline, paralleled by the decline of educational hypergamy.

This paper aims to investigate the understudied issue of partner age differences at childbirth from both the perspective of the mother and the father. We analyze 15 high-income countries in Europe, North America, and East Asia over a time span of several decades, with the longest time series starting in the late 1960s. For all countries our analysis is based on high quality vital registration data.

Research on parental ages and age differences at childbirth bears empirical significance for a few reasons. First of all, shifting age differences among parents are likely to signify evolving gender power relations in societies where women's status has been advancing rapidly. In these processes, changes in age differences can be both a mean and an outcome of changes in power relations. Shifts in age pairings might thus be well suited to contrast family changes in different countries in recent decades. Secondly, parental age differences often have implications in reproductive outcomes, though with mixed findings. Some studies have shown unions with older men seem to have a greater number of offspring (Bereczkei and Csanaky 1996, Fieder and Huber 2007), while others report a U-shaped pattern between partner age differences and total birth count (Kuna et al. 2017). Thirdly, as cohabitation becomes more

prevalent in many developed nations, many of these unions also involve childbirths. This makes long-standing data series on age pairings of grooms and brides at marriage less relevant for understanding age differences among parents.

Existing research on marriage patterns by age has shown a long-term decline in extreme age differences between husbands and wives and a rise in more age-homogamous unions in various contexts (Esteve, Cortina and Cabré 2009, Kolk 2015, Van Poppel et al. 2001). Such a shift has resulted in a general decline in mean age differences between spouses in a number of developed countries. On the other hand, age preferences in the partnering process are also highly gendered. That is, while men increasingly prefer younger women as they become older, women's age preferences for partners become more heterogeneous over the life course (Skopek, Schmitz and Blossfeld 2011). In the current study, we expect similar patterns to be observed in the mean age differences at childbirth among couples in developed countries, but likely with some country variations in terms of scope and timing of change due to existing socio-cultural values and norms in a given society.

Research Design

Data

Our analyses are based on vital registration data covering 315,265,219 live births in 15 high-income countries. The countries (in alphabetical order) and years we cover are the following:

- Canada, 1974-2016
- Denmark, 1986-2015
- England and Wales, 1982-2016
- Estonia, 1989-2015
- France, 1998-2013
- Finland, 1987-2015
- Germany, 1991-2013
- Hungary, 1970-2015
- Italy, 1999-2015
- Japan, 2009-2015
- Poland, 1986-2015
- Spain, 1975-2014
- Sweden, 1968-2015
- Taiwan, 1998-2016
- USA, 1969-2015

The data were obtained from national statistical offices, except for the United States, where the data were provided by the National Bureau of Economic Research. The raw data are mostly similar to the data discussed in Dudel & Klüsener (2018a), and we refer to their documentations for a detailed description. An overview of the most important aspects of these data sources will be discussed in our completed paper.

The data for all years and countries are taken from birth registers and are complete enumerations, except for the first years of the US data. Specifically, US data before 1972 are based on 50% samples taken from the birth registers of U.S. states. To account for this we use sampling weights. From 1972 onward, the data include the complete birth registers of an increasing number of states, and from 1985 full birth register data for all states are available.

Most registers cover all births of the resident population, except for England and Wales, where all births occurring in the corresponding territory are included. For some births the father or the mother might be residing abroad: in the former case the birth is likely not covered by the register; in the latter case the data we have access to usually do not indicate that the information for the father relates to a person abroad. We expect, though, that only very few births are affected by this and that cases where either the mother or the father lived abroad are likely to cancel each other out.

For Japan, the data available to us cover only marital births. The proportion of non-marital births is very low in Japan at only around 2%. Nevertheless, we added the missing births by age using data from the Human Fertility Database (2018). For details of this process, please see Dudel & Klüsener (2018a). In Italy, births are registered at the municipality level with either a short form or a long form. While mostly the long form is used, some small municipalities use the short form. The data we have access to only includes births registered with the long form. We dealt with this the same way as in the case of Japan. Again, see Dudel & Klüsener (2018a) for detailed descriptions of data handling.

