Culture, human capital, and marital homogamy in France*

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Abstract

I present a new model of cultural transmission, in which children are simultaneously socialized to several cultural traits through parental time investments as well as their environment. Using parents–children data on religious affiliation in France, I then analyse the model in reduced form to examine the patterns of intergenerational religious transmission, finding that mothers contribute more to religious transmission to children than fathers; religious minorities more than majorities; and lower-educated parents more than higher-educated ones. To explain this pattern, I embed the cultural transmission model in a collective household problem, in which parents endogenously decide their time investments in their child's culture on one side, and in their formal education on the other side. I verify that the model's predictions replicates the stylized facts in the data. Finally, I estimate this model, finding that a systematic difference in preferences across religions and genders is the main factor explaining disparities in transmission patterns, as opposed to an argument of comparative advantage in human capital transmission for higher-educated individuals.

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1 Introduction

What concessions are people willing to make to uphold their culture? From relatively mild constraints on clothing and diet, all the way to ritual suicide and martyrdom, the endorsement of a cultural identity can be a costly endeavor.[1] Sometimes this cost carries an explicit price tag, like with the *jizya*, the tax which was collected on non-Muslims by the Ottoman Empire. But for the most part, especially in modern societies which accommodate multiculturalism, the cost of upholding one's culture is one of time: time dedicated to practice a language, to go to a religious service, or to learn a national anthem.

This time concern is especially prevalent when it comes to transmitting culture to children.[2] During the process called *socialization*, children learn the tenets and principles of the previous generation's culture. The socialization process involves not only learners, however, but also teachers, and it is a time-consuming activity for both sides. Time being by essence a limited resource, trade-offs then arise on how to socialize children. Parents play of course a central role here: first because they are involved in the socialization process themselves, but also because they usually have some authority on whom the child can be socialized by. Hence they hold some decision power in how much to emphasize cultural transmission in their child's upbringing, and at what cost.

During the recent decades, one particularly striking illustration of this trade-off between cultural transmission and other activities has been the tension between religion and formal education. Modern schooling emphasizing rationality and the scientific approach has long clashed with religion, in part because their respective teachings are sometimes incompatible, but also because they must compete for children's limited attention.[3] In the United States this clash is still unfolding, for instance with the ever-lasting debates around the inclusion of creationism in the public school curriculum. Some religious groups, such as the Amish or Jehovah's Witnesses, also explicitly discourage their affiliates to pursue college or even high school education – arguably because they implicitly acknowledge these trade-offs. In France, the last 20 years have seen a rapid increase in the number of private Muslim schools: from two in 2001, to several dozens in 2018.[4] Yet, only a small number of those have been sanctioned by the government. This means that most of these schools have free rein to design their curriculum and, for this reason, provide

[1]On diet, well-known examples include religious or ethnic prohibitions on beef (Hindus) or pork (Muslims, Jews), but also recent trends like veganism, which can be seen as a cultural identity by itself. On clothing restrictions, head covering is a common cultural practice (especially for women); as is wearing a business suit to work, for instance. On ritual suicide, historical examples include the Japanese honor suicide (*seppuku*) or the self-immolation of widows in India (*sati*). On martyrdom, both Christianity and Islam have for instance a history of glorifying individuals who died for advocating their religious beliefs. The list of costly cultural behaviors goes on, of course.

[2]Intergenerational transmission is one of culture's defining feature: following for instance Guiso, Sapienza and Zingales (2006), culture designates "those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation."

[3]See for instance Squicciarini (2020) and Carvalho et al. (2017) regarding the substitutability between religion and formal education.

[4]Ferrara (2018) estimates this number to be between 45 and 60 active private Muslim schools.

an uncertain added value for their pupils' formal education. Parents who choose to send their children to these private schools may therefore be furthering religious transmission to their children while compromising on their formal education.

In this paper, I investigate the determinants of cultural transmission to children, focusing specifically on the transmission of religious affiliations using 2008 cross-sectional data from France. I show that mothers have more influence than fathers in the religious transmission process, and that parents from religious minorities have more influence than parents from religious majorities. Furthermore, I document a negative correlation between the education level of parents and (1) their religious homogamy, and (2) their religious transmission rates. I try to explain these findings by studying trade-offs on the parents' side, between investments in the child's formal education on the one hand, and in their religious socialization on the other hand. In find that a comparative advantage argument (higher-educated parents are more efficient at formal education) is not sufficient to explain religious transmission disparities between mothers and fathers: instead, the results suggest that systematic disparities in teaching efficiency between mothers and fathers are responsible for mothers' prominent role in religious transmission. In a similar way, the advantage of parents from religious minorities over those of religious majorities cannot be explained by the fact that majorities can rely on a better public provision of religious socialization: instead, they must be explained by systematic differences between religious affiliations in the way that the child's religion is valued compared to the child's education.

My methodology relies both on theoretical work and empirical analysis. I begin with a careful description of the data, in which I document comprehensively how parental religious affiliation and education correlate with religious homogamy and religious transmission rates. I then build a theoretical framework of cultural socialization, using a time allocation approach to the problem of cultural transmission (Bisin and Verdier 2000). In this framework, parents produce the child's *cultural capital* with time investments, using a production technology which is derived from findings on children's human capital formation (Del Boca et al. 2016). The next step is to study this theory of cultural socialization with a reduced-form approach. To this end I establish a link between the theory and the standard multinomial logit model, which I use to estimate the parental contributions to their children's religious socialization. I specifically compare these contributions according to the parents' gender, religious affiliation, and educational attainment. Next, I embed the theory of cultural socialization in a collective household model, so that parental time investment decisions become endogenous choices. In this model, parents must trade off investments in their child's human capital (representing formal education) versus cultural capital. The collective model notably allows to consider how behavior changes depending on whether the household is formed by religion-homogamous or heterogamous parents. Finally, in the last step I estimate this structural model of household behavior, using data on both religious affiliation and educational attainment of survey respondents and their parents.

Cultural transmission and human capital transmission have mostly been studied separately by economists and sociologists before. My approach is notably inspired by the works of Bisin and Verdier (2000; 2011) on the economics of cultural transmission, who predicted that cultural minorities would invest more in the socialization of their children. Their work remained silent, however, on the nature of the opportunity cost of this socialization. By explicitly considering how the parents' education levels affect socialization decisions, I aim to shed light on whether cultural socialization happens at the expense of human capital transmission. In particular, Bisin, Topa and Verdier (2004) acknowledged that "considering religious faith and education levels as joint determinants of the assortativeness of marriage rates is potentially very important." Recent works which look at the interaction between religion and human capital include Squicciarini (2020) or Carvalho et al. (2017). Recently, Bisin and Tura (2020) use a matching with transferable utility approach to study language transmission among Italian migrants. Naturally, my work is thus also linked to the works on children's human capital formation. In this respect, the paper closest to mine is by Chiappori, Salanié and Weiss (2017), who study parental investments in children's human capital formation according to the parents' own human capital levels. Other studies document that homogamy remains strong in many rich countries, and across several dimensions. In the United States for instance, educational homogamy has gone up since the 1950s (Schwartz and Mare 2005), while religious homogamy has gone down between Protestants and Catholics (Kalmijn 1991). This paper also contributes generally to the literature on the economics of culture and religion (see notably Barro and McCleary 2003, Guiso et al. 2006, Alesina and Giuliano 2015, Iannaccone 1990; 1998, Iyer 2016).

The paper is organized as follows. In section 2 I present the data and describe it along several dimensions of interest: education, religion, patterns of marriage and of intergenerational transmission along these dimensions. In section 3 I introduce a theory of cultural socialization. In section 4 I study empirical patterns of religious socialization in the light of the theory, using a reduced-form analysis. In section 5 I present the household model in which parents decide how to produce their children's cultural and human capital. In section 6 I describe my procedure to estimate this model, and I present the results. Finally, section 7 concludes.

2 Data

In order to investigate the relationship between culture and human capital in marriage and transmission to children, I use data from the Trajectories and Origins survey (*Trajectoires et Origines*, or TeO for short; see Beauchemin et al. 2016 for details). The TeO survey was conducted in metropolitan France in 2008. With over 21,000 respondents, it aimed to document the life experiences of migrants living in France and their descendants. Because of this specific aim, the TeO survey is particularly relevant to study intergenerational transmission. First, because it includes questions not only about the respondents, but also about their parents. This information is obviously critical to the study of intergenerational transmission. Second, it is one of a few large-scale surveys in France which collects answers on respondents' religious affiliation and practices. Indeed, collecting such information is in general prohibited by law in France (*loi informatique et libertés* of 1978) and requires a special derogation. For the purpose of this paper, it means that the TeO database is a rare opportunity to study religion as an example of cultural trait in France. Lastly, the TeO survey oversamples migrants and their descendants by design. In doing so, it provides a sizeable sample for several cultural minorities in France, most notably Muslims, thus allowing to draw comparisons across different cultural groups.

Respondents were between 18 and 60 years old at the time of the survey (cohorts born between 1948 and 1990). The sample is slightly skewed towards women (52.8%). In the following, not only do I use data on the respondents, but I also rely extensively on the answers regarding their parents to study time trends, as well as marriage and transmission patterns. Respondents' parents were born as early as 1900, but I ignore pre-1920 parental cohorts on graphical representations (those have less than 100 observations per cohort). I provide more general statistics about the TeO survey in Table 8 (Appendix B). In the rest of this section, I describe the TeO data and some stylized facts regarding education and religion, both in terms of transmission and marriage patterns.

A note on graphical representations: the data can be quite noisy and graphics difficult to interpret when observations are split across the three dimensions of cohorts, religion, and education. For this reason, graphical representations throughout the paper feature nonparametric predictions (LOESS) of different outcomes of interest on birth cohorts. This allows me to obtain smoothed curves which provide a better picture of the evolution of these outcomes across cohorts (see for instance Figure 1 on education in the sample). These curves are systematically accompanied by representations of the corresponding 95% confidence interval. On some graphs I represent the actual data using dots (such as in Figure 1), but when it hampers readability I only represent the nonparametric predictions (such as in Figure 4).

2.1 Education

In the TeO survey, educational attainment is reported using the ISCED 97 classification on the highest diploma obtained. From this variable, I construct three simplified educational attainment categories: (1) "Primary or less," for individuals who completed at most primary education; (2) "Secondary," for individuals who obtained a middle- or high-school diploma, or a technical diploma from an age-equivalent training; (3) "Tertiary or more," for individuals who hold a post-secondary diploma. The proportions of these categories in the respondents' sample are 8% (Primary or less), 64% (Secondary), and 28% (Tertiary or more). Among the respondents' parents, these proportions are 57%, 31%, and 12%,

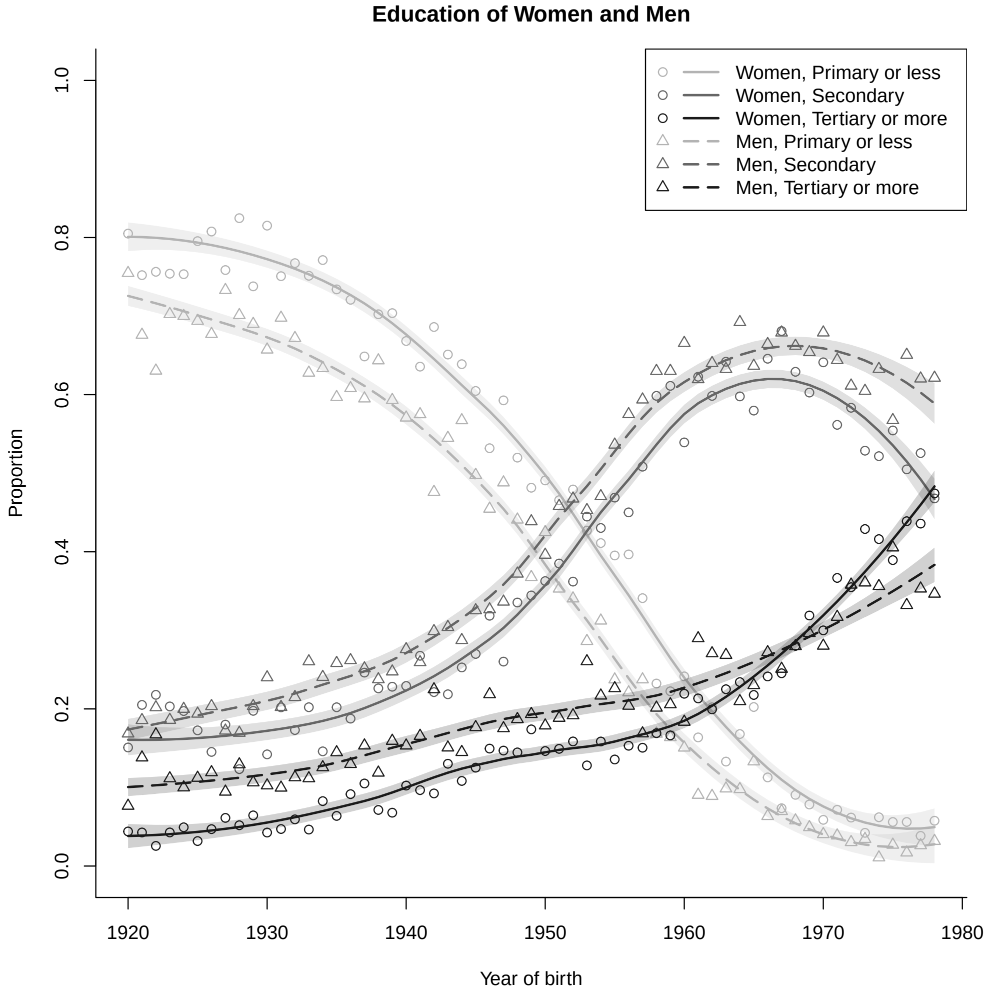

Figure 1: Education of Women and Men.

respectively.

Educational attainment. Figure 1 shows the evolution of educational attainment by gender for the cohorts 1920–1978, mixing data on respondents and their parents. On this figure I omit the youngest cohorts, who may not yet have completed their education at the time of survey. (I choose the 1978 cohort, who is 30 years old at time of survey, as the endpoint.) Educational attainment increases for both genders across the cohorts under study. Starting around the 1970 cohort, women overtake men in tertiary education.

Marital assortment. Even though 72.5% of respondents declared having a partner, information on this partner was collected only when they lived in the same house (60.9% of respondents). Once again, I also use answers on the respondents' parents to draw a long-term picture of marital assortment in the sample, which I present in Figure 2. We can discern some time trends in educational homogamy. The proportion of couples with the same educational attainment is high overall. It decreases for the oldest cohorts, from

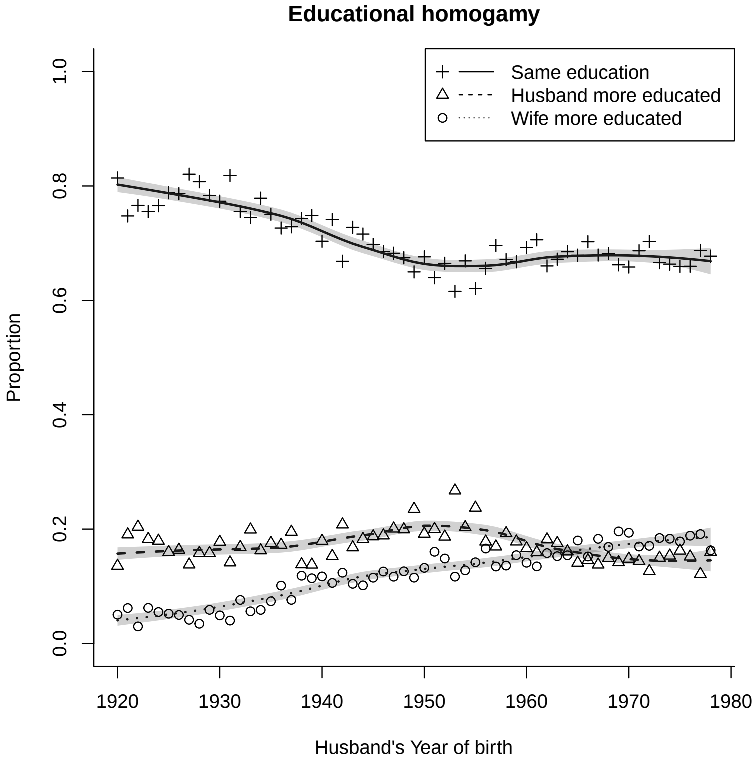

Figure 2: Educational homogamy.

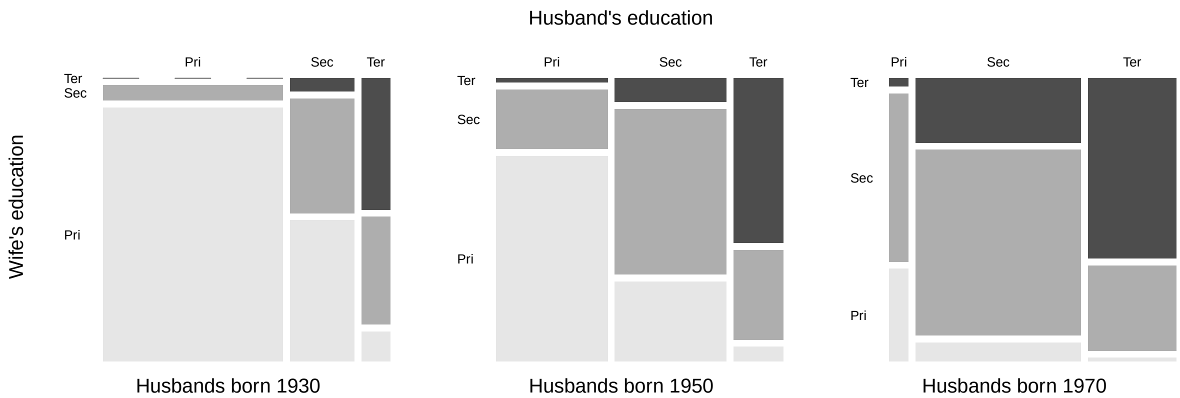

Figure 3: Educational assortment in couples with a husband born in 1930, 1950, and 1970.

80% in 1920 to around 65% in 1950. This might simply be a mechanical consequence of the increasing diversification of educational attainments for these cohorts (early cohorts mostly have a primary education only, so there couldn't be many mixed-education couples). After that, this proportion stagnates between 65% and 70%. The proportion of couples with a more educated husband increases slightly across the oldest cohorts, and then starts to decrease around the 1950 cohort to reach 15%. The proportion of couples with a more educated wife increases across all cohorts, from 5% to almost 20%, overtaking the proportion of couples with a more educated husband by the 1965 cohort.

Could these trends be driven by the simplification of the education variable into three categories? In Figure 17 (Appendix B) I construct the same graph using the detailed diploma categories (8 levels, from no diploma to university graduate). While the proportion of couples with the same educational attainment mechanically falls by considering more education levels, the trends discussed above mostly hold. In particular, the proportion of couples with a more educated wife clearly increases over the cohorts considered, overtaking the proportion of couples with a more educated husband.

Finally, in Figure 3 I report detailed educational assortment patterns for three different cohorts, defined as those couples with a husband born in 1930, 1950, or 1970. (Figure 18 in Appendix B does the same for wives born in 1930, 1950, or 1970.) In accordance with the trends discussed above, we observe that more men marry "up" among younger cohorts (the number of educated women has increased more than the number of educated men). As Figure 2 already suggested, by the 1970 cohort marriage patterns are almost symmetric for men and women: roughly as many women marry up as men do.

In Appendix E I also study homogamy using local log-odds ratios, following Siow (2015). Statistical tests of the TP2 criterion (local log-odds ratios are totally positivity of order 2) provide strong evidence of homogamy, both on the complete sample and conditional on the religious affiliations of the spouses.

2.2 Religion

In the survey, religious affiliation is recorded using 13 possible answers. To simplify the analysis, and because some answers are associated with few observations, I aggregate them into five broad categories: No religion (29% of respondents), Christian (39%), Muslim (27%), Jewish (1%), and Other religion (4%).

Religious affiliation. Figure 4 presents religious affiliation across cohorts in the sample by gender (including parents). For both genders, younger cohorts show a higher representation of Muslims and religious "Nones," and less Christians. Representation of Jews and other religious affiliations remains low and stable across cohorts. For most cohorts, there is a higher proportion of religious Nones among men, and conversely there is a higher proportion of Christians among women; other affiliations (Muslim, Jewish, Other religion) have roughly identical shares among men and women. It is worth noting that religious affiliation in the sample is especially not representative of the French religious mix (for instance, 27% of respondents identify as Muslim, even though usual estimates for the share of Muslims in France hover between 5% and 10% for 2008). This is of course a consequence of the TeO survey oversampling individuals with a family history of immigration. Figure 20 (Appendix B) reproduces the graphs of Figure 4 using the sampling weights provided by the survey, providing a better picture (but still imperfect) of the share of each religion in France.

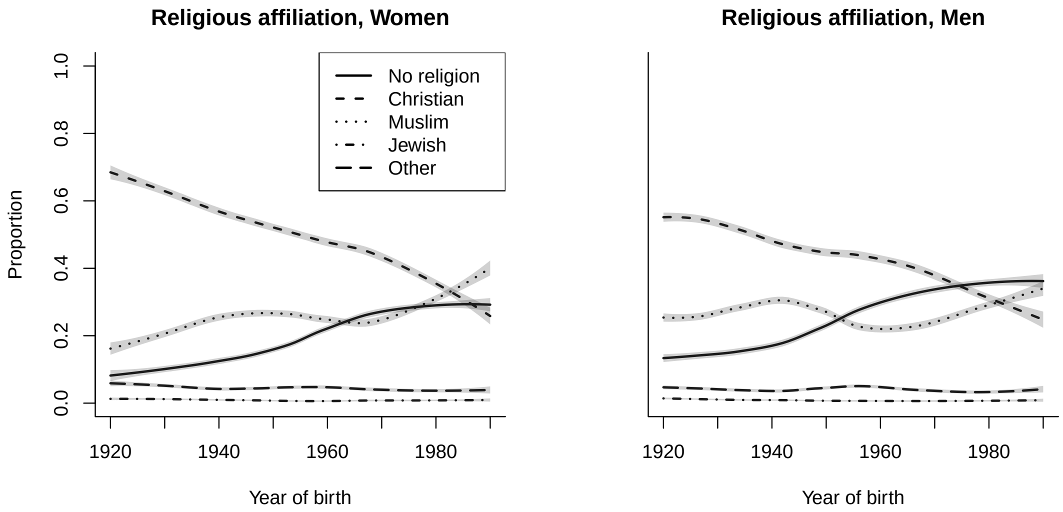

Figure 4: Religious affiliation, Women and Men.