For most countries, maternal and paternal ages above and below certain thresholds are not shown in the data but subsumed in open age-intervals; e.g., births to mothers aged 49 and older are often assigned to the category “49+”. Experimenting with categorizing ages in this way for countries where we always know the correct age shows that the choice of the cutoff ages for these categories is negligible as long as it is high enough. As using these open categories eases application of our imputation method (see below), we chose to use “15-“ and “59+” as open categories for men, and “15-“ and “49+” for women, as below 15 years and above 59 years or respectively 49 years fertility is very low. For instance, for fathers the highest proportion of fathers aged 59+ across all our countries and years is 0.2% in Italy in 1999. It is considerably lower for most other countries and years.

For some countries, we only have access to age data which already is more restricted. This applies to England and Wales (15-55 years for both men and women), France (17-46 years for both men and women), Germany (17-59 years for men; 16-45 years for women), Japan (17-59 years for men), and Sweden (15-50 years for both men and women). For all other countries we can use the full range from 15-59 years for men and 15-49 years for women.

For most births we know the age of the father and the age of the mother in single-year ages. For Sweden the data does not include the parental age at childbirth but the age reached during the year; e.g., if at childbirth a mother was aged 27, but turned 28 years later in the same year, then her age is recorded with 28 years in the data. We do not expect this to affect age differences between parents, though, as it applies to both mothers and fathers.

Imputation and Analytical Strategy

In most country datasets the age of the father is missing for some births, whereas the age of the mother is almost always known, except for very few births. The reasons for missing values are manifold. In some cases the birth might be registered only by the mother who might not provide information on the father; or in other cases the father might not be known. Sometimes the reasons are more structural. For instance, in Germany until 1999 the age of the father was only recorded for marital births and never for non-marital births. For most countries and years the proportions of missing values are low. Nevertheless, we decided to impute missing values. To impute missing paternal ages, we adopt the so-called conditional approach outlined below. We chose this method as extensive simulations show that it performs well, especially compared to competing approaches (Dudel & Klüsener 2018b).

For each country and year, we calculate the mean age at childbirth both for women and men based on the data completed by imputation. Moreover, we also calculate the average difference between mothers and fathers at childbirth. That is, for each birth we take the paternal age minus the maternal age and then calculate the mean. If the average age difference is positive, say 3.5, it means that on average fathers are 3.5 years older than mothers. If the age difference would be negative, e.g., -2, then women would be two years older than men.

For most of our analyses of age differences, we condition either on the maternal age or on the paternal age. When conditioning on the maternal age, we study how the age difference to the father depends on the age of his partner. For instance, it could be that for births with young mothers the age difference to the father is bigger (or smaller) than for births with relatively older mothers.

As explorative analyses demonstrated that the age differences conditional on the maternal and paternal age follow in most countries almost a linear relationship, we decided to model this relationship with linear regression. As dependent variable, we take the conditional average age difference of a given year and country, and use the corresponding maternal (paternal) age as the explanatory variable. Formally, if X denotes the age of the mother and Y the age of the father, then analyses conditioning on the age of the mother use the values of M(Y-X|X) as dependent variable, where M denotes the arithmetic mean, and X is used as explanatory variable: $M(Y - X|X) = \alpha_x + \beta_x X + \varepsilon$, where ε is an error term. When running regressions conditioned on the age of the mother, we restrict X to be in the range from 20 to 40, as for lower or higher ages the number of births is low. When conditioning on the age of the father (i.e. $M(Y - X|Y) = \alpha_Y + \beta_Y X + \varepsilon$), we use the age range of 20 to 45.

Running many of these regressions for each country and year gives us a large set of intercepts α_x and slopes β_x, which have a straightforward interpretation. If, for example, in the regressions in which we condition on the age of the mother the intercept increases, then ceteris paribus the average age difference to fathers increases across all ages; this would also

imply that fathers are getting older in comparison to the mothers. If the slope of the regressions becomes steeper it means that the age difference is becoming more heterogeneous across the age range. The coefficients obtained from conditioning on the age of the father, α_Y and β_Y, have a similar interpretation.

Preliminary Findings

Figure 1 shows the mean age differences between parents at childbirth in 15 countries across the world. The general patterns appear to be a decline in age differences between fathers and mothers, except for the region of Eastern Europe. This trend seems to be driven by a shift toward more age homogamous unions and partly also by age hypogamy gaining relevance as the context of childbearing. However, there are also a number of countries that witnessed stark trend changes over time. This includes Taiwan and the US.