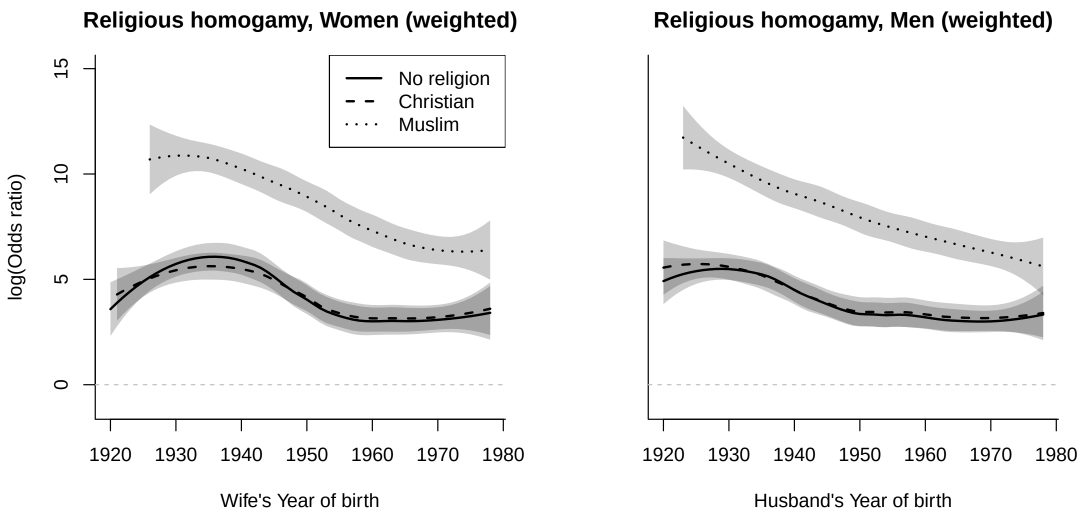

Figure 5: Religious homogamy (log-odds ratios), Women and Men.

Marital assortment. A common way to measure partner assortativity along one dimension (here, religious affiliation) is to compute the log-odds ratios:

$$\ln\left(\frac{n_{aa}\,n_{\bar{a}\bar{a}}}{n_{a\bar{a}}\,n_{\bar{a}a}}\right),$$

where n_{aa} is the number of individuals a with a partner a, $n_{a\bar{a}}$ that of individuals a with a partner non-a, and so on. Log-odds ratios should be equal to 0 when couples are formed randomly (then $\frac{n_{aa}}{n_{aa}+n_{a\bar{a}}} = \frac{n_{\bar{a}a}}{n_{\bar{a}a}+n_{\bar{a}\bar{a}}}$, which implies $n_{aa}\,n_{\bar{a}\bar{a}} = n_{a\bar{a}}\,n_{\bar{a}a}$), while positive log-odds ratios are evidence of homogamy (positive assortative matching), and negative log-odds ratios are evidence of heterogamy (negative assortative matching).

Figure 5 presents these log-odds ratios for any birth cohort of husbands and wives, taking into account sampling weights. All computed log-odds ratios are positive for the cohorts considered, providing evidence of religious homogamy in the sample. Assortativity is stronger among Muslims than among Christians or religious Nones, although it decreases across cohorts: younger Muslims are less prone to religious homogamy than older ones. Christians and religious Nones exhibit similar and stable rates of homogamy from the 1950 cohort onwards. (There is a decline of homogamy rates for these affiliations around 1950, but they could be due to selection issues of the parents' generation in the sample.) I have omitted the log-odds ratios for Jewish and Other religion, since these affiliations have few observations per cohort, resulting in noisy patterns. It is however worth noting that despite this noise, both these affiliations exhibit high average assortativity rates, which are closer to Muslims than to Christians or Nones. Figures 21 and 22 (Appendix B) show assortativity patterns for the three cohorts born in 1930, 1950, and 1970, and confirm the finding of strong homogamy in the sample.

Education by religious affiliation. Educational attainment is not distributed equally among religions, as shown in Figure 6. While religious Nones and Christians exhibit similar levels of educational attainment for the cohorts considered, Muslims have lower educational attainment throughout. Looking at the interaction between gender and religion, for the oldest cohorts (1920–1950) men are more educated across all religions. Around the 1950 cohort, this gender gap starts to close among Christians and Nones (a slight gender gap in favor of women even appears among Nones), while it persists until 1970 among Muslims. It is only for the very latest cohorts that a discernable gender gap appears in the favor of women for all three religious affiliations.

2.3 Marital assortment on education and religion

On education for given religion. Figure 7 presents patterns of educational assortment for same-religion couples. Nones and Christians exhibit similar patterns of high educational assortment: partners have the same education level in around 70% of couples, though this rate decreases slightly over the cohorts considered. Muslims show a greater proportion of couples for which the husband is more educated – but this can be expected as a mechanical consequence of the educational gap in favor of men in that population, as discussed above.

On religion for given education. Figure 8 again shows log-odds ratios, but this time draws a comparison between education levels to see how they might affect religious assortment. In the complete sample (first row of the graph), there appears to be a negative correlation between religious homogamy and educational attainment: religious homogamy is strongest among individuals with a "Primary or less" attainment, and weakest among individuals with a "Tertiary or more" attainment. This could however be due to a corre-

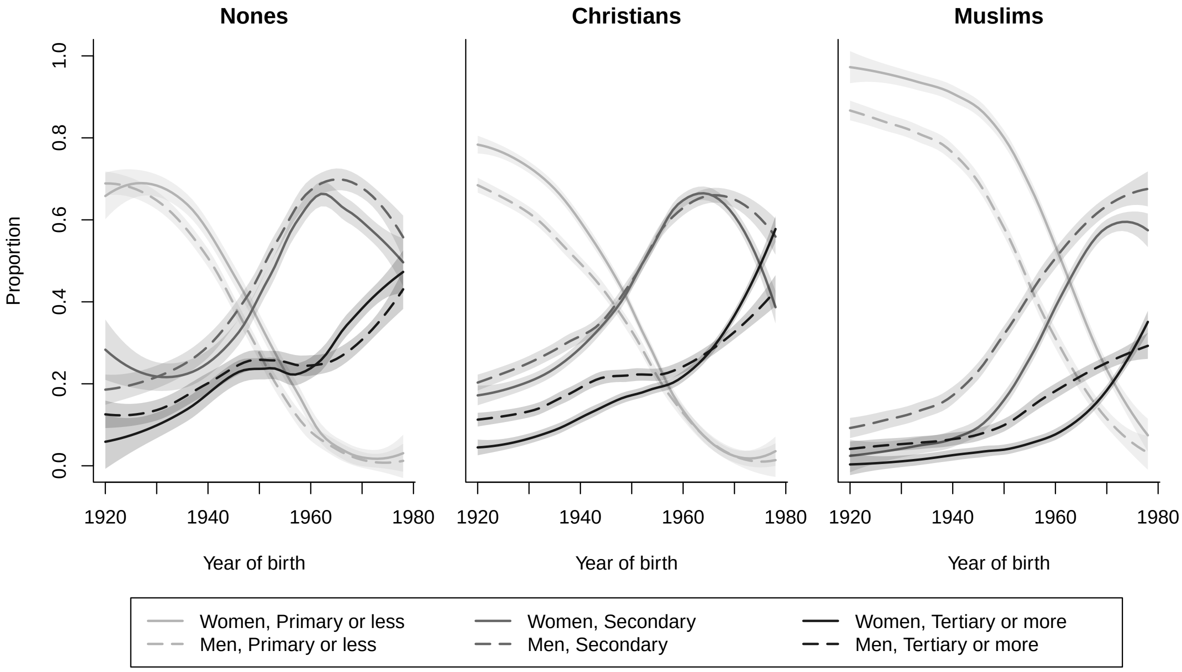

Figure 6: Education by religion and gender.

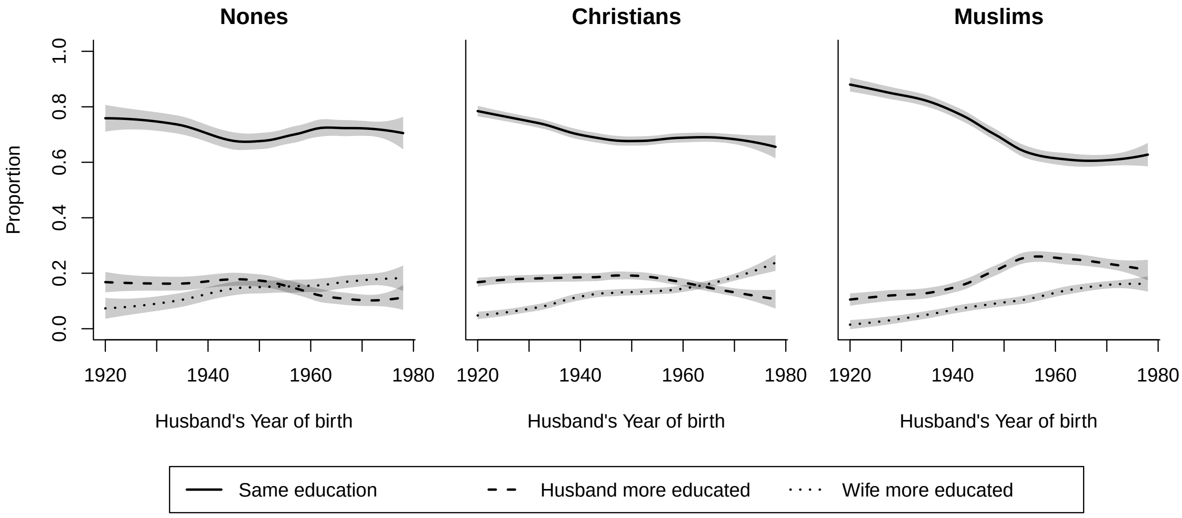

Figure 7: Educational homogamy, same-religion couples.

lation between religious affiliation and educational attainment (we have seen for instance that Muslims in the sample are simultaneously less educated and more homogamous on average). For this reason, we may want to look at how education and religious assortment interact within a given religious affiliation (rows 2 to 4 of the graph). It should be noted that the evidence becomes fragmentary when considering such interactions, because data becomes thinly spread across categories. Yet, the negative correlation between religious homogamy and educational attainment seems to hold within religious affiliations. Inter-

Table 1: Religious homogamy and education.

	Religious homogamy	
	(OLS)	(OLS)
Wife's education	-0.11^{***}	-0.07^{**}
	(0.01)	(0.01)
Husband's education	-0.10^{***}	-0.07^{***}
	(0.01)	(0.01)
Wife's × Husband's education	0.04^{***}	0.03^{***}
	(0.00)	(0.00)
Wife is...		
Christian		-0.30^{***}
		(0.01)
Muslim		0.16^{***}
		(0.02)
Jewish		0.15^{***}
		(0.04)
Other		-0.38^{***}
		(0.03)
Husband is...		
Christian		0.40^{***}
		(0.01)
Muslim		-0.06^{**}
		(0.02)
Jewish		-0.26^{***}
		(0.03)
Other		0.14^{***}
		(0.03)
Observations	31150	31150
Sampling weights	Yes	Yes
Adjusted R^2	0.01	0.17

Note: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Reference category for wife/husband religion fixed effects is "No religion."

estingly, this correlation seems least pronounced for religious Nones, and most pronounced for Muslims, with Christians in the middle.

Table 1 confirms this negative correlation between homogamy and education with a simple regression which uses sampling weights. Specifically, an increase in the wife's educational attainment (from Primary to Secondary, or from Secondary to Tertiary) is associated with a 3 p.p. decrease in the probability that she belongs to a homogamous couple, and an increase in the husband's educational attainment is associated with a 2 to 4 p.p. corresponding decrease (depending on the specification).

2.4 Transmission of education

Education of the parents. Unsurprisingly, the children of higher-educated parents have higher education themselves, as can be seen in Figure 9. This is confirmed in

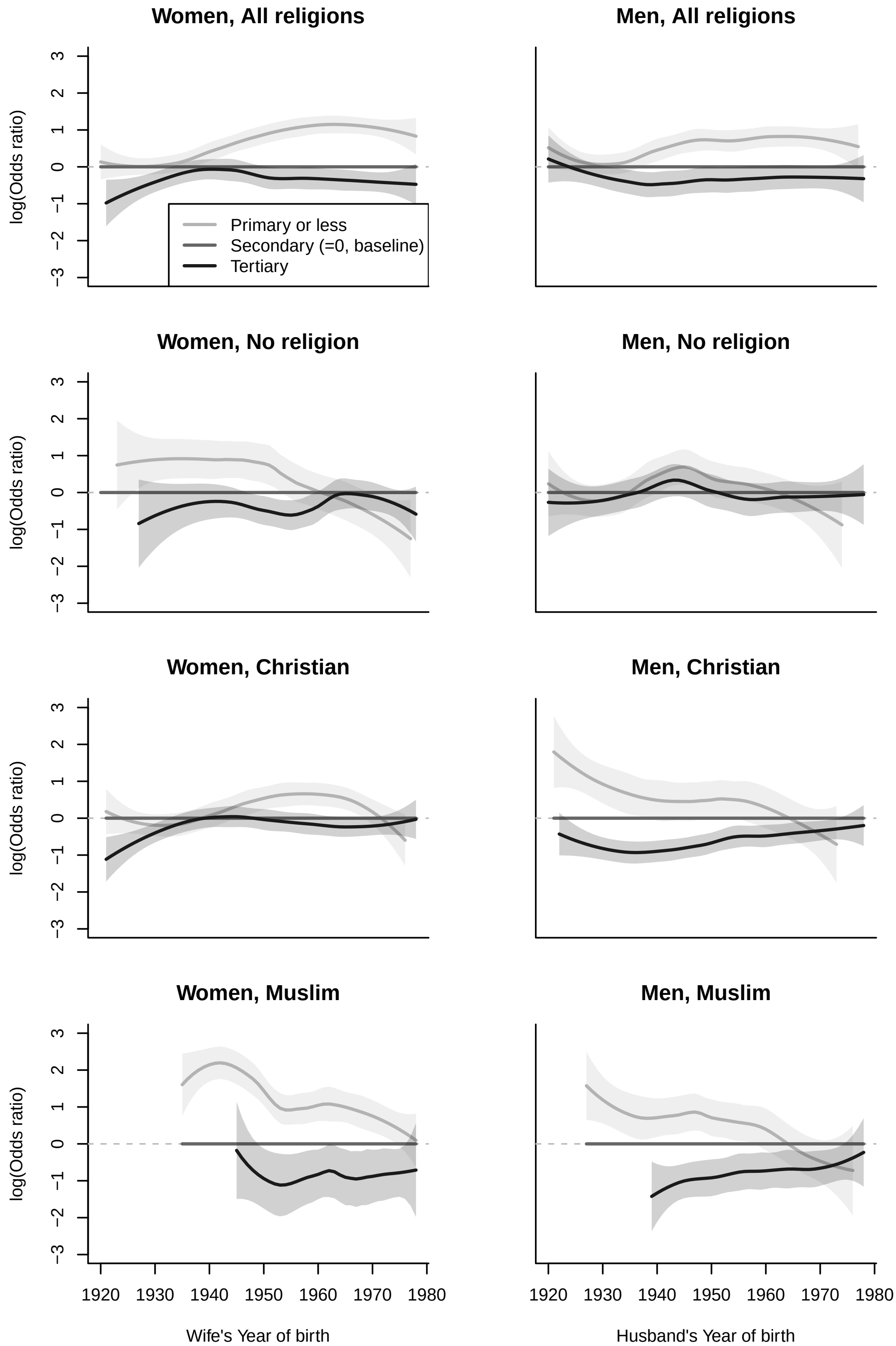

Figure 8: Religious homogamy of Women and Men, by Religion and Education. Here, log-odds ratios are computed relative to the reference category "Secondary." For instance, in the "Women, Christian" graph the "Primary or less" line is obtained by computing the odds of a Primary–Christian woman being partnered with a Christian man, relative to the odds of a Secondary–Christian woman being partnered with a Christian man.

Table 2 by an ordered logit regression with the child's education as the outcome, and the education of the parents as the explanatory variables (I control for the child's year of birth). Corresponding specifications using a linear model instead of an ordered logit model yield similar results (see Table 11 in Appendix B).

Religion of the parents. To see whether religion plays a role in the transmission of education, I add the religion of the parents as an explanatory variable in the previous ordered logit regressions of Table 2. The religious affiliations of the parents do seem to play a role in the transmission of education. Compared to the "No religion" baseline, Christian mothers and Jewish fathers are associated with higher-educated children. Note that these results might be dependent on religious homogamy patterns, for which a regression including interactions between mothers' and fathers' religious affiliations is needed. Once I include those interactions effects, the significant effects of the parents' religious affiliation mostly disappear, with the exception of the positive coefficient for Christian mothers (for lack of space because of the many interactions, I only report these results in Table 10, Appendix B). At this point, it is however impossible to say whether these potential differences in children's education across parental religious affiliations are driven by trade-offs between religious socialization and education, or (for instance) by different cultural preferences for children's education.

2.5 Transmission of religion

Homogamous vs. heterogamous couples. It is well-documented that parents in homogamous couples (i.e. couples in which both parents have the same religious affiliation) pass on their religion more reliably than parents in heterogamous couples (see e.g. Bisin and Verdier 2000, p. 960). This stylized fact remains true for the TeO data, as suggested by Figure 10. The *transmission rate*, defined as the probability that a child has the same religion as their parent, is more than 80% among homogamous couples, and it increases slightly across cohorts. This increase could simply be due to the change in the religious mix of the sample, with more Nones, more Muslims, and less Christians among younger cohorts (cf. Figure 4). But other explanations are possible: younger cohorts could transmit more accurately; or it could also be the result of individuals switching affiliation during their lifetime, so that older individuals would be less likely to still share their parents' affiliation. On the other hand, the transmission rate for mothers and fathers in heterogamous couples is around 40%, half that of homogamous couples.

Figures 25 and 26 (Appendix B) also describe religious transmission patterns across parental religious affiliations, this time aggregating all cohorts. They provide evidence for a homogamy advantage in religious transmission, except for the None affiliation.

By religion. Figure 11 presents transmission rates of mothers and fathers of the three main religious affiliations. Muslim transmission rates are higher overall, which might in

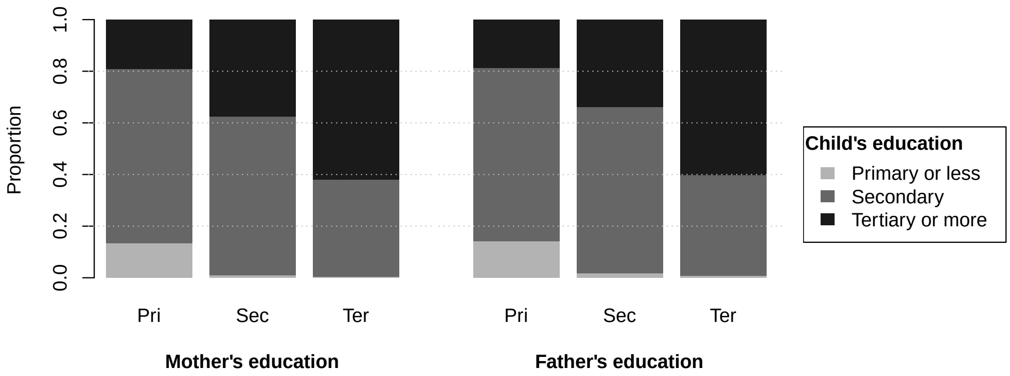

Figure 9: Transmission of education.

Table 2: Transmission of education (Ordered Logit).

	Child's education		
	(Ord. logit)	(Ord. logit)	(Ord. logit)
Mother's education			
Secondary	0.64*** (0.02)	1.04*** (0.03)	0.97*** (0.03)
Tertiary	1.00*** (0.03)	2.60*** (0.10)	2.57*** (0.10)
Father's education			
Secondary	0.63*** (0.02)	0.99*** (0.03)	0.96*** (0.03)
Tertiary	1.56*** (0.03)	1.74*** (0.05)	1.72*** (0.05)
Mother's × Father's education			
Secondary × Secondary		−0.76*** (0.04)	−0.68*** (0.04)
Secondary × Tertiary		−0.40*** (0.06)	−0.36*** (0.07)
Tertiary × Secondary		−2.03*** (0.11)	−2.10*** (0.11)
Tertiary × Tertiary		−1.76*** (0.12)	−1.75*** (0.12)
Mother's religion			
Christian			0.25*** (0.02)
Muslim			0.03 (0.28)
Jewish			−0.02 (0.16)
Other			0.63*** (0.16)
Father's religion			
Christian			0.28*** (0.02)
Muslim			−0.11 (0.28)
Jewish			1.23*** (0.16)
Other			−0.74*** (0.21)
Child's year of birth /100	0.30*** (0.06)	0.40*** (0.06)	1.07*** (0.07)
Cut-off: Primary → Secondary	3.56 (1.24)	5.58 (1.25)	19.03 (1.28)
Cut-off: Secondary → Tertiary	7.70 (1.24)	9.76 (1.25)	23.25 (1.28)
Observations	18793	18793	18222
Sampling weights	Yes	Yes	Yes
Deviance	27098	26947	25901

Note: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Reference category for mother/father education is "Primary."
Reference category for mother/father religion is "No religion."

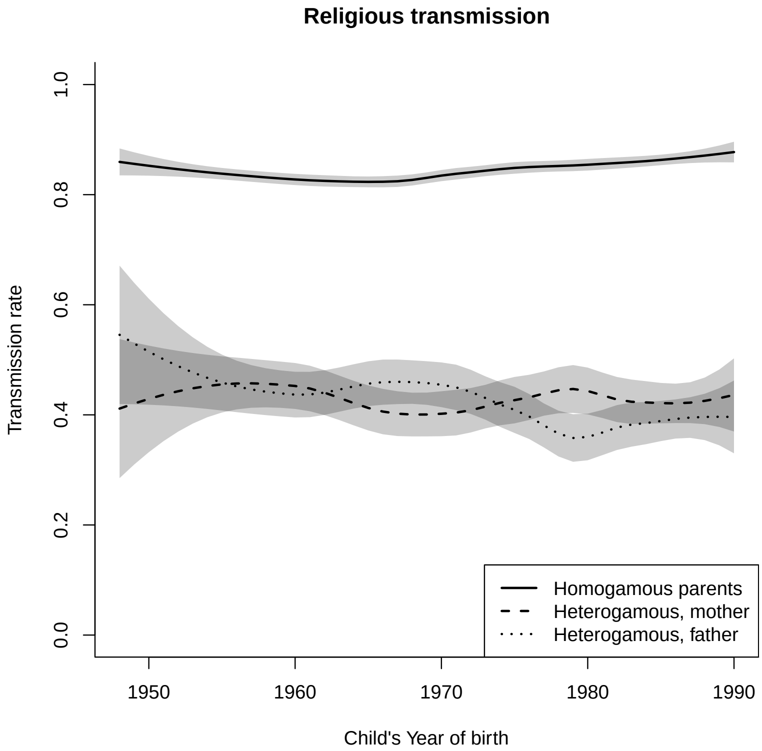

Figure 10: Religious transmission by parents in homogamous and heterogamous couples.

part be a consequence of stronger homogamy among Muslims. Yet, Muslim transmission rates are also increasing across recent cohorts, despite decreasing Muslim homogamy rates (cf. Figure 5). There are at least two possible explanations for this. First, since the population share of Muslims has increased over the period, it is possible that oblique socialization has become a better vector of religious transmission for Muslims. Second, and as already discussed above, older individuals may be more likely to have switched affiliation from the one they inherited from their parents. The transmission rates of None parents follow a similar pattern, and are subject to the same interpretations.

On the other hand, Christian transmission rates are decreasing, falling behind Muslim and None transmission rates starting from the 1960 cohort. Two explanations listed above might contribute to this decrease: the population share of Christians is decreasing (cf. Figure 4), which may worsen oblique socialization; and homogamy rates among Christians are decreasing for the parental cohorts.

There are also comparisons to draw between mothers' and fathers' transmission rates. First, Christian mothers have lower socialization success than Christian fathers. A possible explanation is the asymmetry in the religious distribution of men and women. Indeed, since there is an excess of Christian women compared to Christian men, more Christian women end up partnered in heterogamous couples (most often, with None men), thus hurting their transmission rate. Conversely, None mothers have higher socialization success than None fathers, for the opposite reason: there is an excess of None men compared

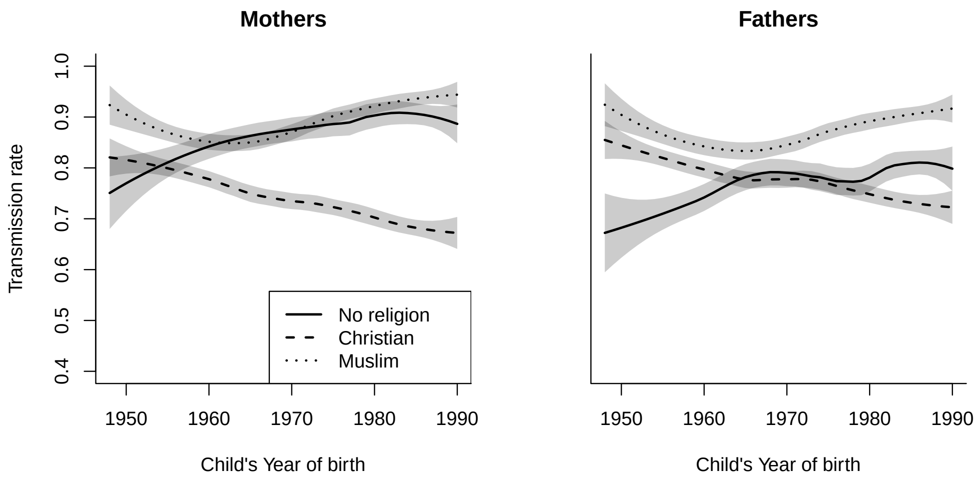

Figure 11: Religious transmission by Mothers and Fathers.

to None women. For Muslims, for whom there is less distributional gender asymmetry, there is no such stark difference between mothers' and fathers' transmission rates.

By education attainment. Does the education of the parents matter in the transmission of religious affiliation? Figure 12 shows the transmission rates of mothers and fathers by educational attainment for all religious affiliations combined, and then separately for Nones, Christians, and Muslims. Despite the noise (data becomes thinly spread across the four dimensions considered: gender, birth cohort, religion, and education), the pattern which seems to emerge is that parents with lower educational attainment have higher transmission rates. This is relatively clear when all religions are combined. When looking within specific affiliations, the educational gap in transmission rate seems to be most pronounced for Muslims, and least for Nones. This closely mirrors the pattern observed for homogamy rates and partner education (cf. Figure 8). For this reason, from Figure 12 it is unclear whether education affects transmission rates directly, or through its effect on religious homogamy. We can alleviate this concern by restricting attention to homogamous households only. In Figure 13 I present the transmission rates for mothers and fathers in homogamous households, excluding Nones. The pattern observed above persists: transmission rates are negatively correlated to parental education.

In order to clarify this I run a simple linear regression, whose results are reported in Table 3. Fathers' educational attainment is negatively correlated with the transmission rate (thus conforming to the pattern observed in Figure 12), consistent with the finding on homogamy: more educated fathers marry less homogamously, and thus can be expected to transmit religion less accurately. On the other hand, mothers' educational attainment is positively correlated with the transmission rate. This positive correlation might seem puzzling: more educated mothers marry less homogamously, and yet they transmit religion more accurately. Note also that education of the parents by itself has very little

Table 3: Religious transmission and education of the parents.

	Transmission rate, Mother			Transmission rate, Father		
	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)	(OLS)
Mother's education	0.014*	0.013*	0.021***	0.006	0.015*	0.022***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Father's education	−0.032***	−0.022***	−0.020***	−0.027***	−0.021***	−0.019***
	(0.006)	(0.005)	(0.006)	(0.006)	(0.005)	(0.005)
Child's year of birth /100			−0.130***			−0.109***
			(0.027)			(0.027)
Mo.'s × Fa.'s religion FE		X	X		X	X
Observations	18 343	18 115	18 115	18 175	18 115	18 115
Sampling weights	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.00	0.12	0.12	0.00	0.11	0.11

Note: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

explanatory power for the transmission rates, as measured by the adjusted R^2.

A first step to disentangle the effect of education from the effect of religious homogamy, is to control for the religious composition of the parents' couple. Yet, the correlations mentioned above persist even after adding these controls. According to the estimates from the last model specification (which also includes the child's year of birth as control), a father with a tertiary education is 4 p.p. less likely to pass on his religion, compared to a father with primary education; and a mother with a tertiary education is 4 p.p. more likely to pass on hers, compared to a mother with primary education.

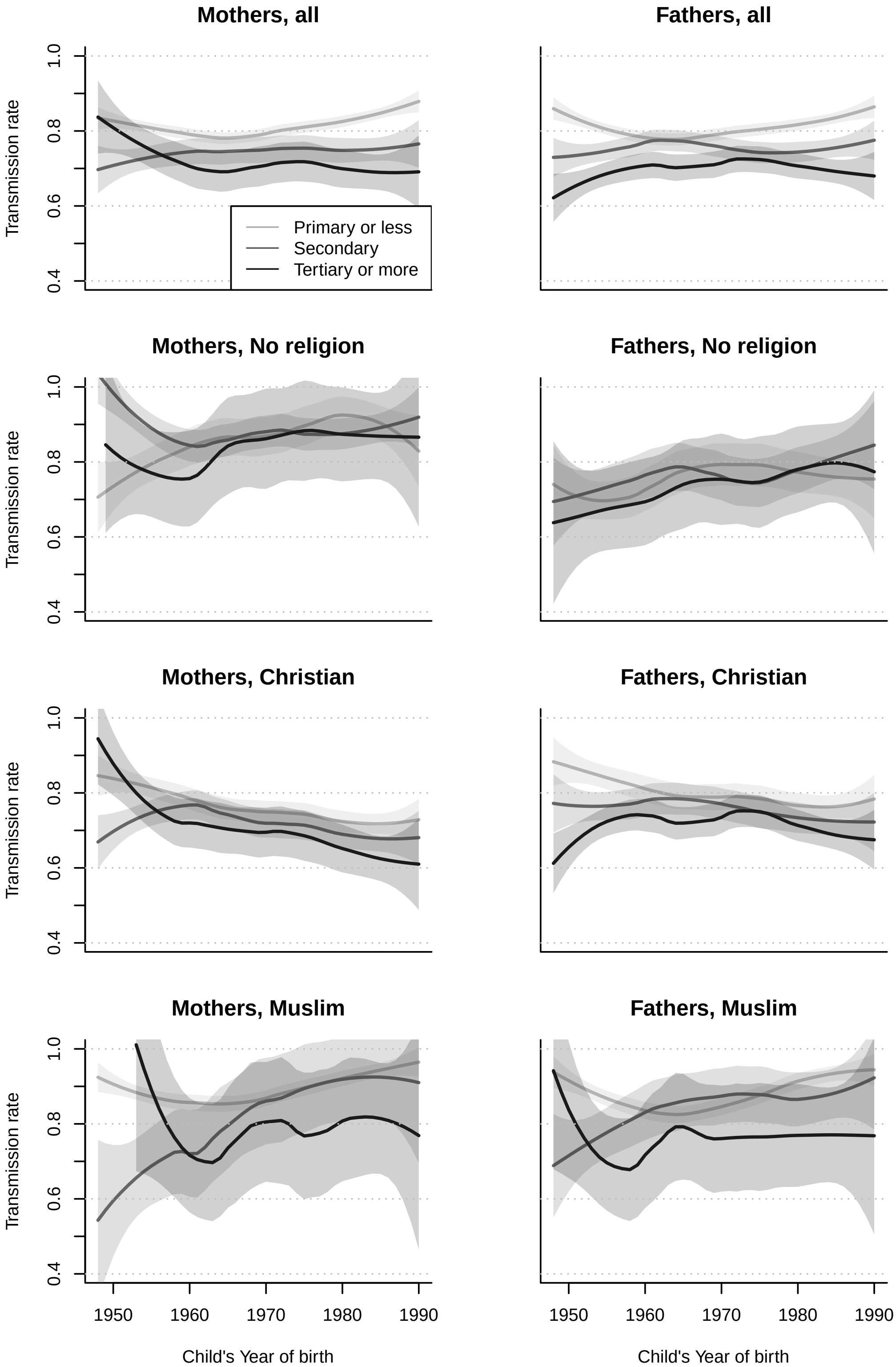

Figure 12: Religious transmission by Mothers and Fathers, by Education.

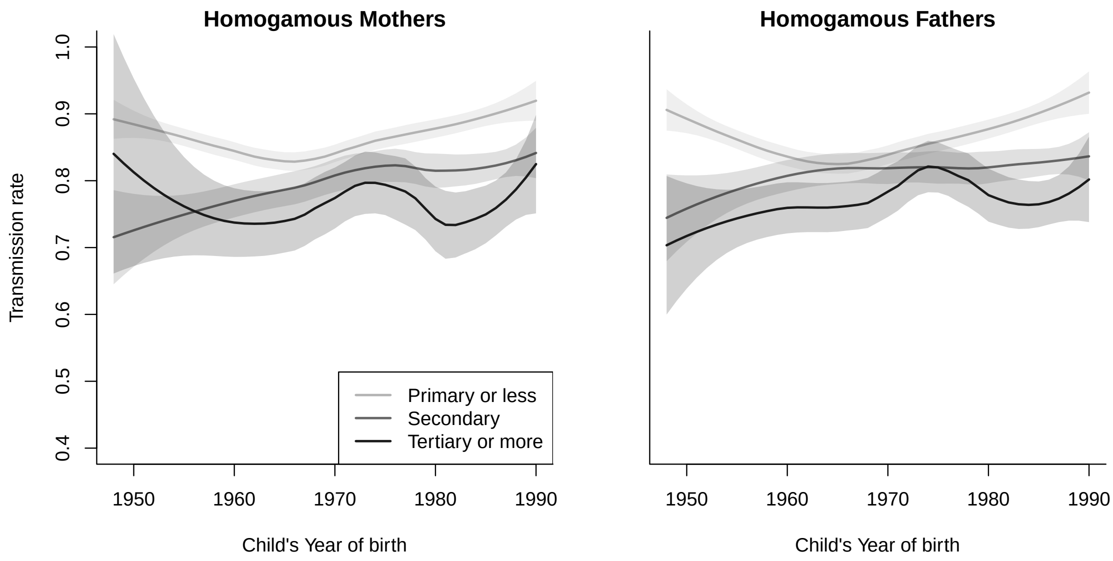

Figure 13: Religious transmission by homogamous Mothers and Fathers, by Education and excluding Nones.

3 A time allocation theory of cultural socialization

In order to analyse religious transmission in the TeO data, I develop in this section a theory of cultural socialization. This theory is grounded in the seminal work on cultural transmission by Bisin and Verdier (2000). In particular, I adopt the distinction between *vertical socialization*, done by the parents, versus *oblique socialization*, done by the rest of the population. Yet, it departs from it several ways, and in so doing bridges the gap with other strands of literature.

In their model Bisin and Verdier consider culture as a discrete, exclusive trait, which is transmitted probabilistically. Instead, I model the culture transmitted to children as multi-dimensional and with an intensive measure. This modelling choice proves important in order to disentangle different influences involved in the cultural socialization process. As I will show starting with section 4, this approach is also particularly convenient for the empirical analysis of cultural socialization.

To represent this intensive and multi-dimensional measure of culture, I introduce the notion of *cultural capital* for individuals. While this terminology has a long tradition in sociology (Bourdieu 1979), its adoption here is more directly inspired by the concept of an intensive religious capital developed in economics by Iannaccone (1990). This approach considers that culture is not simply a static affiliation, but a gradually-built identity in which individuals can invest. Here, I consider the role of the parents in building that cultural identity: this is the socialization process. In the case of religion for instance, the cultural capital then measures the intensity of the child's socialization to Christianity, Islam, Atheism...

Finally, I rely on results from the literature on human capital formation (Del Boca et al. 2016, Chiappori et al. 2017) and the theory of time allocation (Becker 1965) to model the production of children's cultural capital. Indeed, like Iannaccone (1990) in the case of religion, I think about cultural capital as a specific type of human capital, which has the particularity of not being valued uniformly across cultures. (I will come back to this when I discuss parents' preferences in section 5.) As such, I extend some existing results on the production of children's human capital to the production of their cultural capital. Doing so provides tractable solutions to the model while maintaining the intuitive results which would derive from a more agnostic approach.

3.1 Socialization in the household

Consider a household formed by two parents, indexed by $i \in \{1, 2\}$. For simplicity, I assume that each household has one child. Parent i possesses a single cultural trait n_i among N possible ones. In this model, parents domestically produce the child's cultural capital by spending time on cultural socialization.

To model the accumulation of the child's cultural capital, I use a result from the literature on human capital formation. Specifically, Del Boca et al. (2016) showed that time investments in the human capital of children are *intertemporal complements*. This is to say, In other words, time investments in human capital formation compound, just like savings do under a fixed interest rate. Interpreted in a continuous time setting, it means that a marginal time investment $\mathrm{d}s$ is demultiplied by the stock of cultural capital already produced. Following this logic, the law of accumulation of the cultural capital K is

$$\mathrm{d}K = K \times a\,\mathrm{d}s \tag{1}$$

where a is a positive parameter denoting the time productivity of the individual.[5] Integrating equation (1) and ignoring the constant for now, we find that the log-cultural capital is produced from the time investment s by a linear technology:

$$\ln K = a\,s. \tag{2}$$

Equation (2) thus describes the accumulation of cultural capital when one individual is involved in the child's socialization. In reality however, the cultural socialization of children involves several individuals, and most notably the parents. Here, I follow the literature on cultural transmission by assuming that the child is subject to *vertical* and *oblique* socialization (Bisin and Verdier 2000; 2011). Vertical socialization, on the one hand, results from "purposeful socialization decisions inside the family." In my time allocation framework, it is carried out in the form of (endogenous) parental time inputs

[5] This is equivalent to the way that an investment I grows with time under an interest rate r,

$$\mathrm{d}I = I \times r\,\mathrm{d}t.$$

s_i spent socializing the child. Oblique socialization, on the other hand, summarizes other socialization processes which happen outside of the family. To model oblique socialization, first I assume that the child has a fixed time attention span for being socialized, which I normalize to 1. (Hence I choose to ignore the extensive margin of socialization for now.) Deducting the time taken by the parents, this leaves time $1 - s_1 - s_2$ during which the child is subject to oblique socialization. Second, I assume that this remaining socialization time is spent randomly with the rest of the population. It means that if a culture has a population share q, the child spends time $(1 - s_1 - s_2)q$ being socialized to that culture. Thus, as in the standard Bisin and Verdier model, oblique socialization to a given culture is proportional to that culture's share in the population: more widespread cultures have a stronger influence. Taking these different socialization channels into account, the child's cultural capital is produced via the technology

$$\ln K = a_1\, s_1 + a_2\, s_2 + a_0\, (1 - s_1 - s_2)q \tag{3}$$

where a_1 and a_2 are the productivities of parents 1 and 2 respectively; and a_0 is the productivity of oblique socialization.

The socialization technology (3) still describes a unidimensional accumulation process. Culture, however, is multidimensional: the child receives socialization from all N cultural traits present in the population. This constitutes a N-dimensional vector $(K_n)_{1 \leq n \leq N}$, where each K_n corresponds to the child's cultural capital in a different trait. The component K_n is increasing in the parental investments in the child's socialization to trait n, and in the population share q_n of trait n. In the most general case, parents would be able to contribute to the child's socialization to any trait. Yet, to simplify the analysis, it is useful to consider that a parent can only socialize the child to their own trait. There are at least two reasons to justify this assumption. First, a parent is likely to want to transmit their own culture first and foremost, and therefore to use their available time to do so. Second, they might simply not have the capacity to transmit another culture if they are not affiliated or familiar with it themselves (e.g. ethnicity, but also language, religion). For this reason, here I will assume that the time s_i devoted by parent i is fully counted towards the socialization of the child to that parent's trait, n_i. Thus the child's cultural capital in the trait n is equal to

$$\ln K_n = a_1\, s_1\, \mathbf{1}_{\{n_1 = n\}} + a_2\, s_2\, \mathbf{1}_{\{n_2 = n\}} + a_0\, (1 - s_1 - s_2)\, q_n \tag{4}$$

where $\mathbf{1}_{\{n_i = n\}}$ is an indicator equal to 1 if and only if parent i has the trait n.

Examples. *For fixed parental inputs s_1, s_2, a child with homogamous parents of culture n will receive the cultural capital*

$$\ln K_n = a_1\, s_1 + a_2\, s_2 + a_0\, (1 - s_1 - s_2)\, q_n, \qquad \ln K_\ell = a_0\, (1 - s_1 - s_2)\, q_l \quad (\forall \ell \neq n),$$

while a child with heterogamous parents of cultures $n_1 \neq n_2$ will receive

$$\ln K_{n_1} = a_1\, s_1 + a_0\,(1 - s_1 - s_2)\, q_{n_1}, \qquad \ln K_{n_2} = a_2\, s_2 + a_0\,(1 - s_1 - s_2)\, q_{n_2},$$

$$\ln K_\ell = a_0\,(1 - s_1 - s_2)\, q_l \quad (\forall \ell \neq n_1, n_2).$$

The model is also readily extendable to single-parent families: for instance, a child with parent 1 only will receive

$$\ln K_{n_1} = a_1\, s_1 + a_0\,(1 - s_1)\, q_{n_1}, \qquad \ln K_\ell = a_0\,(1 - s_1)\, q_l \quad (\forall \ell \neq n_1).$$

In section 5 I will introduce the decision framework in which parents choose their time inputs s_i endogenously. Before that however, we can already imagine how the functional form (4) will impact the socialization decisions of the household. First, if the parental productivities a_1 and a_2 are different, one parent has a comparative advantage over the other in the child's socialization. This feature of the model opens up the possibility of productivity-driven specialization in the household, which is one possible way to explain disparities in transmission rates between mothers and fathers. Second, the model assumes that vertical socialization comes at the expense of oblique socialization. In consequence, parents who belong to a more widespread culture have lower returns on the time they spend socializing their children. This point relates to the *cultural substitution* property introduced by Bisin and Verdier (2001) – I will come back to this during the analysis.

3.2 Decreasing returns to socialization

Until now, and in order to keep the exposition simple, I have assumed that socializing individuals have a constant productivity of socialization, equal to a_1, a_2, or a_0. In fact, it may be more accurate to assume that the socialization time investments of the parents exhibit decreasing returns, in the sense that the marginal productivity of their time declines as they spend more time socializing the child. (See for instance Chiappori et al. 2017 for children's human capital formation). This could be due to the fact that parents eventually run out of new knowledge to transmit, or that children progressively lose attention when taught by a single teacher.

To account for this, I assume that individuals' socialization productivity decreases with the time s spent socializing the child. In order to keep the model tractable, I consider that productivity decreases linearly: after having spent time s on socialization, an individual has marginal productivity $a \times (1 - \gamma s)$. Under this assumption, a is the initial socialization productivity at $s = 0$, and γ is a positive parameter representing how quickly productivity declines. (Note also that for $s > 1/\gamma$, socialization is counter-productive.) The law of accumulation of cultural capital becomes

$$\mathrm{d}K = K \times a \times (1 - \gamma s)\, \mathrm{d}s. \tag{5}$$

By integrating this equation we obtain the total cultural capital output produced from a socialization time investment s,

$$\ln K = a\left(s - \frac{\gamma}{2}s^2\right).$$

Since they spend a significant amount of time with their children, it is reasonable to assume that parents are subject to this decline in socialization productivity. Oblique socialization, on the other hand, is by assumption carried out by many different individuals who each spend a marginal amount of time socializing the child. For this reason, the time devoted to oblique socialization still produces cultural capital at a constant rate and does not suffer from a decrease in productivity. To summarize, incorporating decreasing returns in socialization yields to the following production of cultural capital:

$$\ln K_n = a_1\left(s_1 - \frac{\gamma_1}{2}s_1^2\right)\mathbf{1}_{\{n_1=n\}} + a_2\left(s_2 - \frac{\gamma_2}{2}s_2^2\right)\mathbf{1}_{\{n_2=n\}} + a_0\left(1 - s_1 - s_2\right)q_n. \tag{6}$$

This is the functional form that I will use in section 5 for the household decision framework, and in section 6 for the structural econometric model.

4 Reduced-form analysis

In this section, I use the theory of cultural socialization developed in section 3 to analyze the intergenerational transmission of religious affiliation in the TeO data. The goal is to understand in reduced form the importance of the different socialization channels in the intergenerational religious transmission. Following the theory above, I am mainly interested in disentangling vertical socialization and oblique socialization, as well as the respective roles of mothers and fathers in vertical socialization.

I use a multinomial logit model to investigate the role of parental religious affiliations and religions' population shares in the formation of the child's religious affiliation. To obtain the baseline econometric specification, I consider that parental contributions to the child's religious capital depend on only two factors: the parent's gender and their religious affiliation. Oblique socialization is assumed to be proportional to the population share. In addition, in this specification I ignore the adverse role of vertical socialization on oblique socialization. Finally, I interpret the religious capital of individuals as a latent variable which predicts their reported religious affiliation, using leading to a standard multinomial logit model.

This section is organized as follows. In section 4.1 I establish the link between the theory of section 3 and the data; in particular, I embed the theory in a discrete-choice framework to reconcile the model's multi-dimensional measure of culture with the single religious affiliation which is available in the data. In section 4.2 I introduce the baseline econometric specification associated with the theory (a multinomial logit model), and estimate it. The results suggest that vertical socialization plays a more important role than oblique socialization in the transmission process, and that within vertical socialization, mothers contribute more than fathers. Furthermore, religious minorities contribute more than religious majorities. Overall, I find that this reduced-form model is quite efficient at predicting religious transmission patterns, confirming that the religion of the parents is a very powerful predictor of the religion of the child. Finally, in section 4.3 I study the role of parental education in the transmission process. Results suggest that effects are heterogeneous across religious affiliations, but the general trend indicates that parental contributions to religious socialization rather decrease with their education level.