Our next step is to examine how age differences evolve over time conditional on maternal and paternal ages at childbirth. The graphs in Figures 2 and 3 demonstrate the changes between 1975 and 2015 for five countries in four different regions of the world. In these graphs the grey-colored lines depict the patterns observed in the data, while the red line show the estimated linear relationship. Graphs in Figure 2 indicate that the trendlines for mothers were both in terms of intercept and slopes not very different across our five countries in 1975 (solid lines). This is remarkable considering that the economic and political situations were very different in these countries at that time. The relationship is negative indicating that mean age differences to the father are smaller among older mothers. The estimated negative slope, which signify the reduction of the age difference as mothers get one year older, vary between -0.06 years and -0.17 years. In 2015 (dashed lines), we still witness a pattern close to a linear relationship in our five countries, but the picture has become more diverse in terms of the intercept and the slope. While all countries experienced between 1975 and 2015 an increase in the intercept and the slope, which signifies higher heterogenetiy in the age differences to the father by maternal age, the shifts were rather small in Canada and the US. Sweden is an intermediate case, while Hungary and Spain registered massive increases in age difference heterogeneity by maternal age.

Turning to Figure 3, which shows the pattern for father, it is important to note that this figure also shows the age differences derived by subtracting from the age of the father the age of the mother. This implies that in order to obtain the mean age of the mother, one has in this case to subtract the number from the paternal age instead of adding it. The estimated slopes are positive and much steeper, which shows that the heterogeneity in the age difference across age is substantially higher among fathers compared to mothers. The intercept is around and in part below zero indicating that the age differences are rather small at young ages, while they become much bigger at higher paternal ages at childbirth. In contrast to women, we do not witness an increase in heterogeneity across these five countries over time. In 1975,

all countries apart from Spain display very similar slopes. Over time, the slope for Spain becomes more similar to those of the other countries, and all countries report a decrease in the intercept indicating that the age difference is decreasing across all paternal ages. Another similarity is that for all five countries a tendency away from a linear relationship was observed. The slope tends to be somewhat less steep at younger ages and to become steeper at ages above 30.

In our last Figure 4, we provide a summary graph of shifting trends by intercept and slope across years for both mothers and fathers. The graph includes observations from 15 countries across 1968 to the last year available for each respective country (between 2013 and 2016). It also shows similar tendencies observed for our five countries that heterogeneity across countries and time is much higher for women, while this is less the case for men. For women, the pattern shifts toward a higher intercept and a more negative slope, while for men the one clear tendency is that the intercept becomes more negative.

Discussion and Outlook

Considering the substantial variations in levels and trends in the average age difference at childbirth, we find it remarkable that the age differences by maternal and paternal ages show notable similarities across these culturally diverse high-income countries. Our findings provide support for the view that the effects of recent family changes on age differences between mothers and fathers are very different for women and men. For women it has led to higher heterogeneity across ages, so that young and old mothers differ today substantially in the reported age differences to the fathers. Fathers, on the other hand, have witnessed a reduction of age differences to the mother independent of the age at which they have a(nother) child. This is in line with existing findings that fertility changes in recent decades by social status or age have been much more massive for women compared to males (see Jalovaara et al. 2018).

As a next step we intend to explore the determinants of the observed shifts. We believe that the increasing age differences among young mothers reflect increasing economic uncertainties for young persons which makes family formation at early ages more difficult, especially for men. Many women are also not interested in early parenthood, as this might interfere with other education and employment plans. As early childbearing becomes less normative, minorities might dominate the patterns at young ages. This might, for example, be immigrants from less-developed contexts, in which big age differences between couples and early motherhood are more common. In addition, women's educational upgrading and rising social status seems to result not only in postponement of union formation and parenthood, but also in more age-homogamous partnerships. It is likely that those who delay childbearing till their thirties are women who have higher educational attainment and rather prefer to partner with similar-aged men.