4.1 From multi-dimensional culture to single-affiliation reporting

In the theory of section 3, individuals have a complex cultural identity which is represented by a multi-dimensional cultural capital. Empirically however, this multi-dimensional approach of culture can prove problematic. Indeed, in order to take this theoretical framework directly to data, the researcher should ideally have an intensive measure of culture along multiple dimensions (e.g. the level of proficiency in several languages). Yet, in most cases, surveys do not report this kind of multi-dimensional, intensive measure of the respondents' culture(s). Rather, survey respondents are often categorized into a single, exclusive affiliation (e.g. religion, ethnicity). This is notably the case for the respondents' religious affiliation in the TeO data.

For this reason, we need to map the multi-dimensional, intensive measure of culture from the theory, into an extensive, discrete cultural affiliation as reported in the data. Fortunately, this problem is not new: it is the object of discrete choice theory (McFadden 1973). Indeed, the reporting of a single cultural affiliation can be understood as a choice between coexisting cultural identities. Following the discrete choice logic, individuals are then more likely to report a cultural affiliation in which they have a higher cultural capital. Thus, the theory above can be used with reported affiliation data; moreover, we will see how it naturally fits into a standard multi-logit framework.

Consider a sample of individuals indexed by i, and suppose that we have the relevant individual observations to construct a measure of K_{in}, the cultural capital of i in the trait n. To apply the theory of section 3, such relevant observations should at least include the parents' cultural affiliations, as well as some measure of the cultures' population shares. As is standard in discrete choice models, assume now that individual i ultimately chooses to report the cultural affiliation for which he has the most cultural capital:

$$\arg\max_n \; K_{in} \times \xi_{in}, \tag{7}$$

where ξ_{in} is unobserved and random. If the ξ_{in} are i.i.d. Fréchet (that is, if their logarithms $\ln(\xi_{in})$ are i.i.d. Gumbel), then the probability that i chooses affiliation n is

$$\pi_{in} = \frac{K_{in}}{\sum_{\ell=1}^{N} K_{i\ell}} = \frac{\exp(\ln K_{in})}{\sum_{\ell=1}^{N} \exp(\ln K_{i\ell})}, \tag{8}$$

where the second expression makes the link with the multi-logit model explicit by using the standard softmax function (generalization of the logistic function to multiple dimensions). Hence, the log-cultural capital $\ln(K_{in})$ plays a role equivalent to mean utility in the usual discrete choice with random utility framework. Furthermore, adapting the expression from equation (6) to include individual heterogeneity, we have

$$\ln K_{in} = a_1 \left(s_{1i} - \frac{\gamma_1}{2} s_{1i}^2 \right) \mathbf{1}_{\{n_1 = n\}} + a_2 \left(s_{2i} - \frac{\gamma_2}{2} s_{2i}^2 \right) \mathbf{1}_{\{n_2 = n\}} + a_0 \left(1 - s_{1i} - s_{2i}\right) q_{in}. \tag{9}$$

where s_{1i} and s_{2i} correspond to the socialization time inputs of i's parents; and n_{1i} and n_{2i} correspond to their cultural affiliations. Note that population shares q_{in} are individual-specific: this accounts for the fact that individuals are socialized in different cultural environments (e.g. depending on when and where they grow up).

The expression (9) is linear in individual characteristics, which conveniently places it in the scope of multi-logit regression. In the rest of this section, I use this method to investigate religious transmission in the TeO data.

4.2 Multi-logit model

I use expression (9) as a basis to define a linear econometric specification of the log-cultural capital $\ln(K_{in})$ as a function of the observables. As mentioned above, the critical information to quantify vertical socialization is the cultural affiliation of the parents. This is the interest of studying religion with the TeO data: respondents reported not only their own religious affiliation, but also those of their parents.

Regarding oblique socialization, the theoretical framework suggests to use religions' population shares. Ideally, one could exploit individual variation in two dimensions to explain differences in oblique socialization. First, the individual's geographical location: the religious mix varies locally, leading to different patterns of oblique socialization. Second, the individual's date of birth: the religious environment also evolved with time. Unfortunately, religions' population shares in France are not comprehensively available at the local level, nor across time. On locality, the available data is insufficient to obtain credible measures: this would require a dense, large-scale collection of individual religious affiliation in France (which is prohibited by law) or, for instance, a comprehensive survey of places of worship of all religions across the country. On time variation however, the TeO data is dense enough to build a credible measure of religious shares in the country across the period of interest. In Appendix C.1 I explain how I reconstruct a time series of religions' population shares in France. These reconstructed population shares, from 1948 to 1990, are presented in Figure 14.

Another useful information to analyse expression (9) would be a measure of parental time use on religious socialization. There is however no such measure in the TeO data. In its absence, we can however rely on parental characteristics to explain differences in the parental contributions to the individuals' socialization. This is the method that I adopt here.

Econometric model. To begin with, I assume that parental socialization time investments depend only on the parent's gender and religious affiliation. Thus, mothers n (resp. fathers n) provide a fixed contribution m_n (resp. f_n) towards the socialization of their child to their own affiliation. These fixed contributions encapsulate both the religion-specific socialization time investment as well as its productivity.[6] Next, oblique socialization contributes towards each religious trait in proportion to its population share. For individual i, I use the population shares q_{in} corresponding to the year i turned 18 years old. Compared to expression (9), I also ignore the adverse effect of vertical socialization on oblique socialization. In this way I focus on measuring the importance of three socialization chan-

[6]If we denote by s_{1n} and s_{2n} the socialization time investments of mothers n and fathers n respectively, then m_n and f_n are defined as

$$m_n = a_1 \left(s_{1n} - \frac{\gamma_1}{2} (s_{1n})^2 \right), \qquad f_n = a_2 \left(s_{2n} - \frac{\gamma_2}{2} (s_{2n})^2 \right).$$

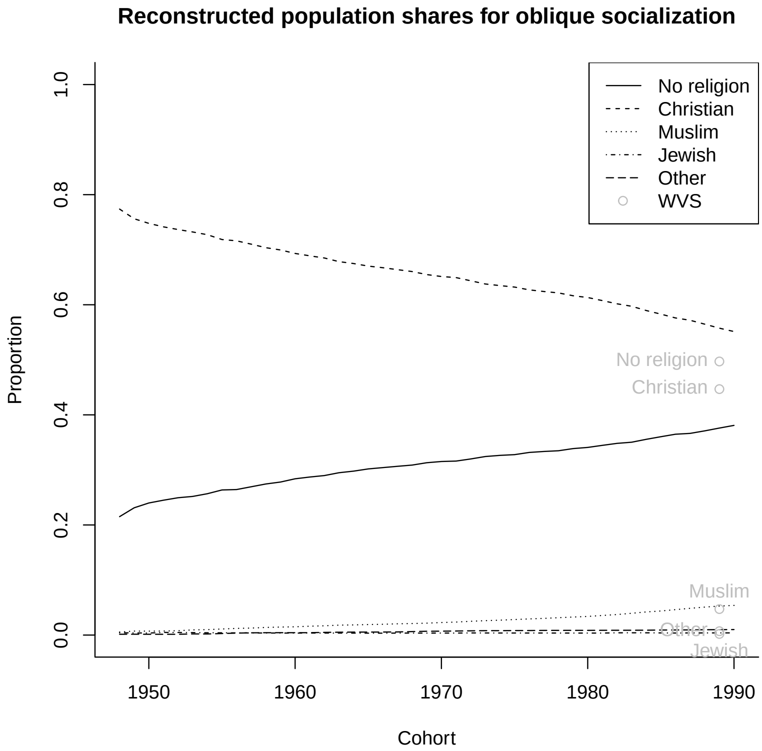

Figure 14: Religions' population shares, reconstructed from the TeO survey. Comparison points are taken from the World Values Survey (5th wave, 2005–2009).

nels: vertical socialization from mothers, vertical socialization from fathers, and oblique socialization. To summarize, I use the following econometric specification:

$$\ln K_{in} = k_n + m_n\,\mathbf{1}_{\{i\text{'s mother is } n\}} + f_n\,\mathbf{1}_{\{i\text{'s father is } n\}} + \alpha\, q_{in}. \tag{10}$$

In this expression, the parameters to estimate are k_n, m_n, f_n (for each religion n), and α. I have already mentioned that m_n and f_n correspond to the socialization contributions by mothers n and fathers n respectively. In addition, α measures the importance of oblique socialization. Finally, the constant k_n captures religion-specific effects in the socialization process. In an abstract way, k_n measures the probability of an individual reporting the religious affiliation n in the hypothetical scenario in which she would not have received any socialization, vertical nor oblique. In practice, a higher k_n may reflect that the religious affiliation n demands little in terms of knowledge of its affiliates; or that it makes particular efforts to gain new affiliates (above and beyond the role played by its population share). For this reason, we can expect the "No religion" affiliation to have a high k_n, because by definition it requires little if any active teaching. On the other hand, we can expect the Jewish affiliation to have a low k_n, because it is mostly passed on vertically from the mother. In the model, the constant k_n could also be understood as a systematic difference in the initial level of religious capital.

If we gather all these parameters in a vector $\boldsymbol{\beta}$ and define vectors of individual characteristics $\mathbf{z}_{in}$ appropriately, then we can rewrite $\ln(K_{in})$ concisely as

$$\ln K_{in} = \mathbf{z}_{in} \cdot \boldsymbol{\beta}.$$

Thus equations (8) and (10) together define a conditional logit model (McFadden 1973, Greene 2008). The conditional logit structure means in particular that all the parameters m_n and f_n are identified, unlike in the more standard multinomial logit where they are only determined up to a constant. This is because the model (10) is imposing restrictions compared to a standard multinomial logit model. Specifically, in a multinomial logit the variable $\mathbf{1}_{\{i\text{'s mother is } n\}}$ would be allowed to have an effect on any latent variable $\ln(K_{i\ell})$; here this effect is assumed to be zero if $\ell \neq n$. The same can be said for the variables $\mathbf{1}_{\{i\text{'s father is } n\}}$ and q_{in}, which have no effect on $\ln(K_{i\ell})$ if $\ell \neq n$. On the other hand, the parameters k_n are identified only up to an additive constant.

Testable restrictions. The model imposes restrictions on the transmission probabilities. These restrictions ultimately come from the independence of irrelevant alternatives assumption inherent to the conditional logit model,

$$\ln\left(\frac{\pi_{in}}{\pi_{i\ell}}\right) = (\mathbf{z}_{in} - \mathbf{z}_{i\ell}) \cdot \boldsymbol{\beta} \qquad (\forall n, \ell). \tag{11}$$

In my framework, this is simply

$$\begin{aligned}(\mathbf{z}_{in} - \mathbf{z}_{i\ell}) \cdot \boldsymbol{\beta} &= \ln K_{in} - \ln K_{i\ell} \\ &= k_n + m_n \mathbf{1}_{\{i\text{'s mother is } n\}} + f_n \mathbf{1}_{\{i\text{'s father is } n\}} + \alpha\, q_{in} \\ &\quad - K_\ell - m_k \mathbf{1}_{\{i\text{'s mother is } \ell\}} - f_k \mathbf{1}_{\{i\text{'s father is } \ell\}} - \alpha\, q_{i\ell}.\end{aligned}$$

Call $\pi_{in\,|\,yab}$ the probability that an individual i acquires trait n conditional on belonging to the cohort y, and having a mother a and a father b. We can use the last expression to show (see Appendix C) that (11) implies

$$\ln\left(\frac{\pi_{ia\,|\,yaa}}{\pi_{ib\,|\,yaa}}\right) - \ln\left(\frac{\pi_{ia\,|\,yab}}{\pi_{ib\,|\,yab}}\right) - \ln\left(\frac{\pi_{ia\,|\,\tilde{y}ba}}{\pi_{ib\,|\,\tilde{y}ba}}\right) + \ln\left(\frac{\pi_{ia\,|\,\tilde{y}bb}}{\pi_{ib\,|\,\tilde{y}bb}}\right) = 0. \tag{12}$$

The issue with formally testing this equality however, is that many of these cells (individuals born in year y with a mother a and a father b) have very few observations, or even none. For this reason, as an approximation I ignore the role of cohorts y and I test whether the equality

$$\ln\left(\frac{\pi_{ia\,|\,aa}}{\pi_{ib\,|\,aa}}\right) - \ln\left(\frac{\pi_{ia\,|\,ab}}{\pi_{ib\,|\,ab}}\right) - \ln\left(\frac{\pi_{ia\,|\,ba}}{\pi_{ib\,|\,ba}}\right) + \ln\left(\frac{\pi_{ia\,|\,bb}}{\pi_{ib\,|\,bb}}\right) = 0 \tag{13}$$

holds in the sample, where $\pi_{in\,|\,ab}$ is the probability that an individual i acquires trait n conditional on having a mother a and a father b (but no longer conditional on the birth cohort y). This simplification relies on the assumption that the population shares q_{in} are not moving drastically over the period considered (see Figure 14). In total there are $N^2 = 25$ such tests to perform. Those for which $a = b$ are trivially verified. Those for which $b > a$ have a symmetric equivalent with $a > b$. This leaves 10 tests to perform. Estimators for $\pi_{ia\,|\,bb}$ follow binomial distributions, and I use this to construct 95% confidence intervals by simulation. Out of these 10 tests, 5 tests cannot reject the null hypothesis that (13) holds (None–Christian, None–Jewish, Christian–Muslim, Christian–Other, and Muslim–Other); 2 tests reject the null hypothesis (None–Muslim and None–Other); and the 3 other tests cannot be computed because of lack of observations.

Estimation. We can now proceed with the estimation of the model defined by equations (8) and (10). Identification comes from the variation in the respondents' religious affiliation. The mother contributions to socialization m_n are identified through variation in the father's religion; the father contributions f_n are identified symmetrically; and the oblique socialization coefficient α is identified through cohort variation in population shares. As in a multinomial logit, the intercepts k_n are only identified up to a constant: I choose the most common affiliation, Christian, as the baseline category. This leaves a total of $3N - 1 + 1 = 15$ free parameters. I estimate $\boldsymbol{\beta}$ by maximum likelihood, using the log-likelihood expression

$$\begin{aligned} \ln L &= \sum_i w_i \sum_{n=1}^{N} \mathbf{1}_{\{i \text{ is } n\}} \times \ln \pi_{in} \\ &= \sum_i w_i \left[\left(\sum_{n=1}^{N} \mathbf{1}_{\{i \text{ is } n\}} \ln K_{in} \right) - \ln \left(\sum_{\ell=1}^{N} K_{i\ell} \right) \right], \end{aligned} \tag{14}$$

where the w_i are probabilistic sampling weights provided in the TeO survey. For the covariance matrix I compute the BHHH estimator (Berndt et al. 1974), from which I obtain the standard errors reported throughout this section.

Results are presented in Table 4, column 1. First consider the parental contributions m_n and f_n, measuring vertical socialization. These parental contributions are highest among minorities (Muslims and Jews, and to a lesser extent, Others), suggesting that the cultural substitution property proposed by Bisin and Verdier (2000) holds here. They are lower for Christians, and close to zero for Nones. Comparing mother and father contributions within a given affiliation, we see that Jewish mothers have significantly higher contributions than Jewish fathers: this is consistent with the fact that being Jewish is transmitted primarily through the mother. Mothers also contribute more than fathers among Nones and Others, although the difference is less striking. Finally, among Muslims and Christians, mothers and fathers contribute almost equally. Second, the magnitude of oblique socialization is comparable to but less than that of vertical socialization. The estimate for α implies, for instance, that a 50% population share induces an oblique socialization amount equivalent to half the contribution of a Christian mother, or a quarter of the contribution of a Jewish father. Third and last, the estimates for the intercepts s_n can be interpreted in the light of the specificities of each affiliation. The intercept for None is the highest, reflecting the fact that while actual religions need to be taught, being non-religious can simply result from the absence of any religious teaching. This makes the "no religion" trait special, as it can be acquired not only through active socialization (to secularism, atheism), but also through lack of socialization in other religions. For this reason, it makes sense that transmission is biased by default towards the "no religion" trait. In the French context specifically, this bias could also account for the socialization influence of schools, which are in majority secular. The intercept for Jewish, on the other hand, is significantly lower than the others, so that individuals are very unlikely to become Jewish unless they have a Jewish parent. This is consistent with the fact that Judaism is not a proselytic religion and is mostly transmitted from parents to children. The intercepts for Muslim and Other are not significantly different from the Christian reference category, which suggests that no strong structural difference exists in the way these religions are transmitted.

Model fit. The specification (10) can be compared to the null model defined by an intercept only, $\ln(K_{in}) = k_n$, which has deviance 51 268. With a LR test statistic of $51\,268 - 20\,948 = 30\,320$ on 11 degrees of freedom (which is significant at any conventional confidence level), the model (10) explains the data significantly better than the null model. The associated pseudo-R^2 is 0.46, also indicating a good model fit.

Using the estimated parameters, I then simulate transmission rates to see how well the model fits aggregate patterns in the data. Figure 15 presents observed vs. simulated transmission rates for the three main religious affiliations. Overall, simulated rates match observed rates quite closely. Transmission rates of Christians are slightly underpredicted, while those of Nones are slightly overpredicted. Furthermore, observed Muslim transmission rates have a slight U-shape that is not predicted by the model either.

Complementarities. The baseline model (10) rules out complementarities between the affiliations of the parents. I address this by adding interaction effects to the model,

$$\ln K_{in} = k_n + m_n \mathbf{1}_{\{i\text{'s mother is } n\}} + f_n \mathbf{1}_{\{i\text{'s father is } n\}} + b_n \mathbf{1}_{\{i\text{'s mother is } n\}} \times \mathbf{1}_{\{i\text{'s father is } n\}} + \alpha\, q_{in}, \quad (15)$$

so that b_n measures the additional effect of having both parents of religion n on the log-religious capital $\ln(K_{in})$.

Estimation results are presented in Table 4, column 2. Compared to the model without

Table 4: Conditional logit transmission, Estimates.

	Conditional logit estimates	
	(10)	(15)
Constant k_n		
None	2.86*** (0.08)	2.76*** (0.08)
Christian	0 (baseline)	0 (baseline)
Muslim	−1.32*** (0.08)	−1.58*** (0.09)
Jewish	−2.93*** (0.11)	−3.00*** (0.16)
Other	−0.66*** (0.08)	−0.79*** (0.09)
Mother's contribution m_n		
None	0.11 (0.08)	−0.61*** (0.13)
Christian	2.24*** (0.08)	1.92*** (0.10)
Muslim	3.80*** (0.21)	4.67*** (0.33)
Jewish	5.33*** (0.28)	5.17*** (0.32)
Other	3.90*** (0.13)	3.85*** (0.13)
Father's contribution f_n		
None	0.30*** (0.07)	0.05 (0.08)
Christian	1.30*** (0.07)	0.62*** (0.14)
Muslim	3.22*** (0.22)	3.66*** (0.32)
Jewish	3.45*** (0.43)	2.77* (1.31)
Other	0.78*** (0.18)	1.51 (1.06)
Interaction contribution b_n		
None		1.10*** (0.16)
Christian		0.90*** (0.16)
Muslim		−1.20* (0.47)
Jewish		0.93 (1.39)
Other		−0.68 (1.06)
Oblique socialization coefficient α	1.36*** (0.08)	1.37*** (0.08)
Observations	20 547	20 547
Sampling weights	Yes	Yes
Deviance ($-2\ln L$)	21 937	21 901
Pseudo-R^2	0.46	0.46
LR test p-value	baseline	0.000

Note: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

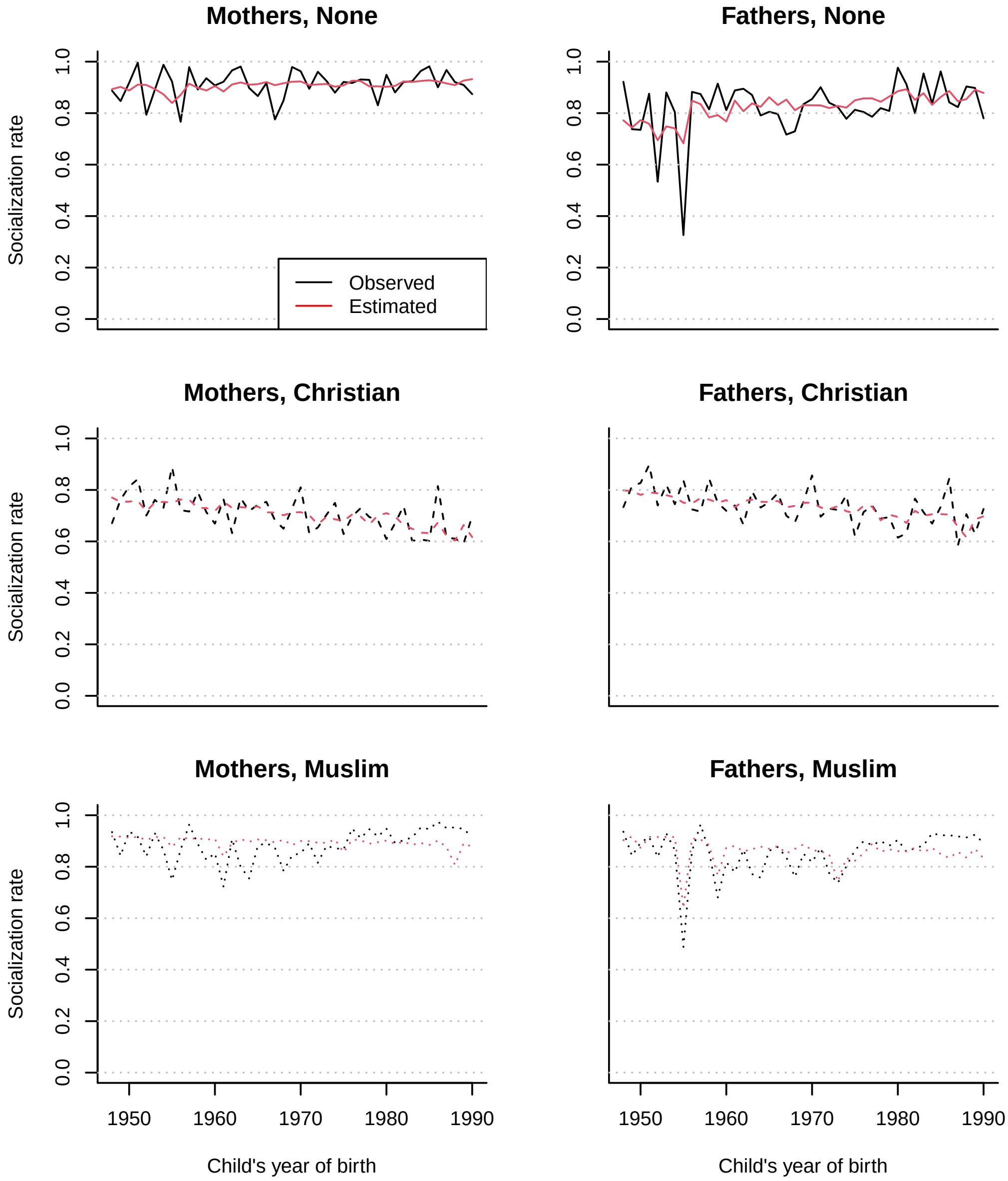

Figure 15: Conditional logit transmission, Observed vs. simulated transmission rates (by Religion).

interaction effects, the likelihood ratio test statistic is $21\,937 - 20901 = 36$ on 5 degrees of freedom, validating the inclusion of these interaction terms as relevant predictors. The interaction parameters are positive for Nones, Christians, and Jews; and negative for Muslims and Others. Yet, the most precise estimates are for Nones and Christians, pointing towards a complementarity between the parents' religious affiliations in their socialization contributions.

4.3 Religious socialization and parental education

[ESTIMATES OF SECTIONS 4.3 NOT YET UPDATED TO INCLUDE SAMPLING WEIGHTS]

In order to learn more about the potential effect of the parents' education levels on the transmission of religion, I extend the previous model by allowing socialization contributions to differ across education levels. Suppose that contributions to socialization now depend not only on the parent's religion n, but also on their education level $e \in \{1, \ldots, E\}$. Mothers' contributions are thus denoted m_{ne}, and fathers' f_{ne}, with ne the bidimensional trait {religion, education} of the parent. The religious capital of i in trait n is now predicted by the equation

$$\ln K_{in} = k_n + \sum_e (m_{ne}\mathbf{1}_{\{i\text{'s mother is } ne\}} + f_{ne}\mathbf{1}_{\{i\text{'s father is } ne\}}) + \alpha\, q_{in}. \tag{16}$$

The requirement of knowing the educational attainments of the parents leads to some sample attrition, with 18 155 observations against 20 547 previously. As a baseline, I re-estimate the specification (10) on this subsample (Table 5, column 1). The estimates do not vary significantly from those obtained when using the full sample.

Primary vs. Secondary vs. Tertiary. The estimation procedure for the model with education effects remains the same, except that we now have $2NE + 2$ parameters to estimate. To begin with, I consider the three education levels which I used in section 2: Primary or less, Secondary, and Tertiary or more. Results are presented in Table 5, column 2. The likelihood ratio test statistic is $18\,308 - 18\,271 = 37$ on 20 degrees of freedom, for a p-value of 0.011, providing evidence that the parents' education levels matter in predicting transmission rates. Regarding the estimates, there is no clear pattern for the relationship between education and socialization contributions. The estimated parameters remain qualitatively close to the ones estimated in the model without educational effects.

Primary vs. Secondary. I attempt to estimate the effect of education more precisely by reducing the number of educational categories to two: Primary or less ($e = 1$), and Secondary or more ($e = 2$). Results are presented in Table 5, column 3. The likelihood ratio test statistic is $18\,308 - 18\,288 = 20$ on 10 degrees of freedom, for a p-value of 0.031.

Table 5: Conditional logit transmission with education effects, Estimates.

			(1)	(2)	(3)	(4)
Parental socialization contributions						
Religion	Parent	Education				
None	Mother		0.41 (0.11)			
		Primary or less		0.31 (0.14)	0.32 (0.13)	
		Secondary (or more / or less)		0.42 (0.13)	0.45 (0.12)	0.37 (0.11)
		Tertiary or more		0.53 (0.19)		0.54 (0.19)
	Father		–0.31 (0.10)			
		Primary or less		–0.32 (0.11)	–0.33 (0.11)	
		Secondary (or more / or less)		–0.26 (0.12)	–0.30 (0.11)	–0.30 (0.10)
		Tertiary or more		–0.36 (0.14)		–0.34 (0.14)
Christian	Mother		1.98 (0.10)			
		Primary or less		2.06 (0.11)	2.06 (0.11)	
		Secondary (or more / or less)		2.00 (0.11)	1.97 (0.10)	2.01 (0.10)
		Tertiary or more		1.89 (0.12)		1.88 (0.12)
	Father		1.95 (0.09)			
		Primary or less		1.98 (0.10)	1.99 (0.10)	
		Secondary (or more / or less)		1.94 (0.10)	1.91 (0.10)	1.97 (0.10)
		Tertiary or more		1.86 (0.11)		1.84 (0.11)
Muslim	Mother		3.31 (0.12)			
		Primary or less		3.30 (0.13)	3.29 (0.13)	
		Secondary (or more / or less)		3.55 (0.16)	3.42 (0.15)	3.35 (0.12)
		Tertiary or more		2.84 (0.28)		2.85 (0.28)
	Father		3.30 (0.12)			
		Primary or less		3.24 (0.14)	3.26 (0.13)	
		Secondary (or more / or less)		3.39 (0.16)	3.37 (0.14)	3.26 (0.13)
		Tertiary or more		3.38 (0.21)		3.41 (0.20)
Jewish	Mother		4.16 (0.32)			
		Primary or less		3.53 (0.68)	3.40 (0.70)	
		Secondary (or more / or less)		4.49 (0.51)	4.48 (0.37)	4.12 (0.40)
		Tertiary or more		4.64 (0.65)		4.63 (0.66)
	Father		2.82 (0.38)			
		Primary or less		2.86 (0.72)	2.96 (0.73)	
		Secondary (or more / or less)		2.33 (0.73)	2.91 (0.46)	2.48 (0.50)
		Tertiary or more		3.65 (0.66)		3.66 (0.66)
Other	Mother		3.02 (0.16)			
		Primary or less		3.09 (0.18)	3.09 (0.17)	
		Secondary (or more / or less)		2.98 (0.20)	2.90 (0.18)	3.05 (0.16)
		Tertiary or more		2.54 (0.28)		2.55 (0.28)
	Father		2.04 (0.16)			
		Primary or less		2.08 (0.20)	2.09 (0.20)	
		Secondary (or more / or less)		2.01 (0.20)	1.99 (0.17)	2.06 (0.17)
		Tertiary or more		1.91 (0.22)		1.89 (0.22)
Secularization bias s_0			3.35 (0.07)	3.36 (0.08)	3.36 (0.08)	3.35 (0.07)
Oblique socialization coefficient α			2.50 (0.13)	2.44 (0.13)	2.43 (0.13)	2.47 (0.13)
Observations			18 155	18 155	18 155	18 155
Deviance ($-2\ln L$)			18 308	18 271	18 288	18 284
LR test p-value			baseline	0.011	0.031	0.008

Note: Standard errors in parentheses.

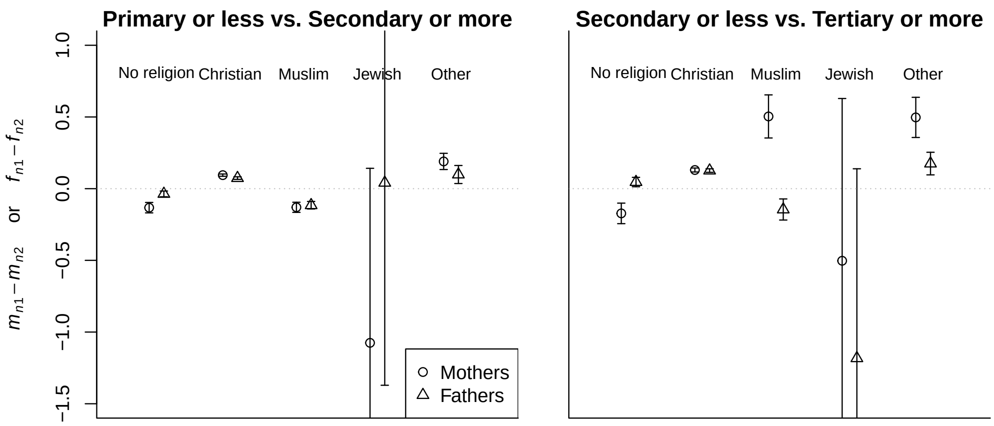

Figure 16: Differences in socialization contributions by education. 95% confidence intervals for $m_{n1} - m_{n2}$ and $f_{n1} - f_{n2}$ are reported for each religion n. Left panel: Primary or less ($e = 1$) vs. Secondary or more ($e = 2$). Right panel: Secondary or less ($e = 1$) vs. Tertiary or more ($e = 2$).

Once again, estimated contributions are qualitatively close to their level in the absence of education effects.

With only two education levels, it is also easier to verify whether human capital has a discernable effect on socialization contributions or not. To do so, I test the two hypotheses $m_{n1} = m_{n2}$ and $f_{n1} = f_{n2}$ for every religion n. I use the delta method to recover the distributions of $\hat{m}_{n1} - \hat{m}_{n2}$ and $\hat{f}_{n1} - \hat{f}_{n2}$. In short, these distributions are obtained from the asymptotic normality of the maximum likelihood estimator $\hat{\boldsymbol{\beta}}$ and from the fact that we can write

$$m_{n1} - m_{n2} = \Delta_n^m \boldsymbol{\beta}$$
$$f_{n1} - f_{n2} = \Delta_n^f \boldsymbol{\beta}$$

for every n, where Δ_n^m and Δ_n^f are row vectors of the form $(0, \ldots, 0, 1, -1, 0, \ldots, 0)$. In this way I obtain 95% confidence intervals for $m_{n1} - m_{n2}$ and $f_{n1} - f_{n2}$ (Figure 16, left panel). Differences between the socialization contributions of Primary or less parents and Secondary or more parents are statistically significant, except for Jewish parents. There is no clear direction for this effect however: half of the differences are positive (Christian and Other parents, and Jewish mothers), and half are negative (Nones and Muslim parents, and Jewish fathers).

It is difficult to say whether these differences across religions are structural, or if they are the result of a model misspecification. For instance, it might be the case that higher-educated Nones contribute more to the transmission of their affiliation than lower-educated ones, because they value secularism more. Or that higher-educated Christians contribute less because they value formal education more than religious socialization. But it might also be the case that the actual transmission pattern is not captured well enough by the model to accurately measure interaction effects between religion and education.

Secondary vs. Tertiary. Finally, I replicate this exercise with the following two education levels: Secondary or less, and Tertiary or more (Table 5, column 4). The likelihood ratio test statistic is $18\,308 - 18\,284 = 24$ on 10 degrees of freedom, for a p-value of 0.008. Again, I test whether education has a significant effect on socialization contributions (Figure 16, right panel). Differences are still statistically significant except for Jewish parents. In this specification, a majority of the differences are positive. In other words: the socialization contributions from lower-educated parents are higher than those from higher-educated parents in a majority of cases.

4.4 Alternative model for influence of education

Suppose instead that education has a uniform multiplicative effect on contributions across religious affiliations, so that

$$\begin{aligned} \ln K_{in} = k_n &+ (1 + \kappa_1 \mathbf{1}_{\{i\text{'s mother has } e \geq 2\}} + \kappa_2 \mathbf{1}_{\{i\text{'s mother has } e \geq 3\}}) \times m_n \mathbf{1}_{\{i\text{'s mother is } n\}} \\ &+ (1 + \rho_1 \mathbf{1}_{\{i\text{'s father has } e \geq 2\}} + \rho_2 \mathbf{1}_{\{i\text{'s father has } e \geq 3\}}) \times f_n \mathbf{1}_{\{i\text{'s father is } n\}} + \alpha\, q_{in}. \end{aligned} \tag{17}$$

This model is still linear in the observables, but it imposes more structure than the previous model from section 4.3. Indeed, here I impose $m_{n2} = (1 + \kappa_1) m_{n1}$ and $m_{n3} = (1 + \kappa_1 + \kappa_2) m_{n1}$ for all religions n, where the parameters κ_1 and κ_2 do not depend on n (and similarly for f_n with ρ_1 and ρ_2). The goal is to see the effects of education by measuring κ_1, κ_2, ρ_1, and ρ_2. If they were negative for instance, this would provide evidence of lower contributions in average for more-educated parents.

Results are presented in Table 6. In column 1 I re-estimate the baseline model on the subsample of individuals for whom the educational attainment of both parents is available. Results remain comparable to the estimation on the full sample. Next, I estimate the new model with multiplicative education effects. The estimates for κ_1, κ_2, ρ_1, and ρ_2 suggest that education has an opposite effect on contributions to socialization across genders: positive for mothers, and negative for fathers. For mothers, more education is associated with higher contributions: mothers with a Tertiary education or more have contributions which are 10% higher than mothers who have a Primary education or less. For fathers it is the opposite: a Tertiary education is associated with contributions which are 13% lower. The effect of having a Secondary education goes in the same direction (1% higher contributions for mothers, 2% lower for fathers), but it is not statistically significant. The LR test value is 10 on 4 degrees of freedom, yielding a p-value of 0.033, so despite the low significance of the added parameters, this model explains the data significantly better than the baseline model.

Table 6: Conditional logit transmission with education effects, Estimates.

	Conditional logit estimates	
	(10)	(17)
Constant k_n		
None	2.82*** (0.09)	2.87*** (0.09)
Christian	0 (baseline)	0 (baseline)
Muslim	−1.37*** (0.09)	−1.32*** (0.10)
Jewish	−2.72*** (0.12)	−2.70*** (0.12)
Other	−0.72*** (0.09)	−0.67*** (0.10)
Mother's contribution m_n		
None	0.07 (0.09)	0.14 (0.09)
Christian	2.26*** (0.09)	2.15*** (0.09)
Muslim	3.82*** (0.23)	3.75*** (0.23)
Jewish	5.79*** (0.32)	5.60*** (0.31)
Other	3.76*** (0.16)	3.70*** (0.16)
Father's contribution f_n		
None	0.39*** (0.07)	0.30*** (0.07)
Christian	1.24*** (0.07)	1.37*** (0.07)
Muslim	3.28*** (0.23)	3.38*** (0.24)
Jewish	3.04*** (0.48)	3.17*** (0.49)
Other	1.13*** (0.23)	1.20*** (0.23)
Multiplicative education effets		
Secondary or more mother κ_1		0.01 (0.01)
Tertiary or more mother κ_2		0.09*** (0.02)
Secondary or more father ρ_1		−0.02 (0.02)
Tertiary or more father ρ_2		−0.11*** (0.02)
Oblique socialization coefficient α	1.41*** (0.08)	1.48*** (0.09)
Observations	18 115	18 115
Sampling weights	Yes	Yes
Deviance ($-2\ln L$)	19 198	19 188
Pseudo-R^2	0.47	0.47
LR test p-value	baseline	0.033

Note: Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

5 A household model of cultural socialization

Section 4 documented several facts about religious transmission. One, there is heterogeneity in religious socialization across religions: for instance, Muslim and Jewish parents contribute more to the socialization of their children than Christians. Two, there is also heterogeneity between mothers and fathers, with mothers contributing more overall. Three, the education levels of the parents are relevant predictors of their contributions to religious socialization.

In an attempt to explain these facts, in this section I construct a model of intergenerational cultural socialization and human capital formation. In this model, parents care about passing on both human capital and cultural capital to their child. To do so, they can allocate their time between two activities: human capital production, and cultural socialization. The goal of the model is to describe a simple trade-off between these two activities. Crucially, the human capital of the parents is assumed to be productive in the human capital formation of the child, but not in cultural socialization. Thus by construction, parents with higher human capital have a comparative advantage in human capital formation, relative to cultural socialization. Because of this, an increase in the human capital of the parents will lead to a reallocation of time in favor of the child's human capital formation, and at the expense of her cultural socialization.

This mechanism also interacts with the main idea developed by Bisin and Verdier (2000) on cultural transmission: cultural minorities must make more effort to transmit their culture than majorities, because majorities can rely on the public provision of cultural socialization, or *oblique socialization*. In my framework this would happen at the expense of human capital formation, thus creating an imbalance between minorities and majorities: all else equal, minorities devote less time to their child's human capital formation than majorities.

In section 5.1 I describe the model, and in section 5.2 I provide a short analysis of the trade-offs involved.

5.1 Model description

The model builds around the theory of socialization developed in section 3. The unit of analysis is still a household of two parents $i \in \{1, 2\}$ with a child. In addition to the cultural trait n_i, parent i is also characterized by a human capital level h_i (continuous). Parents have a fixed time budget, which they must allocate between the production of the child's human capital and cultural capital.

The child's cultural capital is produced from the parents' socialization time inputs s_i according to the technology (6), which I recall here for convenience:

$$\ln K_n = a_1 \left(s_1 - \frac{\gamma_1}{2} s_1^2\right) \mathbf{1}_{\{n_1=n\}} + a_2 \left(s_2 - \frac{\gamma_2}{2} s_2^2\right) \mathbf{1}_{\{n_2=n\}} + a_0 \left(1 - s_1 - s_2\right) q_n. \tag{18}$$

I assume that the child's human capital is produced with a fundamentally similar technology from time inputs t_i of the parents. Unlike for cultural socialization however, I assume that the parental human capital h_i increases the productivity of parent i during human capital production.[7] These two assumptions are consistent with existing models of children's human capital formation (Del Boca et al. 2016, Chiappori et al. 2017). Thus the child's human capital is produced from parental inputs and characteristics according to

$$\ln H = (b_1 + h_1)\left(t_1 - \frac{\gamma_1}{2}t_1^2\right) + (b_2 + h_2)\left(t_2 - \frac{\gamma_2}{2}t_2^2\right). \tag{19}$$

As for a_1 and a_2 in the case of cultural capital production, the constants b_1 and b_2 denote the baseline productivities of parent 1 and 2 respectively. (One could also add a source of "oblique" production of human capital, without consequence on the model's insights.)

Parents care about their child's human capital and cultural capital. To simplify, I assume that parent i values only the cultural capital of the child in their own trait, n_i. Based on this assumption, I consider a Cobb–Douglas utility for parent i of the form:

$$u_i = \nu_i \ln(K_{n_i}) + \ln H.$$

Here ν_i represents the value of the child's cultural capital (relative to her human capital) for parent i.

I use a collective household model (Chiappori 1992) to represent the parents' decision-making, so that parental decisions lead to an outcome on the Pareto frontier of the household. In other words, the intrahousehold decisions must maximize a weighted sum of the parents' utilities:

$$\max_{t_i, s_i} \left\{\mu\, u_1 + u_2 = \mu\, \nu_1 \ln K_{n_1} + \nu_2 \ln K_{n_2} + (\mu + 1) \ln H\right\}, \tag{20}$$

where μ is the relative power (Pareto weight) of parent 1, fixed exogenously. The constraints concern the time available to the parents: I assume a fixed time budget T_i for each parent, so that the household constraints are

$$t_i + s_i \leq T_i, \qquad i = 1, 2. \tag{21}$$

These constraints must be saturated at the optimal time allocation as long as γ is small enough compared to T_i.

Discussion. This framework shares similar features with existing models of cultural transmission and human capital formation. The seminal model of cultural transmission was proposed by Bisin and Verdier (2000), in which parents also care about passing on their culture to their children, and can contribute to their child's cultural socialization to

[7]Results would still hold if, instead of parental human capital having no effect of the production of cultural capital, it simply had a lesser effect.

their own trait. In particular, the fact that parents might want to transmit a different culture than their own is therefore not considered in their model nor in mine. A reason for this to happen could be discriminations against or in favor of a given culture. Such a phenomenon has been documented for instance by Saleh (2016), who shows how differential taxation in medieval Egypt incentivized Coptic Christians (who faced higher taxes) to adopt the Muslim affiliation. The crucial feature of the Bisin and Verdier model, namely the substitution between vertical and oblique socialization, is also embedded in my model through the cultural capital production technology (section 3).

My model also departs from Bisin and Verdier in several ways. First, in their model, parents' efforts to socialize the child have an abstract convex cost. In my model, these efforts are specified as time allocations, which are made at the expense of the child's human capital production.

Second, in my model parents care about the cultural capital in their own trait, as opposed to the transmission probability to every trait in Bisin and Verdier (2000). The two formulations are in fact theoretically equivalent in the case with two traits (which is the case considered by Bisin and Verdier). This is because with only two traits, an increase in the population share of trait 1 mechanically leads to a decrease in the share of trait 2. Thus, a parent who cares about the population share of trait 1 must indirectly care about that of trait 2 as well. This is not true anymore, however, when there are three traits or more in the population. Indeed, in my model any change in the population shares which holds the share of the parent's trait constant will have no effect on that parent's utility and decision. This is unlike the Bisin and Verdier framework, in which a parent could for instance decrease their socialization effort if a trait which they prefer becomes more widespread (e.g. a Catholic might prefer that their child becomes Protestant rather than Muslim). But then again, fewer theoretical results exist in the case with three traits or more (see Montgomery 2010). Assuming that parents care about the cultural capital, and not the transmission probability, greatly facilitates the analysis when there are three traits or more, and is therefore well-suited to an empirical framework.

Third and last, in my model the socialization technology extends to both culturally homogamous and heterogamous households. This is not possible in the Bisin and Verdier model, which uses a unitary framework and for this reason assumes that heterogamous households have no available socialization technology (because then it would be unclear which culture the representative agent would want to transmit). Instead, in my model the technology of cultural capital production extends naturally to heterogamous households, yielding a trade-off between the socialization to the two parents' traits.

Regarding the production of the child's human capital, as in Chiappori et al. (2017) parents produce the human capital of their child using time inputs which are complements. Furthermore, parental human capital improves the productivity of these time inputs. In their model, time investments into the child's human capital production are made at the expense of the household's income – in my model, they are made at the expense of the child's cultural socialization.

5.2 Model analysis

With the technologies (18) and (19), the household problem (20)–(21) has closed-form solutions s_i^*, t_i^*. For the sake of clarity in the exposition, I make the following simplifying assumption.

Assumption 1: $\gamma_i = \dfrac{1}{T_i}$.

This assumption imposes that a parent's time productivity in socialization or human capital formation reaches exactly 0 when spend all of their time budget on only one activity. It guarantees interior solutions, and at the same time provides much simpler formulas for the solutions s_i^* and t_i^*. I now describe these solutions as well as a some of their properties.

Homogamous households. In a homogamous household the two parents have aligned interests. They both wish to transmit their common culture as well as human capital to the child, although they may disagree on how much to favor one over the other. Denoting by n the common trait of the two parents, the first-order conditions are

$$(\mu\,\nu_1 + \nu_2)\big(a_i(1-\gamma_i s_i^*) - a_0\,q_n\big) = (\mu+1)(b_i+h_i)(1-\gamma_i t_i^*) \qquad (i=1,2).$$

At the optimum, parent i's marginal returns from investing time in cultural capital or human capital formation should be equal. On the left-hand side, the marginal return from the socialization time s_i is increasing in the two parents' relative preference for cultural capital ν_1 and ν_2, and in parent i's productivity a_i; and is decreasing in the productivity and intensity of oblique socialization, a_0 and q_n. On the right-hand side, the marginal return from the time t_i spent on human capital formation is increasing in the productivity b_i and the human capital of parent i, h_i.