Among males, the observed downward shift in the intercept might be driven by increased economic independence among women that enable them to partner with younger (and perhaps more gender egalitarian) men or men who are closer in age as themselves. The diminishing mean age differences between partners across all countries apart from some Eastern European countries also support the view that age differences between parents tend to decrease as societies modernize and become more gender egalitarian. Over the upcoming months we will investigate determinants of the observed pattern more thoroughly. For some countries the vital registration data allows more detailed analyses by parity, migration background and social status. These will deepen our understanding of the processes that drive the observed patterns. In addition, we will extend the discussion by adding additional demographic and policy implications of the remarkable regularities that we detect in the age differences between parents conditional on maternal and paternal ages.

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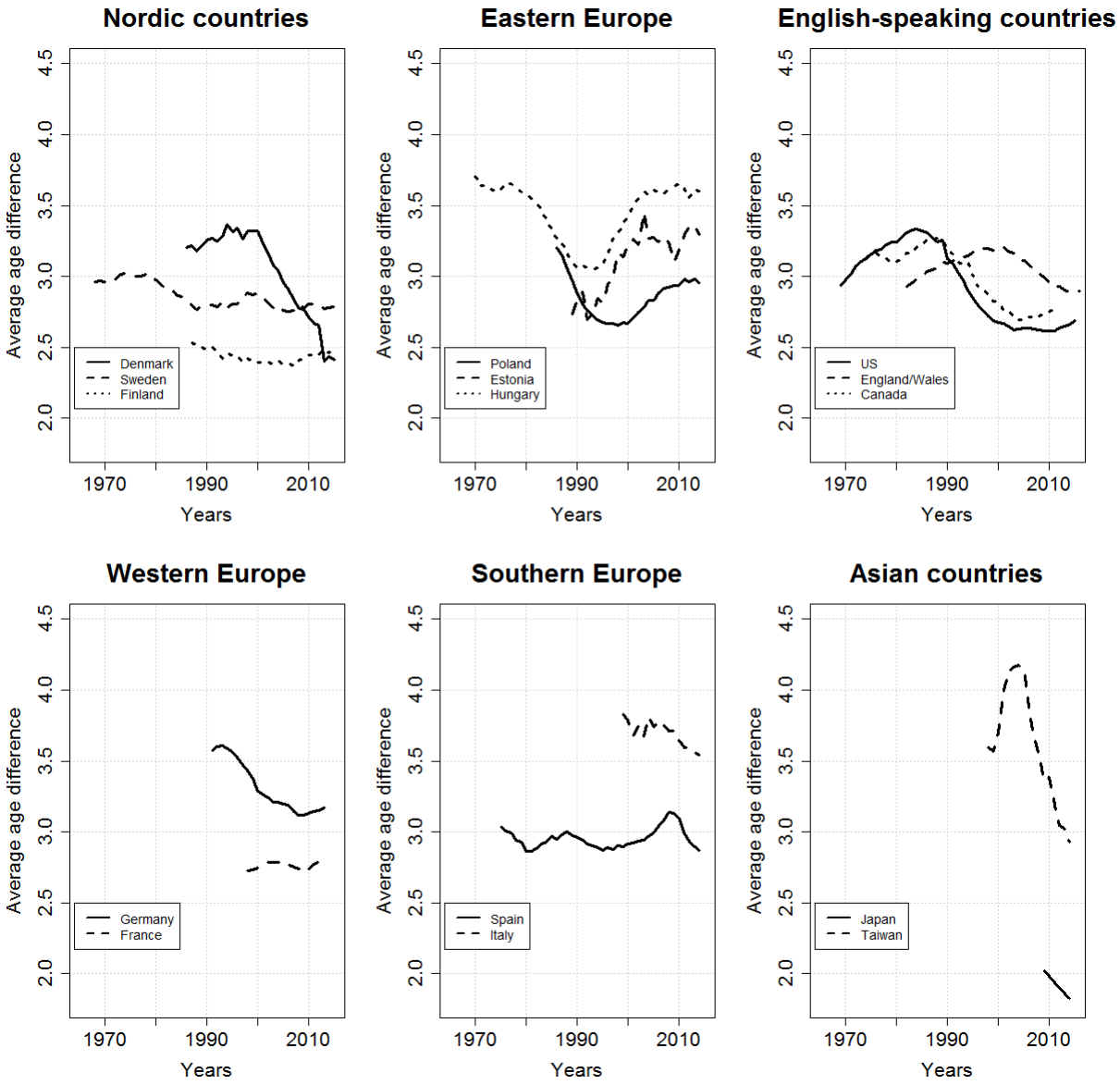
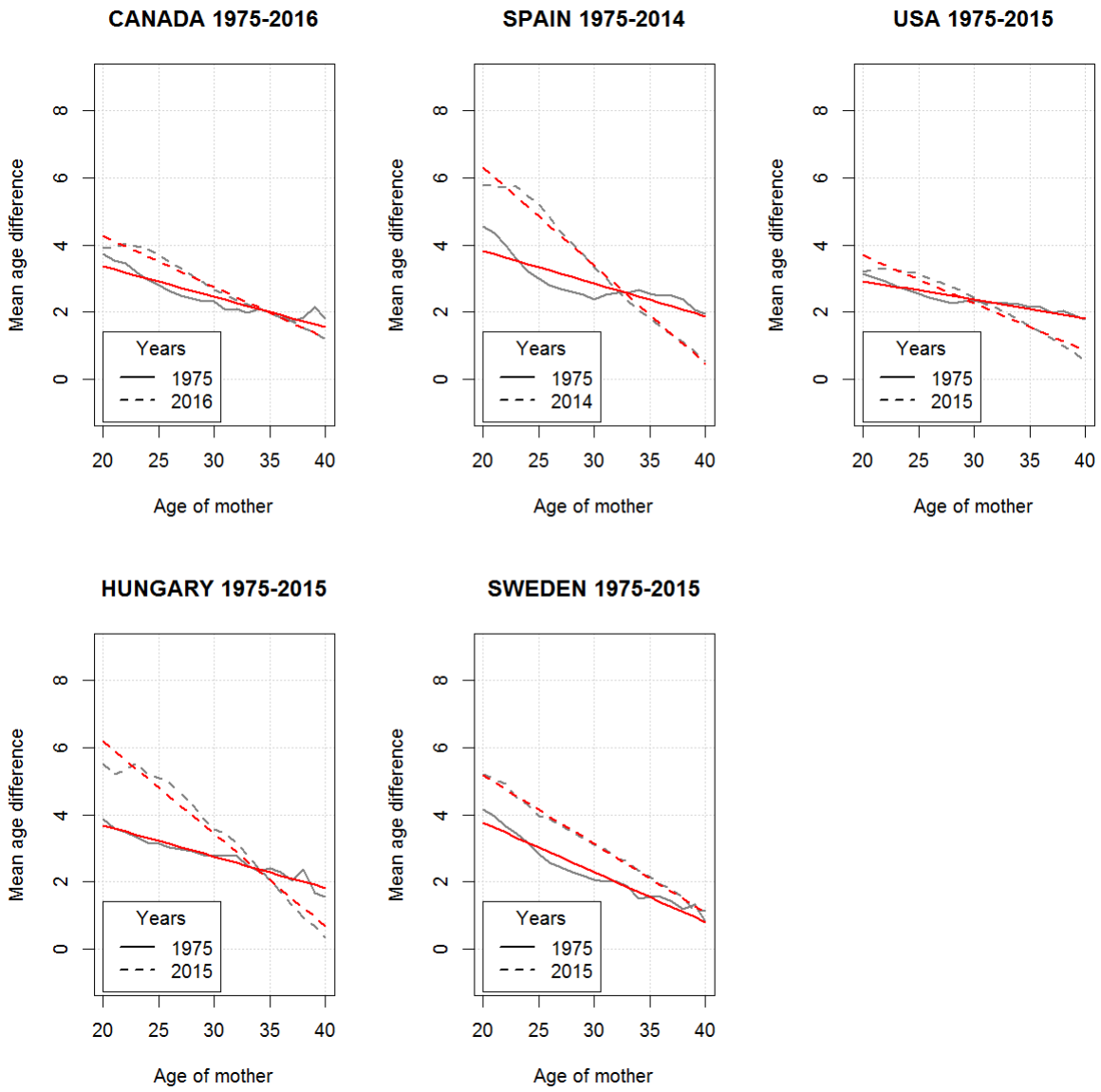
Figure 1. Trends in the difference between mean paternal and mean maternal age at childbirth by country