The solution is obtained by using the saturated time constraint (21) as well as Assumption 1:

$$s_i^* = T_i \times \frac{(\mu\,\nu_1+\nu_2)(a_i - a_0\,q_n)}{(\mu\,\nu_1+\nu_2)a_i + (\mu+1)(b_i+h_i)} \tag{22}$$

whenever this expression is positive, and 0 otherwise (i.e. when $a_i < a_0 q_n$, so that there is no incentive to vertical socialization for parent i). Note that the expression (22) is always inferior to 1, so that parent i never devotes their whole time budget on socialization. The following proposition describes how this optimal time allocation changes with the characteristics of the parents and of the population.

Proposition 1: In homogamous households, the time that parent i spends on cultural socialization is decreasing in his or her human capital level h_i; and in the population share of the parents' trait, q_n; and it is increasing in both parents' relative preference for cultural capital, ν_1 and ν_2.

The proof is simply obtained by differentiating the solution (22) with respect to the parameters of interest. Proposition 1 confirms that the model encapsulates the trade-offs between human capital formation and cultural socialization mentioned at the beginning of this section. Two types of time substitution occur in the model: higher-human capital parents reallocate their time towards human capital formation, and cultural-majority parents as well. The first kind of substitution results from the comparative advantage of higher-human capital parents in the child's human capital production. The second kind is a consequence of vertical socialization coming at the expense of oblique socialization: this relates to the *cultural substitution* property introduced by Bisin and Verdier (2001).

Heterogamous households. In a heterogamous household, parents have different objectives: parent 1 wants to socialize the child to trait n_1, and parent 2 to trait n_2. On top of the mechanisms involved in homogamous households which are described in Proposition 1, other factors impact the intensity of vertical socialization in each direction. First, the relative preference of each parent for cultural capital: parents who value it more dedicate more time to socialization. Second, a higher population share for any parents' trait decreases the incentive to vertical socialization for both parents. This is because vertical socialization happens at the expense of oblique socialization in all traits. Thus, if oblique socialization becomes better for one of the two parents, the household's incentive to vertical socialization decreases. Third, the power of the parents: a parent with high power means that the household will favor that parent's trait in the cultural socialization decision.

Formally, the first-order conditions are

$$\mu\,\nu_1\big(a_1(1-\gamma_1 s_1^*) - a_0\,q_{n_1}\big) - \nu_2\,a_0\,q_{n_2} = (\mu+1)(b_1+h_1)(1-\gamma_1 t_1^*)$$
$$\nu_2\big(a_2(1-\gamma_2 s_2^*) - a_0\,q_{n_2}\big) - \mu\,\nu_1\,a_0\,q_{n_1} = (\mu+1)(b_2+h_2)(1-\gamma_2 t_2^*).$$

These conditions are mostly similar to the homogamous case. The novelty is the adverse effect of vertical socialization from parent i on the oblique socialization to parent $-i$'s trait (in the first line for instance, this effect is represented by the term $-\nu_2\,a_0\,q_{n_2}$).

Once again, the solution is obtained by using the time constraint (21):

$$s_1^* = T_1 \times \frac{\mu\,\nu_1(a_1 - a_0\,q_{n_1}) - \nu_2\,a_0\,q_{n_2}}{\mu\,\nu_1\,a_1 + (\mu+1)(b_1+h_1)} \tag{23}$$

$$s_2^* = T_2 \times \frac{\nu_2(a_2 - a_0\,q_{n_2}) - \mu\,\nu_1\,a_0\,q_{n_1}}{\nu_2\,a_2 + (\mu+1)(b_2+h_2)}. \tag{24}$$

The following proposition describes the mechanisms at hand in heterogamous households: on top of the two kinds of substitution occurring in homogamous household, there is also a question of bargaining which depends on the relative power of the parents.

Proposition 2: In heterogamous households, the time that parent i spends on cultural socialization is decreasing in his or her human capital level, h_i; in the population shares of the two parents' traits, q_{n_1} and q_{n_2}; and in the relative preference for cultural capital of the other parent, ν_{-i}; and it is increasing in his or her relative power, and in his or her relative preference for cultural capital ν_i.

Contrarily to the homogamous case, here a concession is made between the two parents on producing the child's human capital, which is a public good, versus producing cultural capital in the parents' respective traits, which is a private good enjoyed by each parent separately. The power balance notably determines the importance of socializing the child to parent 1's trait versus parent 2's trait. As a parent gets more power, they dedicate more time to the cultural socialization of the child (their private good), while the other parent reallocates time towards human capital production (the public good).

This concludes the short analysis of the model. In Appendix D I discuss implications for household formation using a matching framework, as well as for population dynamics.

6 Estimation of the structural model

In this section I estimate the structural model described in section 5. This estimation is very similar in spirit to that of the reduced-form model from section 4. Indeed, I still exploit the variation in the traits of the respondents and their parents as a source of identification. This time however, I use not only the respondents' religious affiliation as an explained variable, but also their educational attainment. This is now possible because the structural model predicts both the religious socialization and the human capital of individuals. As I will explain in this section, the estimation framework can thus be understood as a mixed multinomial and ordered logit model.

In section 6.1, as a preliminary discussion I address the fact that the human capital level of the parents is measured using a discrete variable, education. In section 6.2 I present the framework for the estimation. In section 6.3 I present the results.

6.1 Measuring the parents' human capital

Before delving into the estimation, an inconsistency between the model and the data needs to be addressed. In the model, the parents have a human capital trait h, which is continuous. In the data however, I measure this level of human capital using the educational attainment variable, which is discrete. Thus, when solving the household program for two parents with observed educational attainments e_1 and e_2, I must decide how e_1 and e_2 translate into human capital levels h_1 and h_2.

As a simple solution, I assume that each educational attainment e is associated with a fixed human capital level $\tilde{h}_e$. Rather than choosing the $\tilde{h}_e$ exogenously however, I consider them as parameters to be estimated. In the model, any parent with educational attainment e is thus assumed to have the human capital level $\tilde{h}_e$.

6.2 Methodology

I can now proceed with the estimation framework. I use two sources of identification: variation in the religious affiliation of the respondents and their parents, and variation in their educational attainments.

Religious affiliation. For each individual i, the model predicts the cultural capital of i in any religion n, K_{in}, as a function of her parents' religious and educational traits and of the religions' population shares. To map this onto the data, assume as in section 4 that i ultimately picks the religious affiliation

$$\arg\max_n \ \ln(K_{in}) + \varepsilon_{in}, \tag{25}$$

where the ε_{in} are distributed i.i.d. Gumbel. Again, the probability that i picks each religion n is then given by

$$\pi_{in} = \frac{\exp(\ln K_{in})}{\sum_{\ell=1}^{N} \exp(\ln K_{i\ell})}. \tag{26}$$

This is a nonlinear multinomial logit model.

Educational attainment. Similarly, for each individual i the model also predicts the level of human capital of i, H_i. To map this onto the data, I consider H_i as the deterministic component of a latent variable which, in turn, predicts the educational level of i. Precisely, suppose that the actual level of (log-)human capital of individual i is $\ln(H_i) + \eta_i$, where η_i is a random shock. Suppose further that i attains the educational level e_i according to the rule

$$e_i = \begin{cases} 1 & \text{if} \quad \ln(H_i) + \eta_i \leq \bar{h}_1, \\ 2 & \text{if} \quad \bar{h}_1 < \ln(H_i) + \eta_i \leq \bar{h}_2, \\ \vdots & \\ E & \text{if} \quad \ln(H_i) + \eta_i > \bar{h}_{E-1}, \end{cases} \tag{27}$$

where E is the number of possible educational levels and $\bar{h}_1, \ldots, \bar{h}_{E-1}$ are parameters to be estimated. If the η_i are distributed i.i.d. logistic this is an ordered logit model, so that the probability that i reaches the educational level e is given by

$$\phi_{ie} = \begin{cases} \dfrac{1}{1 + \exp(\ln(H_i) - \bar{h}_1)} & \text{if } e = 1, \\ \dfrac{1}{1 + \exp(\ln(H_i) - \bar{h}_2)} - \dfrac{1}{1 + \exp(\ln(H_i) - \bar{h}_1)} & \text{if } e = 2, \\ \vdots & \\ 1 - \dfrac{1}{1 + \exp(\ln(H_i) - \bar{h}_{E-1})} & \text{if } e = E. \end{cases} \tag{28}$$

Log-likelihood function and parametrization. Suppose finally that the error terms ε_{in} and η_i are independent as well. Then the probability that i picks the religious affiliation n and reaches the educational level e is simply $\pi_{in} \times \phi_{ie}$. I can then construct the log-likelihood function

$$\ln L = \sum_i w_i \sum_{n=1}^{N} \sum_{e=1}^{E} \mathbf{1}_{\{i \text{ is } ne\}} \ln(\pi_{in} \times \phi_{ie}), \tag{29}$$

where the probabilities π_{in} and ϕ_{ie} implicitly depend on the model's parameters, and the w_i are sampling weights.

For the estimation, I make two restrictions on the parametrization of the model as exposed in section 5. First, I assume that relative preferences for religious capital versus human capital are homogeneous within a gender–religion category. In other words, all mothers of religion n are assumed to have the same preference, denoted by ν_{1n}. Similarly, all fathers of religion n have the same preference ν_{2n}. This is consistent with the model by Bisin and Verdier (2000), who assume that preferences are culture-specific constants. I extend this approach by supposing that within a culture, preferences may differ between men and women (which Bisin and Verdier could not do because they used a unitary model of the household). Second, I assume away the productivity difference between mothers and fathers, both in cultural socialization and human capital formation: $a_1 = a_2 = a$ and $b_1 = b_2 = b$. The reason is that differences in preferences between mothers and fathers are not precisely identified from differences in productivity between them, as can be seen from the solutions to the household problem (22)–(23)–(24). Identifying one from the other relies on the variation in the population shares q_{in}, which does not seem sufficient to obtain robust estimates on different specifications. Thus a choice has to be made to allow for gender heterogeneity in preferences or in productivity: here I choose the former.

I summarize the parametrization of the model under these additional assumptions, also taking into account Assumption 1:

$$\begin{aligned}
\ln K_n &= k_n + a\left(s_1 - \frac{s_1^2}{2T_1}\right)\mathbf{1}_{\{n_1=n\}} + a\left(s_2 - \frac{s_2^2}{2T_2}\right)\mathbf{1}_{\{n_2=n\}} + a_0\left(1 - s_1 - s_2\right)q_n \\
\ln H &= (b+h_1)\left(t_1 - \frac{t_1^2}{2T_1}\right) + (b+h_2)\left(t_2 - \frac{t_2^2}{2T_2}\right) \\
u_i &= \nu_{in_i}\ln(K_{n_i}) + \ln H.
\end{aligned}$$

For now, I fix exogenously the power balance in the couple by setting $\mu = 1$, so that the spouses have equal power. The parameters to estimate are thus the following:

- the relative preference for religious capital, ν_{1n} for mothers of religion n and ν_{2n} for fathers of religion n,
- the cultural adoption constants k_n for all n,
- the time productivities of religious socialization, a for vertical socialization by mothers and fathers, and a_0 for oblique socialization,
- the time productivity of human capital formation, b,
- the total time budgets of the parents, T_1 for mothers and T_2 for fathers,
- the human capital levels $\tilde{h}_e$ associated with the educational attainments e,
- the ordered logit thresholds $\bar{h}_e$.

With $N = 5$ religions and $E = 3$ education levels, this makes a total of $3N+5+2E-1 = 25$ parameters. Out of those, two are not identified. First, as in the reduced-form analysis of section 4, the k_n are identified only up to an additive constant. Again, I choose the normalize this constant to 0 for the most common denomination, Christians: $k_2 = 0$. Second, the contribution from the lowest human capital level cannot be distinguished from the baseline time productivity of human capital formation.[8] As such, I normalize to 0 the added productivity of having a primary school diploma or less: $\tilde{h}_1 = 0$. This leaves

[8] Choosing the parameters $(b_1, b_2, \tilde{h}_e)$ or $(b_1+\kappa, b_2+\kappa, \tilde{h}_e-\kappa)$ leads to the same model outcomes.

23 free parameters to estimate. Again I compute the maximum likelihood estimator of these parameters, using the log-likelihood expression (29). As in section 4, the covariance matrix is obtained using the BHHH estimator.

6.3 Results

Table 7 presents the estimation results. The fit can be compared to the null model ($N \times E - 1 = 14$ free parameters), which has a deviance of 75 735. This yields a pseudo-R^2 of 0.39.

I now turn to the estimated parameters. First, the estimates for the cultural adoption constants k_n are broadly consistent with the corresponding estimates in the reduced-form analysis. By default, individuals are most likely to pick up the No religion affiliation, followed by Christian, Muslim, Other, and finally Jewish. (In the reduced-form results, Other was a more likely adoption than Muslim.) As discussed above, this reflects to some extent the specificities of religious affiliations: for instance, while adopting the No religion trait requires little investment in religious capital, becoming Jewish without a Jewish ascendency is very rare.

Second, the relative value of religious capital ν_n exhibits wide differences across religions. The estimates suggest that Muslims and Jews value religious capital the most relative to education-oriented human capital, followed by Others, Nones, and finally Christians. These differences seems to explain in a large way the differences in contributions to religious socialization found in the reduced-form analysis.

Third, the estimates of the productivity in religious socialization, a_1, a_2, and a_0, suggest that mothers and oblique socialization have similar productivities, in front of fathers. Thus, a systematic productivity difference between mothers and fathers partly explains the gap in contributions found in the reduced-form results.

Moving to the estimates related to human capital formation, estimates for b_1 and b_2 suggest that mothers are also found to be more productive than fathers, although the gap is much reduced compared to religious socialization. The estimates for the human capital productivity $\tilde{h}_e$ are, reassuringly, increasing in the associated educational attainment e. This confirms that more educated parents are more productive when spending time to transmit human capital to their children. This is of course driven by the fact that more-educated parents have more-educated children in the data. Furthermore, the estimates indicate that the parents' educational attainment is a more important factor than their gender for their productivity. The added productivity obtained from having a Secondary diploma is approximately the same as that from having a Tertiary diploma, and both are around twice the difference between mothers' and fathers' productivities. Note finally that the lower human capital threshold which determines the child's educational attainment in the ordered logit model, $\bar{h}_1$, is negative, even though the child's log-human capital in the model is always positive (by assumption b_1 and b_2 are positive, which is confirmed by the estimation). This reflects the fact that 92% of the respondents have at least a Secondary

Table 7: Structural model of cultural socialization and human capital formation, Estimates

	Estimates
	(Mult./ord. logit)
Religious socialization	
Value of religious capital for mothers ν_{1n}, by religion n	
None	5.05 (1.85)
Christian	1.28 (0.40)
Muslim	21.66 (10.08)
Jewish	15.88 (14.1)
Other	5.08 (1.47)
Value of religious capital for fathers ν_{2n}, by religion n	
None	5.01 (1.44)
Christian	0.00 (0.32)
Muslim	14.69 (5.58)
Jewish	4.74 (1.72)
Other	0.00 (1.52)
Cultural adoption constants k_n, by religion n	
None	0.33 (0.11)
Christian	0 (baseline)
Muslim	−2.37 (0.21)
Jewish	−3.66 (0.27)
Other	−2.78 (0.22)
Vertical religious socialization time productivity, a	2.66 (0.22)
Oblique religious socialization time productivity, a_0	3.81 (0.29)
Total time budget of mothers, T_1	1.24 (0.11)
Total time budget of fathers, T_2	1.34 (0.12)
Human capital formation	
Human capital formation time productivity, b	0.15 (0.04)
Added productivity $\tilde{h}_e$, by education level e	
Primary	0 (baseline)
Secondary	1.05 (0.09)
Tertiary	2.13 (0.18)
Human capital threshold $\bar{h}_1$: Primary $\rightarrow$ Secondary	−2.29 (0.03)
Human capital threshold $\bar{h}_2$: Secondary $\rightarrow$ Tertiary	1.81 (0.03)
Observations	18 155
Sampling weights	Yes
Deviance ($-2 \ln L$)	45 927
Pseudo-R^2	0.39

Note: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

education (which has been compulsory in France since 1959), such that any education level below that must be explained by a negative shock on the child's human capital.

7 Conclusion

In this paper I have primarily studied how the religious affiliations and the education levels of the parents interact in predicting the religious affiliation of their children. I find that higher-educated parents marry less homogamously, and that they transmit their religious affiliation less accurately than lower-educated parents. Using a reduced-form model of religious transmission, I quantify the contributions to religious socialization of parents based on their gender, religious affiliation, and education level. I find that mothers contribute in general more than fathers, and than religious minorities (Muslims and Jews) contribute more than majorities (Nones and Christians). I show that oblique socialization plays a non-trivial role in the transmission process and that there is a strong trend of secularism for the cohorts considered. Moreover, I provide evidence that the education levels of the parents are relevant factors in the socialization process, though it remains unclear whether their effect is unidirectional or if it is heterogeneous across religious affiliations. Finally, I describe a structural, collective household model of cultural socialization and human capital formation of the child, and I derive preliminary results on this model in the single-parent case. I present a roadmap for the estimation of this model and to embed it in a matching framework.

References

Alesina, A. and Giuliano, P. (2015), 'Culture and institutions', *Journal of Economic Literature* **53**(4), 898–944.

Barro, R. J. and McCleary, R. M. (2003), Religion and economic growth. NBER Working Paper 9682.

Beauchemin, C., Hamel, C. and Simon, P. (2016), *Trajectoires et origines: enquête sur la diversité des populations en France*, INED éditions.

Becker, G. S. (1965), 'A theory of the allocation of time', *The Economic Journal* **75**(299), 493–517.

Berndt, E., Hall, B., Hall, R. and Hausman, J. (1974), 'Estimation and inference in nonlinear structural models', *Annals of Economic and Social Measurement* **3**(4), 653–665.

Bisin, A., Topa, G. and Verdier, T. (2004), 'Religious intermarriage and socialization in the United States', *Journal of Political Economy* **112**(3), 615–664.

Bisin, A. and Tura, G. (2020), Marriage, fertility, and cultural integration in Italy. Working Paper.

Bisin, A. and Verdier, T. (2000), '"Beyond the Melting Pot": Cultural Transmission, Marriage, and the Evolution of Ethnic and Religious Traits', *The Quarterly Journal of Economics* **115**(3), 955–988.

Bisin, A. and Verdier, T. (2001), 'The economics of cultural transmission and the dynamics of preferences', *Journal of Economic Theory* **97**, 298–319.

Bisin, A. and Verdier, T. (2011), The economics of cultural transmission and socialization, *in* 'Handbook of Social Economics', Vol. 1, North-Holland, pp. 339–416.

Bourdieu, P. (1979), 'Les trois états du capital culturel', *Actes de la recherche en sciences sociales* **30**(1), 3–6.

Carvalho, J.-P., Koyama, M. and Sachs, M. (2017), 'Education, identity, and community: lessons from the Jewish emancipation', *Public Choice* **171**, 119–143.

Chiappori, P.-A. (1992), 'Collective labor supply and welfare', *Journal of Political Economy* **100**(3), 437–467.

Chiappori, P.-A. (2017), *Matching with transfers: The economics of love and marriage*, Princeton University Press.

Chiappori, P.-A., Salanié, B. and Weiss, Y. (2017), 'Partner choice, investment in children, and the marital college premium', *The American Economic Review* **107**(8), 2109–2167.

Choo, E. and Siow, A. (2006), 'Who marries whom and why', *Journal of Political Economy* **11'**(1), 175–201.

Del Boca, D., Flinn, C. and Wiswall, M. (2016), 'Transfers to households with children and child development', *The Economic Journal* **126**(596), F136–F183.

Ferrara, C. A. (2018), 'Transmitting faith in the republic: Muslim schooling in modern plural France', *Religious Education* **113**(1), 14–25.

Galichon, A., Kominers, S. D. and Weber, S. (2019), 'Costly concessions: An empirical framework for matching with imperfectly transferable utility', *Journal of Political Economy* **127**(6), 2875–2925.

Galichon, A. and Salanié, B. (2022), 'Cupid's invisible hand: Social surplus and identification in matching models', *The Review of Economic Studies* **89**(5), 2600–2629.

Garre, F. G., Vermunt, J. K. and Croon, M. A. (2002), 'Likelihood-ratio tests for order-restricted log-linear models: A comparison of asymptotic and bootstrap methods', *Metodologa de las Ciencias del Comportamiento* **4**(1), 1–18.

Greene, W. H. (2008), *Econometric analysis*, 6th edn, Pearson Education, Inc.

Guiso, L., Sapienza, P. and Zingales, L. (2006), 'Does culture affect economic outcomes?', *Journal of Economic Perspectives* **20**(2), 23–48.

Iannaccone, L. R. (1990), 'Religious practice: A human capital approach', *Journal for the Scientific Study of Religion* **29**(3), 297–314.

Iannaccone, L. R. (1998), 'Introduction to the economics of religion', *Journal of Economic Literature* **36**(3), 1465–1495.

Iyer, S. (2016), 'The new economics of religion', *Journal of Economic Literature* **54**(2), 395–441.

Kalmijn, M. (1991), 'Shifting boundaries: Trends in religious and educational homogamy', *American Sociological Review* **56**(6), 786–800.

McFadden, D. (1973), Conditional logit analysis of qualitative choice behavior, *in* P. Zarembka, ed., 'Frontiers in Econometrics', Academic Press, New York, chapter 4, pp. 105–142.

Montgomery, J. D. (2010), 'Intergenerational cultural transmission as an evolutionary game', *American Economic Journal: Microeconomics* **2**(4), 115–136.

Roth, A. E. and Sotomayor, M. A. O. (1990), *Two-sided matching: A study in game-theoretic modeling and analysis*, Cambridge University Press.

Saleh, M. (2016), 'Public mass modern education, religion, and human capital in twentieth-century Egypt', *The Journal of Economic History* **76**(3), 697–735.

Schwartz, C. R. and Mare, R. D. (2005), 'Trends in educational assortative marriage from 1940 to 2003', *Demography* **42**(4), 621–646.

Siow, A. (2015), ‘Testing Becker’s theory of positive assortative matching’, *Journal of Labor Economics* **33**(2), 409–441.

Squicciarini, M. (2020), ‘Devotion and development: Religiosity, education, and economic progress in 19th-century France’, *The American Economic Review* **110**(11), 3454–3491.

Appendix

A Proofs

Proof of comparative statics, homogamous household.
The first-order conditions to the homogamous household problem are

$$\frac{\delta h_1}{1+h_1 t_1^*} = \nu \left.\frac{\partial \ln S}{\partial s_1}\right|_{s_1^*,s_2^*,q_n}$$
$$\frac{(1-\delta) h_2}{1+h_2 t_2^*} = \nu \left.\frac{\partial \ln S}{\partial s_2}\right|_{s_1^*,s_2^*,q_n}.$$

The second-order condition is that the Hessian matrix

$$\mathcal{H} = \begin{pmatrix} \frac{-\delta h_1^2}{(1+h_1 t_1^*)^2} + \nu \left.\frac{\partial^2 \ln S}{\partial s_1^2}\right|_{s_1^*,s_2^*,q_n} & \nu \left.\frac{\partial^2 \ln S}{\partial s_1 \partial s_2}\right|_{s_1^*,s_2^*,q_n} \\ \nu \left.\frac{\partial^2 \ln S}{\partial s_1 \partial s_2}\right|_{s_1^*,s_2^*,q_n} & \frac{-(1-\delta) h_2^2}{(1+h_2 t_2^*)^2} + \nu \left.\frac{\partial^2 \ln S}{\partial s_2^2}\right|_{s_1^*,s_2^*,q_n} \end{pmatrix}$$

must be negative semi-definite. Note that since S is concave in s_1 and s_2 (and positive) by assumption, $\ln S$ is also concave in s_1 and s_2. Thus the second-order derivatives $\frac{\partial^2 \ln S}{\partial s_i^2}$ are negative.

Let's first see how the optimal time allocation changes with parent 1's human capital h_1. The total differentiation of the two first-order conditions with respect to h_1 can be written

$$\mathcal{H} \begin{pmatrix} \mathrm{d}t_1^*/\mathrm{d}h_1 \\ \mathrm{d}t_2^*/\mathrm{d}h_1 \end{pmatrix} = \begin{pmatrix} -\frac{\delta}{(1+h_1 t_1^*)^2} \\ 0 \end{pmatrix}.$$

Since $\mathcal{H}$ is negative semi-definite, this notably implies

$$0 \geq \begin{pmatrix} \mathrm{d}t_1^*/\mathrm{d}h_1 \\ \mathrm{d}t_2^*/\mathrm{d}h_1 \end{pmatrix}^\top \mathcal{H} \begin{pmatrix} \mathrm{d}t_1^*/\mathrm{d}h_1 \\ \mathrm{d}t_2^*/\mathrm{d}h_1 \end{pmatrix} = -\frac{\delta}{(1+h_1 t_1^*)^2} \frac{\mathrm{d}t_1^*}{\mathrm{d}h_1} \quad \Longrightarrow \quad \frac{\mathrm{d}t_1^*}{\mathrm{d}h_1} \geq 0.$$

The second row of the second-order condition then provides

$$\operatorname{sign}\left(\frac{\mathrm{d}t_2^*}{\mathrm{d}h_1}\right) = \operatorname{sign}\left(\left.\frac{\partial^2 \ln S}{\partial s_1 \partial s_2}\right|_{s_1^*,s_2^*,q_n}\right).$$

The changes with respect to h_2 are of course symmetric.

Now let's see the effect of ν on the optimal allocation. Total differentiation of the first-order conditions with respect to ν yields

$$\mathcal{H} \begin{pmatrix} \mathrm{d}t_1^*/\mathrm{d}\nu \\ \mathrm{d}t_2^*/\mathrm{d}\nu \end{pmatrix} = \begin{pmatrix} \left.\frac{\partial \ln S}{\partial s_1}\right|_{s_1^*,s_2^*,q_n} \\ \left.\frac{\partial \ln S}{\partial s_2}\right|_{s_1^*,s_2^*,q_n} \end{pmatrix}.$$

Since $\mathcal{H}$ is negative semi-definite, this implies

$$0 \geq \frac{\mathrm{d}t_1^*}{\mathrm{d}\nu} \times \left.\frac{\partial \ln S}{\partial s_1}\right|_{s_1^*,s_2^*,q_n} + \frac{\mathrm{d}t_2^*}{\mathrm{d}\nu} \times \left.\frac{\partial \ln S}{\partial s_2}\right|_{s_1^*,s_2^*,q_n}.$$

Since $\ln S$ is increasing in s_1 and s_2, this inequality guarantees that at least one of $\frac{\mathrm{d}t_1^*}{\mathrm{d}\nu} \leq 0$ or $\frac{\mathrm{d}t_2^*}{\mathrm{d}\nu} \leq 0$ holds, but we cannot say more. However, given that $\frac{\mathrm{d}t_i^*}{\mathrm{d}\nu} = -\frac{\mathrm{d}s_i^*}{\mathrm{d}\nu}$, this last inequality also directly implies

$$\frac{\mathrm{d}\ln S_n^*}{\mathrm{d}\nu} = \frac{\mathrm{d}s_1^*}{\mathrm{d}\nu} \times \left.\frac{\partial \ln S}{\partial s_1}\right|_{s_1^*,s_2^*,q_n} + \frac{\mathrm{d}s_2^*}{\mathrm{d}\nu} \times \left.\frac{\partial \ln S}{\partial s_2}\right|_{s_1^*,s_2^*,q_n} \geq 0,$$

which completes the comparative statics results in the homogamous case. □

Proof of comparative statics, heterogamous household.
The first-order conditions to the heterogamous household problem are

$$\begin{aligned}(\mu+1)\frac{\delta h_1}{1+h_1 t_1^*} &= \mu\,\nu_1 \left.\frac{\partial \ln S}{\partial s_1}\right|_{s_1^*,0,q_{n_1}} \\ (\mu+1)\frac{(1-\delta)h_2}{1+h_2 t_2^*} &= \nu_2 \left.\frac{\partial \ln S}{\partial s_2}\right|_{0,s_2^*,q_{n_2}}.\end{aligned}$$

The second-order condition is that the Hessian matrix

$$\mathcal{H} = \begin{pmatrix} -(\mu+1)\frac{\delta h_1^2}{(1+h_1 t_1^*)^2} + \mu\,\nu_1 \left.\frac{\partial^2 \ln S}{\partial s_1^2}\right|_{s_1^*,0,q_{n_1}} & 0 \\ 0 & -(\mu+1)\frac{(1-\delta)h_2^2}{(1+h_2 t_2^*)^2} + \nu_2 \left.\frac{\partial^2 \ln S}{\partial s_2^2}\right|_{0,s_2^*,q_{n_2}} \end{pmatrix}$$

must be negative semi-definite, which is always true since it is diagonal negative (since S is concave in s_1 and s_2).

Let's first see how the optimal time allocation changes with parent 1's human capital h_1. The total differentiation of the two first-order conditions with respect to h_1 can be written

$$\mathcal{H}\begin{pmatrix}\mathrm{d}t_1^*/\mathrm{d}h_1 \\ \mathrm{d}t_2^*/\mathrm{d}h_1\end{pmatrix} = \begin{pmatrix}-\frac{\delta}{(1+h_1 t_1^*)^2} \\ 0\end{pmatrix},$$

which, since $\mathcal{H}$ is diagonal negative, immediately yields

$$\frac{\mathrm{d}t_1^*}{\mathrm{d}h_1} \geq 0, \qquad \frac{\mathrm{d}t_2^*}{\mathrm{d}h_1} = 0.$$

The changes with respect to q_{n_1}, ν_1, h_2, q_{n_2}, and ν_2 are obtained in a similar fashion.

Now let's see how the optimal allocation changes with the power μ. Denoting $\mathcal{H}_{11}$ and $\mathcal{H}_{22}$ the (negative) diagonal elements of $\mathcal{H}$, total differentiation of the first-order conditions with respect to μ yields

$$\begin{aligned}
\frac{\delta h_1}{1+h_1 t_1^*} + \frac{\mathrm{d}t_1^*}{\mathrm{d}\mu} \times \mathcal{H}_{11} &= \nu_1 \frac{\partial \ln S}{\partial s_1}\bigg|_{s_1^*,0,q_{n_1}} \\
\frac{(1-\delta)h_2}{1+h_2 t_2^*} + \frac{\mathrm{d}t_2^*}{\mathrm{d}\mu} \times \mathcal{H}_{22} &= 0.
\end{aligned}$$

The second line immediately yields

$$\frac{\mathrm{d}t_2^*}{\mathrm{d}\mu} > 0.$$

For the first line, remark that by first-order condition we have

$$\nu_1 \frac{\partial \ln S}{\partial s_1}\bigg|_{s_1^*,0,q_{n_1}} = \left(1+\frac{1}{\mu}\right)\frac{\delta h_1}{1+h_1 t_1^*}$$

so that

$$\frac{\mathrm{d}t_1^*}{\mathrm{d}\mu} \times \mathcal{H}_{11} = \frac{1}{\mu}\frac{\delta h_1}{1+h_1 t_1^*} \qquad \Longrightarrow \qquad \frac{\mathrm{d}t_1^*}{\mathrm{d}\mu} < 0$$

which completes the comparative statics results in the heterogamous case. $\square$

B Descriptive statistics for the TeO survey

B.1 General descriptives

Table 8: General descriptive statistics of the TeO survey.

	Mean	StdDev	Min	Max	Obs.
Age	36	11.5	17	60	21,761
Female (%)	52.8				21,761
Education (%)					21,761
Primary or less	8.0				–
Secondary	63.6				–
Tertiary or more	28.4				–
Religion (%)					21,443
No religion	29.3				–
Christian	39.2				–
Muslim	26.6				–
Jewish	0.8				–
Other	4.1				–
Partner					
Has partner (%)	72.5				21,761
Same-sex partner[1] (%)	0.7				13,242
Raised by... (%, several may apply)					21,761
Both parents	86.1				
Mother only	14.9				
Father only	2.3				
Mother's education (%)					20,239
Primary or less	59.3				–
Secondary	30.4				–
Tertiary or more	10.2				–
Father's education (%)					19,239
Primary or less	54.2				–
Secondary	31.2				–
Tertiary or more	14.7				–
Parents' religion					
Homogamous parents (same religion, %)	89.3				20,671
Shares religion with at least one parent (%)	84.9				20,988

Notes: [1] Information only available if the partner lives in the same house.

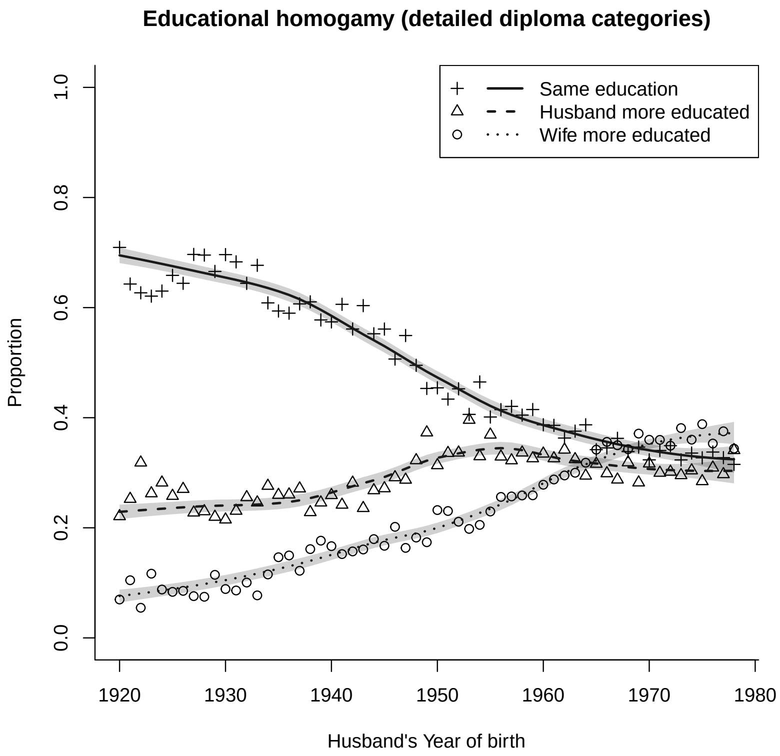

Figure 17: Educational homogamy with detailed diploma categories.

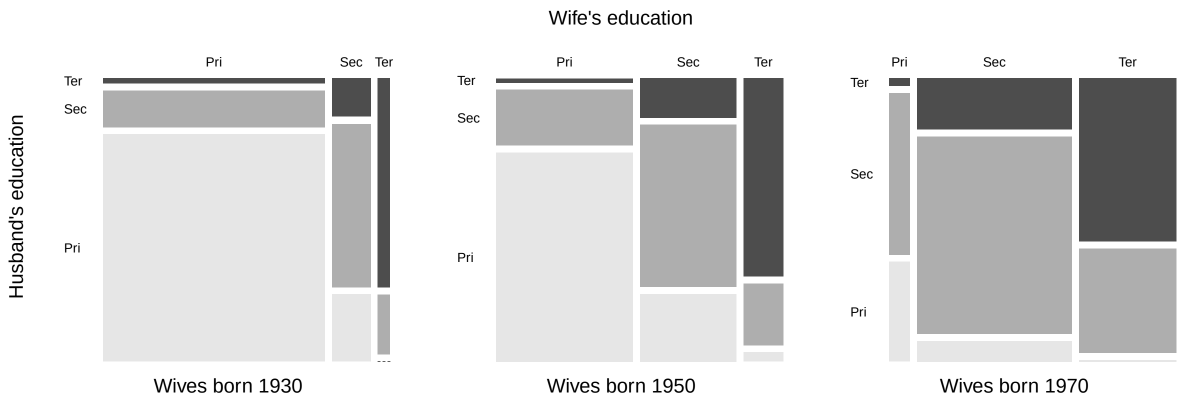

Figure 18: Educational assortment in couples with a wife born in 1930, 1950, and 1970.

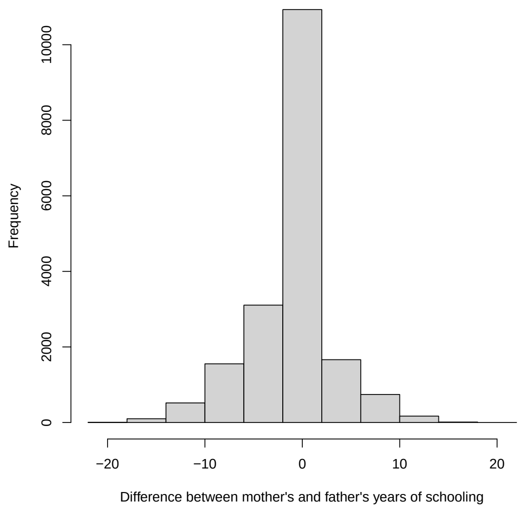

Figure 19: Distribution of the difference in years of schooling between mothers and fathers.

See Figures 20, 21, 22; and Table 9.

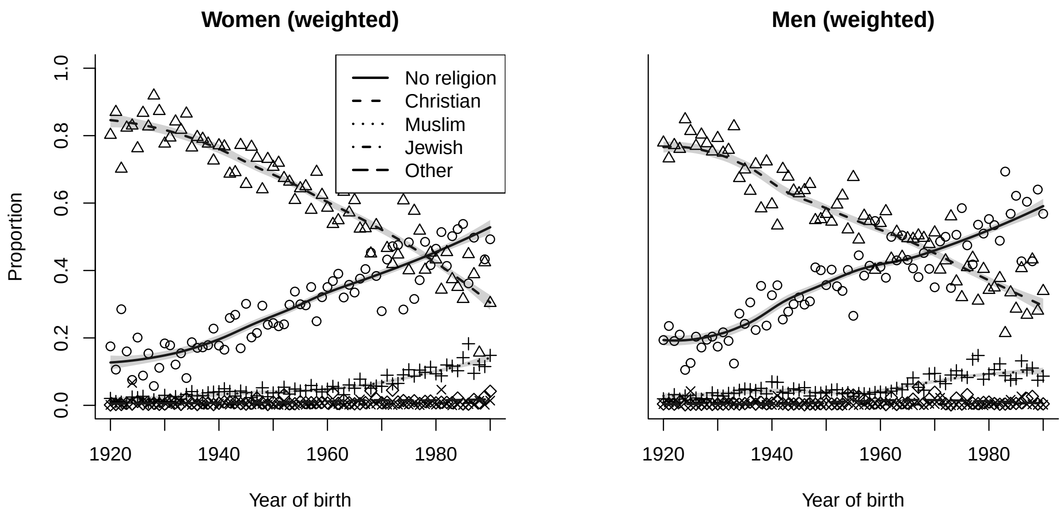

Figure 20: Religious affiliation, Women and Men (using sampling weights).

Table 9: Religious affiliations and homogamy.

Mother's religion	Father's religion					Total	Homogamy
	None	Christian	Muslim	Jewish	Other		
None	2448	221	105	8	28	2810	0.87
Christian	1071	9044	240	32	89	10476	0.86
Muslim	118	42	5905	0	3	6068	0.97
Jewish	9	25	4	149	1	188	0.79
Other	110	76	19	1	923	1129	0.82
Total	3756	9408	6273	190	1044	20671	
Homogamy	0.65	0.96	0.94	0.78	0.88		

Note: For each line, homogamy is computed as the ratio of mothers in a homogamous union divided by the total number of mothers in that line (idem for fathers in each column). Homogamy rates can thus differ within a single religion between mothers and fathers because of they have different distributions regarding religion.

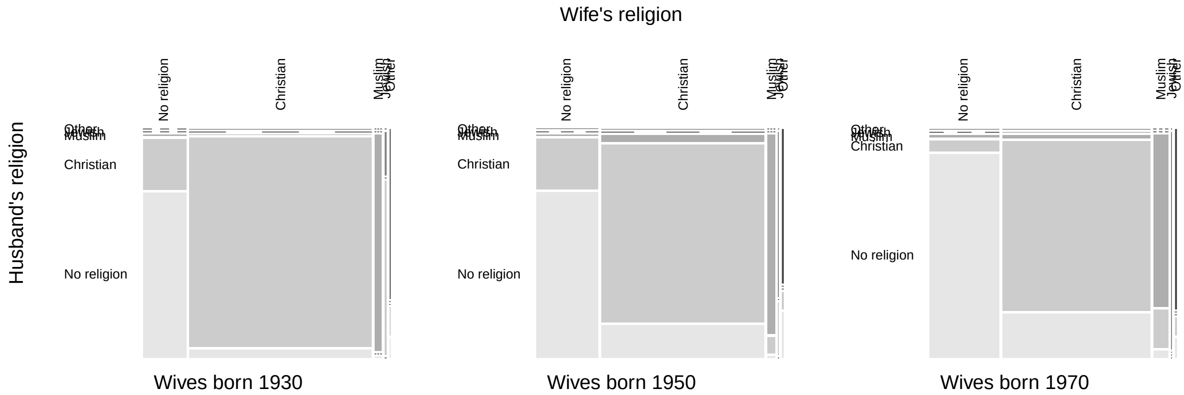

Figure 21: Religious assortment in couples with a wife born in 1930, 1950, and 1970 (using sampling weights).

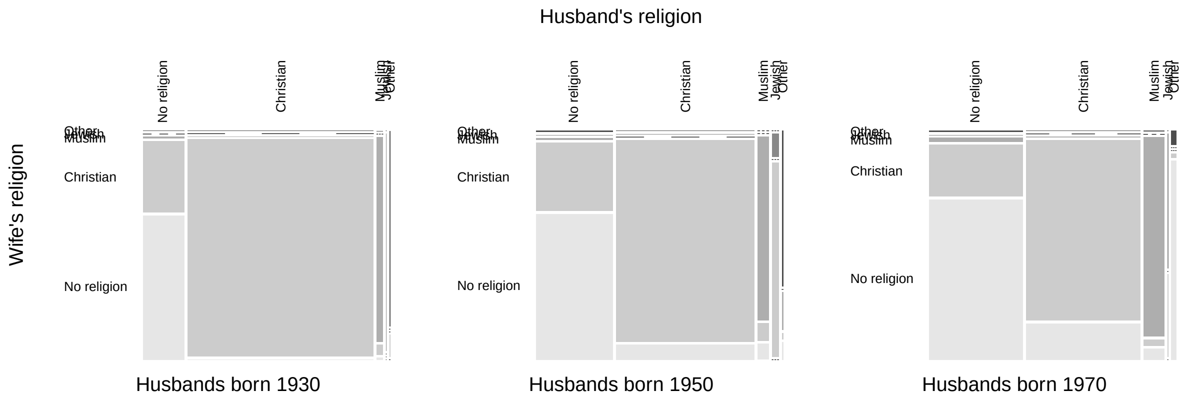

Figure 22: Religious assortment in couples with a husband born in 1930, 1950, and 1970 (using sampling weights).

B.4 Transmission of education

See Tables 10 and 11 for additional regressions.

Let's investigate further the interaction between the mother's and the father's education levels, e_m and e_f, in determining the education of the child e_c. To do this, let's simplify the education variable even more than above, by defining e_i as

$$e_i = \mathbf{1}_{\{i \text{ has (at least) a Secondary diploma}\}}.$$

Call $\mu_{h_m h_f} = \mathbb{P}(e_c = 1 \mid e_m, e_f)$ the probability that a child has (at least) a Secondary diploma, conditional on her mother and father having education levels e_m and e_f respectively. A simple measure of the interaction effect between the parents' education levels is then

$$\mu_{11} - \mu_{10} - \mu_{01} + \mu_{00}. \tag{30}$$

(For instance, in the linear probability model $\mu_{h_m h_f} = \alpha + \beta_m e_m + \beta_f e_f + \gamma e_m e_f$, we have $\mu_{11} - \mu_{10} - \mu_{01} + \mu_{00} = \gamma$.) I estimate the expression (30) on the whole sample first. The estimator

Table 10: Transmission of education (Ordered Logit).

	Child's education			
	(Ord. logit)	(Ord. logit)	(Ord. logit)	(Ord. logit)
Mother's education				
Secondary	0.65 (0.04)	1.10 (0.07)	1.00 (0.07)	1.00 (0.07)
Tertiary	1.16 (0.07)	2.04 (0.20)	1.84 (0.21)	1.84 (0.21)
Father's education				
Secondary	0.59 (0.04)	0.91 (0.05)	0.85 (0.05)	0.85 (0.05)
Tertiary	1.27 (0.06)	1.50 (0.12)	1.47 (0.12)	1.47 (0.12)
Mother's × Father's education				
Secondary × Secondary		−0.78 (0.09)	−0.76 (0.09)	−0.76 (0.09)
Secondary × Tertiary		−0.61 (0.15)	−0.61 (0.15)	−0.61 (0.15)
Tertiary × Secondary		−1.23 (0.23)	−1.18 (0.23)	−1.17 (0.24)
Tertiary × Tertiary		−1.05 (0.24)	−0.99 (0.25)	−0.99 (0.25)
Mother's religion				
Christian			0.25 (0.07)	0.27 (0.08)
Muslim			−0.02 (0.11)	0.06 (0.21)
Jewish			0.35 (0.28)	−0.30 (0.77)
Other			0.10 (0.14)	0.30 (0.22)
Father's religion				
Christian			0.05 (0.06)	0.19 (0.16)
Muslim			−0.19 (0.11)	0.01 (0.23)
Jewish			0.60 (0.27)	1.24 (0.77)
Other			−0.07 (0.14)	−0.78 (0.42)
Mother's × Father's religion				
Christian × Christian				−0.15 (0.17)
Christian × Muslim				−0.33 (0.28)
Christian × Jewish				−0.77 (0.88)
Christian × Other				1.20 (0.49)
Muslim × Christian				−0.70 (0.43)
Muslim × Muslim				−0.27 (0.31)
Muslim × Jewish				no data
Muslim × Other				1.36 (1.23)
Jewish × Christian				0.53 (0.90)
Jewish × Muslim				1.75 (1.47)
Jewish × Jewish				0.05 (1.11)
Jewish × Other				no data
Other × Christian				−0.12 (0.37)
Other × Muslim				−0.97 (0.63)
Other × Jewish				−3.24 (2.21)
Other × Other				0.49 (0.48)
Child's year of birth /100	0.96 (0.14)	0.93 (0.14)	1.53 (0.15)	1.53 (0.15)
Cut-off: Primary → Secondary	17.03 (2.79)	16.55 (2.79)	28.39 (2.95)	28.40 (2.96)
Cut-off: Secondary → Tertiary	20.65 (2.79)	20.19 (2.79)	32.07 (2.96)	32.08 (2.96)
Observations	18793	18793	18222	18222
Sampling weights	No	No	No	No
Residual Deviance	29642	29540	28438	28419

Note: Standard errors in parentheses.
Reference category for mother/father education is "Primary."
Reference category for mother/father religion is "No religion."