Source: Official Statistical Data, NBER (USA), own calculations

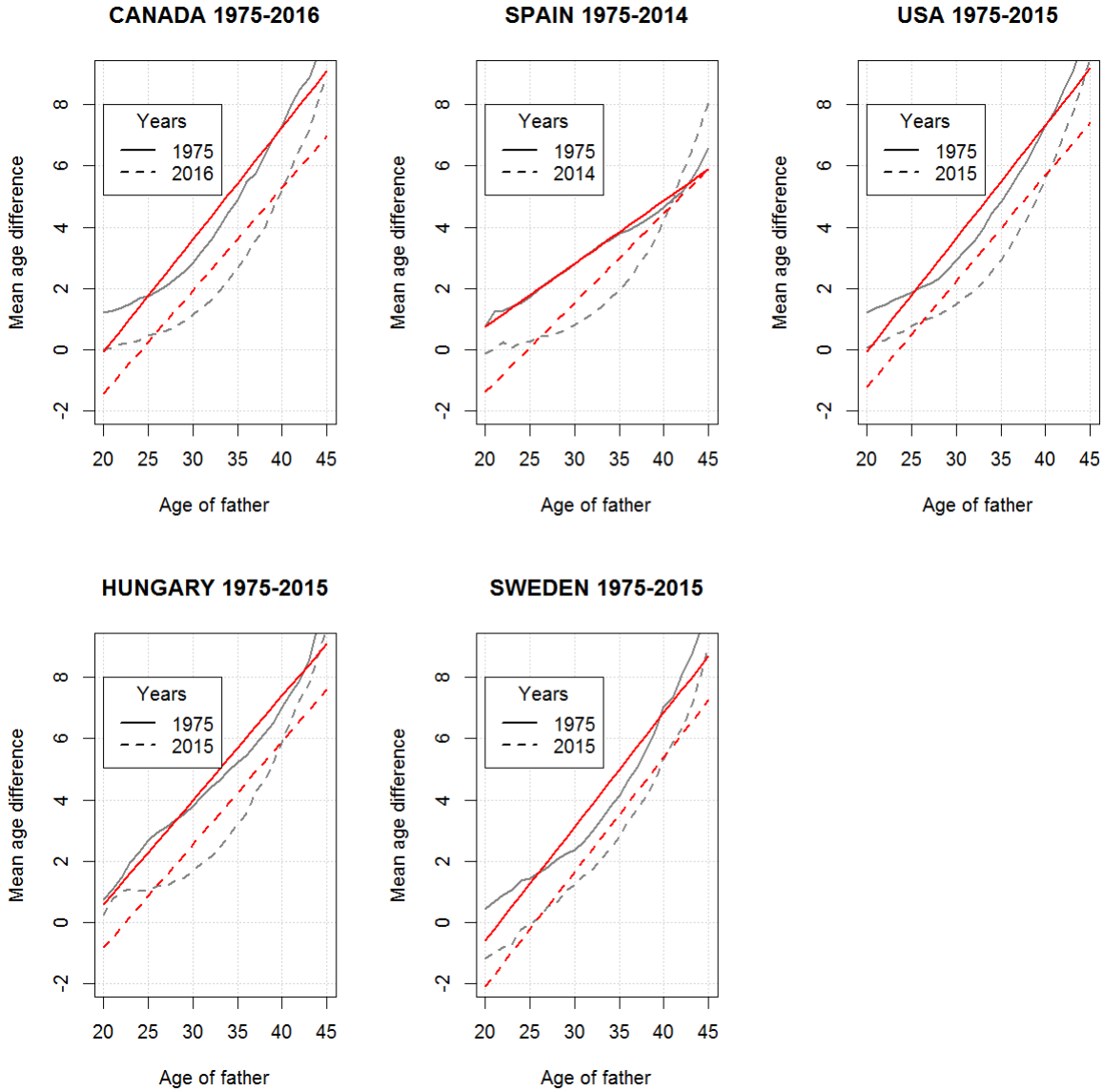
Figure 2. Mean spousal age differences at childbirth by mother's age, 1975-2015



Note: solid lines for 1975 and dashed lines for 2015. Grey lines are observed values and red lines are fitted regression lines.

Source: Official Statistical Data, NBER (USA), own calculations

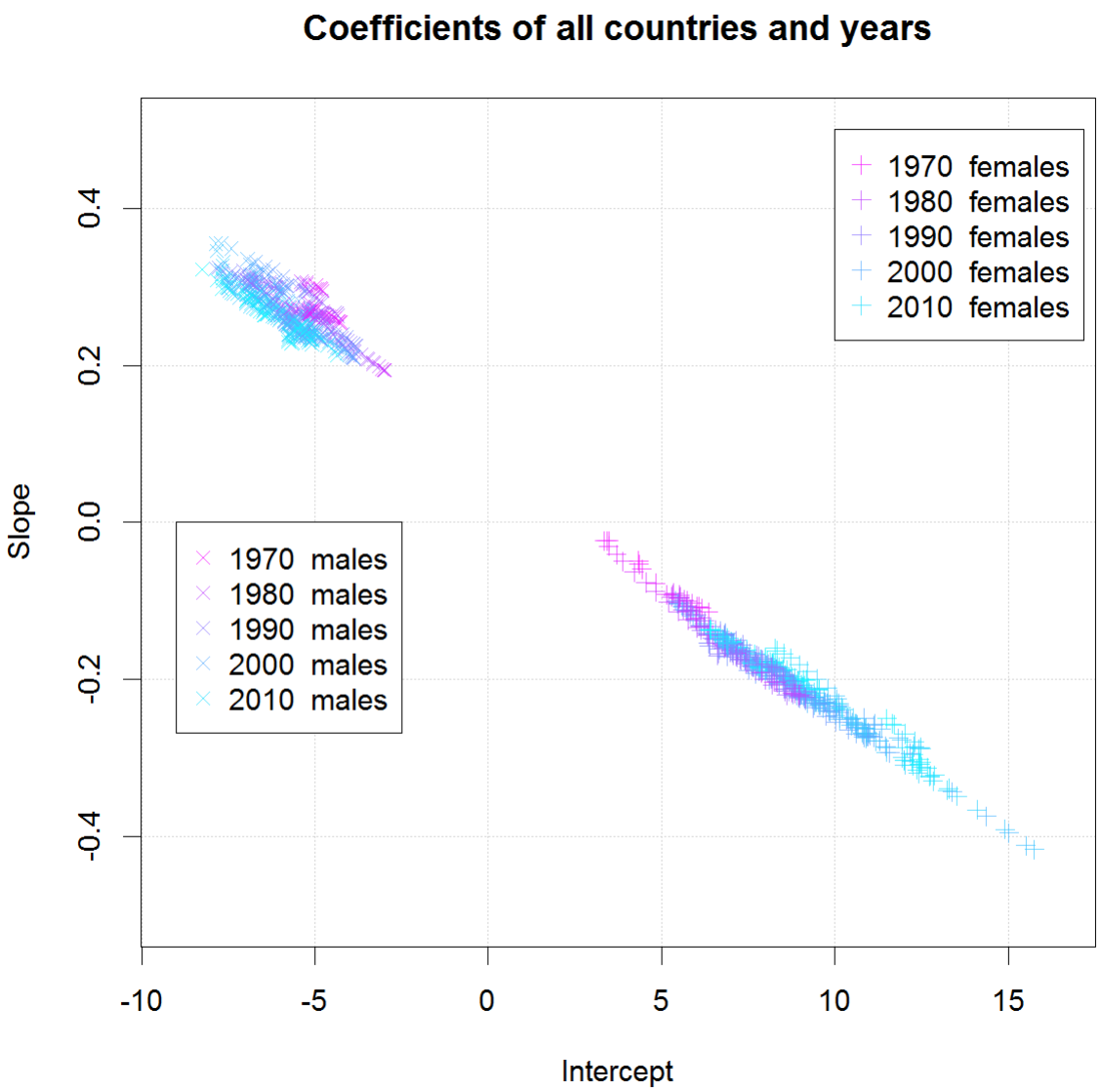
Figure 3. Mean partner age differences at childbirth by father's age, 1975-2015



Note: solid lines for 1975 and dashed lines for 2015. Grey lines are observed values and colored lines are fitted regression lines.

Source: Official Statistical Data, NBER (USA), own calculations

Figure 4. Trajectories of changes in age differences at childbirth across time for all countries



Source: Official Statistical Data, NBER (USA), own calculations