Table 11: Transmission of education (OLS).

	Child's education		
	(OLS)	(OLS)	(OLS)
Mother's education	0.13***	0.21***	0.20***
	(0.01)	(0.02)	(0.02)
Father's education	0.18***	0.25***	0.24***
	(0.01)	(0.01)	(0.02)
Mother's × Father's education		−0.04***	−0.04***
		(0.01)	(0.01)
Mother's religion...			
Christian			0.06***
			(0.01)
Muslim			0.01
			(0.05)
Jewish			−0.01
			(0.07)
Other			0.15**
			(0.05)
Father's religion...			
Christian			0.06***
			(0.01)
Muslim			−0.02
			(0.04)
Jewish			0.30***
			(0.07)
Other			−0.18**
			(0.06)
Child's year of birth /100	0.11**	0.08*	0.23***
	(0.03)	(0.03)	(0.03)
Observations	18793	18793	18222
Sampling weights	Yes	Yes	Yes
Adjusted R^2	0.14	0.15	0.16

Note: Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
Reference category for wife/husband religion fixed effects is "No religion."

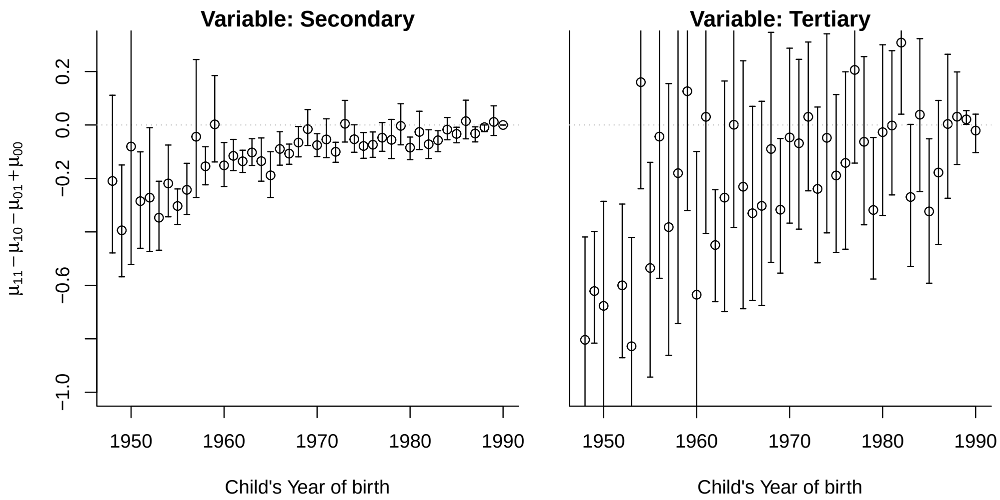

Figure 23: Interaction effects of parents' education levels for the child's education. 95% confidence intervals for $\mu_{11}-\mu_{10}-\mu_{01}+\mu_{00}$ are reported for each cohort. Left panel uses Secondary diplomas to define the binary education variable e_i, right panel uses Tertiary diplomas.

$\hat{\mu}_{e_m e_f}$ of $\mu_{e_m e_f}$ is the sample mean of e_c on the subsample of respondents with a mother e_m and a father e_f. The point estimate for (30) is then simply $\hat{\mu}_{11} - \hat{\mu}_{10} - \hat{\mu}_{01} + \hat{\mu}_{00}$. The confidence interval is obtained by simulation, knowing that each $\hat{\mu}_{e_m e_f}$ follows a binomial distribution. I obtain the point estimate -0.120, with $[-0.132, -0.108]$ for the 95% confidence interval. This estimate can be interpreted in the following way: the gain from having an additional Secondary-educated parent is 12 p.p. less for children who already have one Secondary-educated parent, compared to children who have none. This result provides a strong indication that interaction effects are in fact negative. Next I perform the same exercise within cohorts. Results are shown in Figure 23. Again, estimates for (30) are negative, even within cohorts.

As a last control, I perform the same exercise but instead defining e_i as

$$e_i = \mathbf{1}_{\{i \text{ has a Tertiary diploma}\}}.$$

Estimation of (30) on the full sample yields the point estimate -0.122 with 95% confidence interval $[-0.178, -0.066]$. Estimation within cohorts is again reported in Figure 23. Most point estimates remain negative, although many cannot be statistically distinguished from 0.

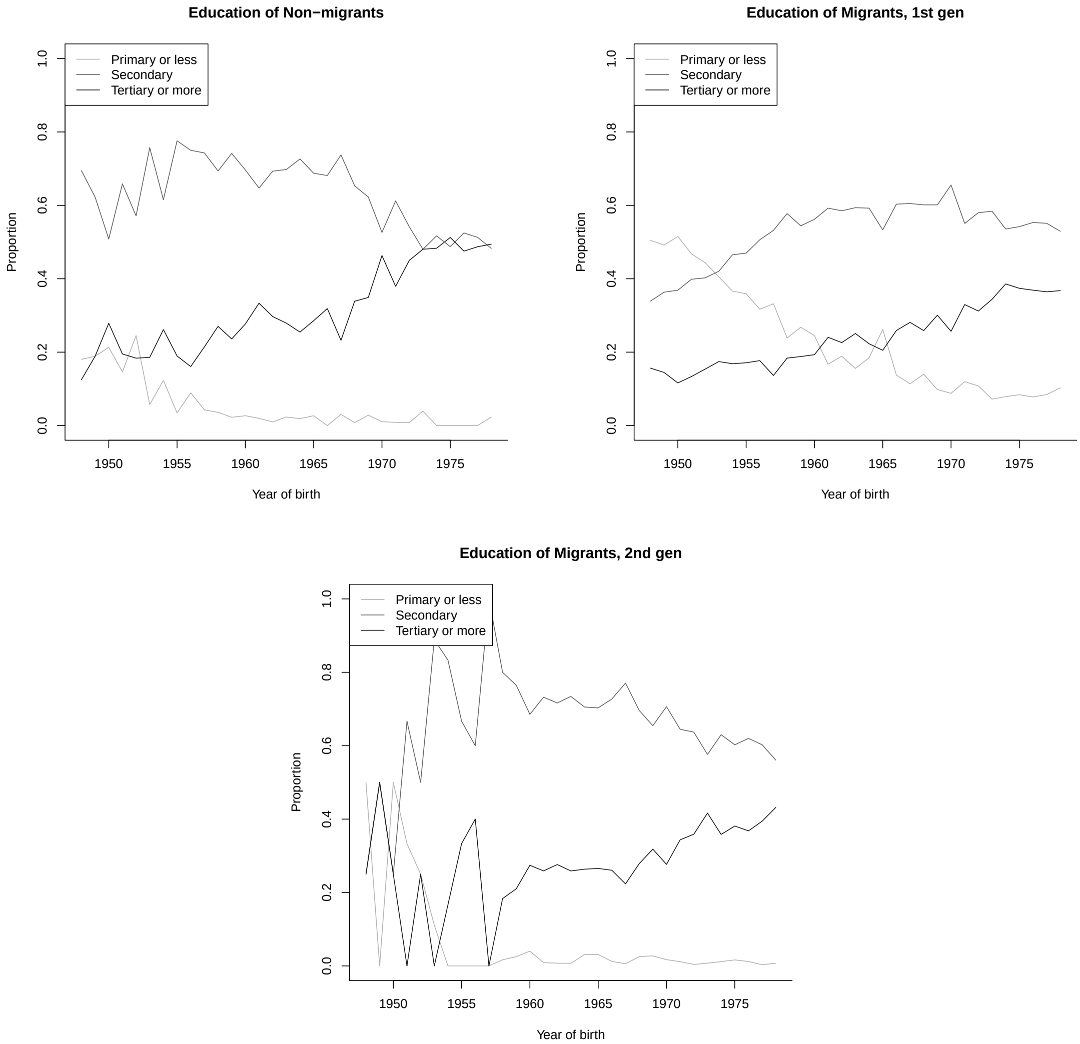

Figure 24: Education by Migration status.

Homogamy advantage. When focusing on households without a None parent, homogamous households perform significantly better than heterogamous households in passing on religious traits (Figure 25).

This is also confirmed when looking at transmission rates for any combination of parental religious affiliations (Figure 26).

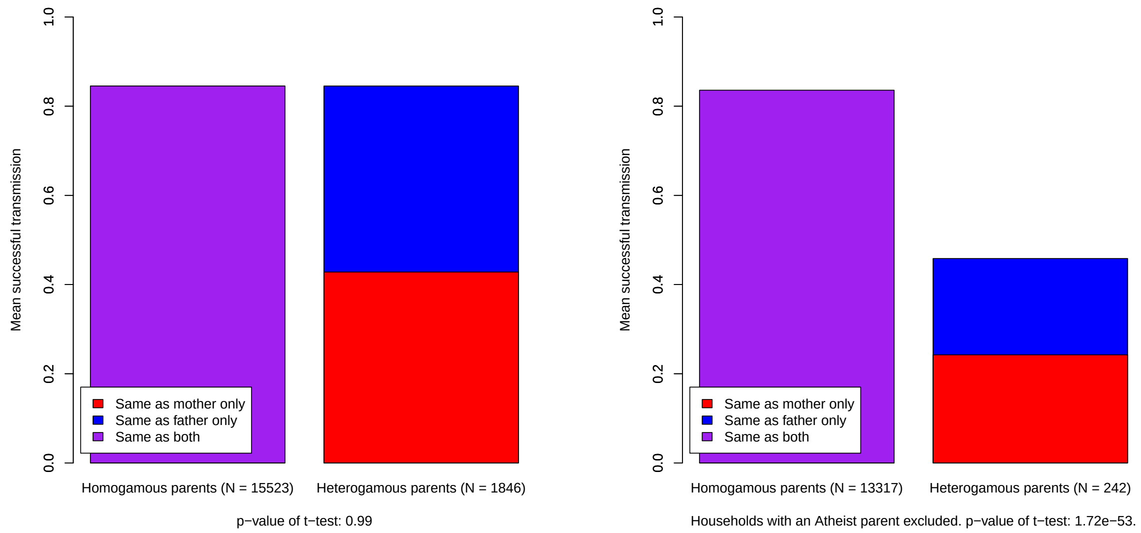

Figure 25: Transmission rates for homogamous and heterogamous households. The right-hand graph omits the respondents who declared having a 'No religion' parent.

Gender asymmetry. Another documented fact is that mothers pass on their cultural trait with a higher rate than fathers do. This is somewhat visible on Figure 26, where mothers' transmission rates (in red) seem overall more prominent than fathers' (in blue). However, no clear pattern emerges from the aggregated evidence. This is because the distribution of religious traits is different for mothers and fathers in the sample: in particular, there are more None fathers than mothers, which biases transmission success in the favor of fathers given the trend towards No religion mentioned above. For this reason, we need to look at how mothers and fathers perform when they are in comparable situations. I systematically investigate this mother–father asymmetry in Figure 27, by comparing the respective religious transmission rates of mothers and fathers in symmetric household configurations. Specifically, for any religious traits a and b, I compute the difference between the transmission rate of mothers in households ab (i.e. when the mother has religion a and the father religion b) and the transmission rate of fathers in households ba (i.e. when the father has religion a and the mother religion b). I find that an argument can indeed be made for mothers playing a larger role in religious transmission: in five cases this difference in transmission rates is significant at the 95% level in favor of mothers (None vs. Christian, None vs. Muslim, Christian vs. None, Jewish vs. Christian, Other vs. Christian). The Jewish vs. Christian case is notable as it reflects that Jewish affiliation is passed down from the mother and not the father. On the other hand, there is no significant advantage for fathers at

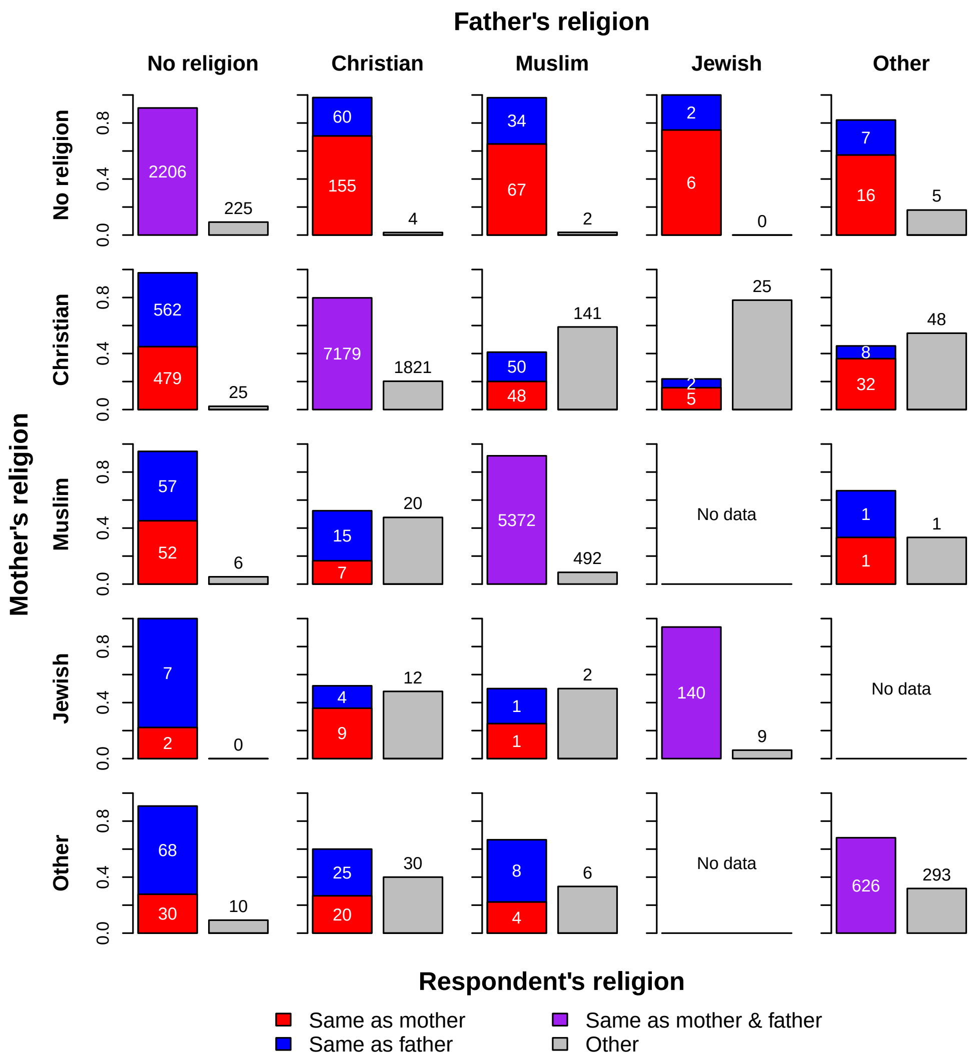

Figure 26: Transmission rates for all combinations of the parents' religions (number of observations reported for each bar).

the 95% level. If we broaden the confidence interval to the 90% level, mothers gain a significant advantage in the Muslim vs. None case, while fathers gain a significant advantage in the Christian vs. Muslim case (maybe reflecting the fact that Muslim affiliation is primarily passed down from the father).

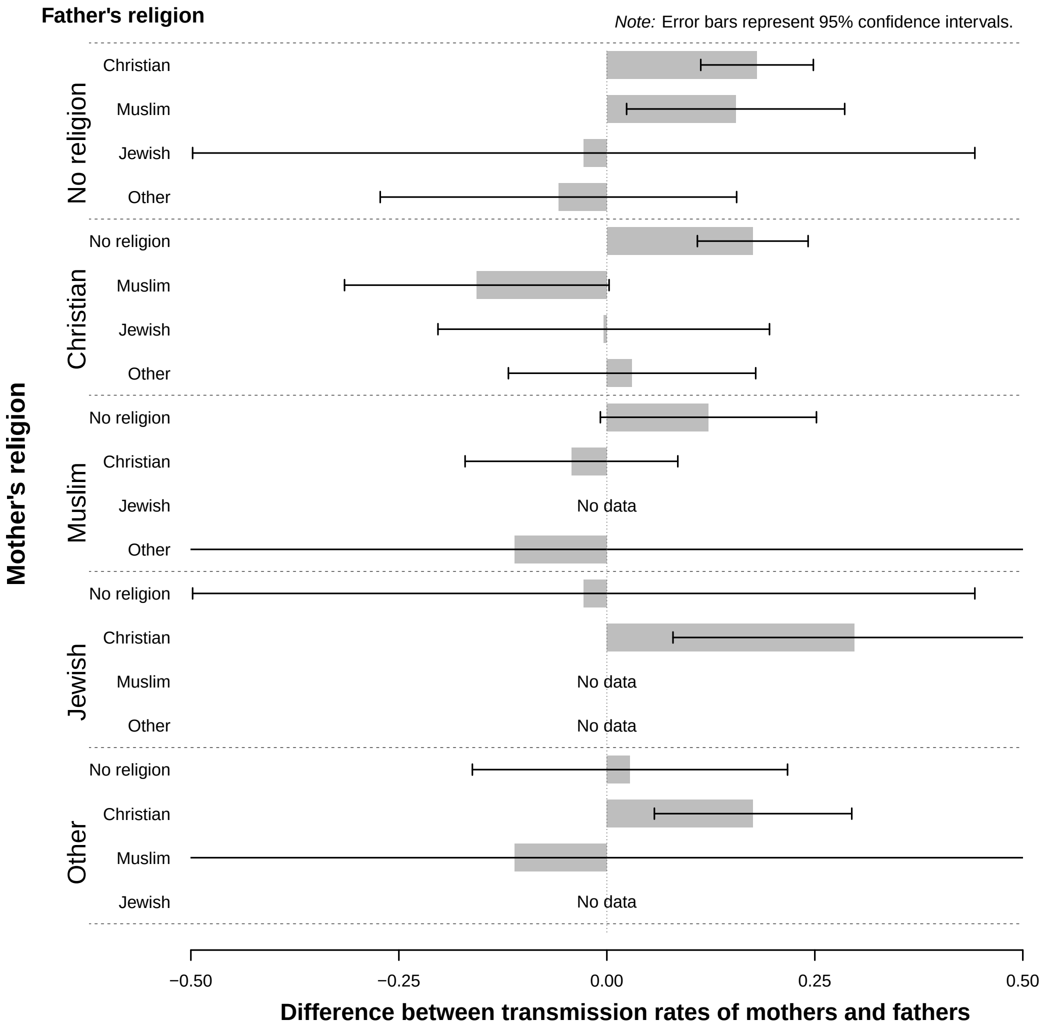

Figure 27: Mothers' advantage in religious transmission. Plotted are the differences between the transmission rate of mothers in households ab and the transmission rate of fathers in households ba for any religions $a \neq b$.

C Reduced-form models of transmission

C.1 Reconstructing population shares

Finding which population shares to use is not straightforward. Ideally, one should use a time series of religious shares in France over the period considered. Unfortunately, this information is not consistently available for every year. Instead, I resort to using the TeO survey data in order to reconstruct these population shares. I assume that for a given birth cohort y, the population which contributes to oblique socialization for that cohort consists of all individuals born between $y-1$ and $y-60$ and who were residents of metropolitan France no later than $y+18$. Population shares for each trait n are computed accordingly in that subsample (which includes respondents' parents) using sampling weights. The limit of $y-60$ means that individuals born more than 60 years before a given cohort do not affect that cohort's oblique socialization. This limit is chosen somewhat arbitrarily to account for deaths among older individuals, given that dates of death are not available. Furthermore, behind the decision to count only residents at $y+18$ is the implicit assumption that religious affiliation is decided by age 18. The resulting population shares involved in oblique socialization for every birth cohorts are shown in Figure 14. As a point of comparison, on the same figure I also show the corresponding estimates from the 2005 World Values Survey, based on 996 respondents. (The 2005 population shares correspond to those involved in the oblique socialization of cohort $2005-18=1992$). The estimates for the shares of Nones and Christians differ, with about 12 p.p. more Nones in the World Values Survey than in the reconstructed shares. Yet, these shares are consistent with estimates from other studies.

C.2 Derivation of testable restrictions

We have seen that the independence of irrelevant alternatives assumption of the conditional logit model takes the form

$$\ln\left(\frac{\pi_{in}}{\pi_{ik}}\right) = s_n + m_n \mathbf{1}_{\{i\text{'s mother is } n\}} + f_n \mathbf{1}_{\{i\text{'s father is } n\}} + \alpha\, q_{y_i n} - s_k - m_k \mathbf{1}_{\{i\text{'s mother is } k\}} - f_k \mathbf{1}_{\{i\text{'s father is } k\}} - \alpha\, q_{y_i k}$$

where I have made explicit that q_{in} depends on i only through her year of birth y_i.

Call $\pi_{in\,|\,yab}$ the probability that i adopts trait n conditional on belonging in birth cohort y, and having a mother a and a father b. Then for any two traits a and b and two birth cohorts y and $\tilde{y}$, we have:

$$\ln\left(\frac{\pi_{ia\,|\,yaa}}{\pi_{ib\,|\,yaa}}\right) = s_a + m_a + f_a + \alpha\, q_{ya} - s_b - \alpha\, q_{yb} \tag{31}$$

$$\ln\left(\frac{\pi_{ia\,|\,yab}}{\pi_{ib\,|\,yab}}\right) = s_a + m_a + \alpha\, q_{ya} - s_b - f_b - \alpha\, q_{yb} \tag{32}$$

$$\ln\left(\frac{\pi_{ia\,|\,\tilde{y}ba}}{\pi_{ib\,|\,\tilde{y}ba}}\right) = s_a + f_a + \alpha\, q_{\tilde{y}a} - s_b - m_b - \alpha\, q_{\tilde{y}b} \tag{33}$$

$$\ln\left(\frac{\pi_{ia\,|\,\tilde{y}bb}}{\pi_{ib\,|\,\tilde{y}bb}}\right) = s_a + \alpha\, q_{\tilde{y}a} - s_b - m_b - f_b - \alpha\, q_{\tilde{y}b}. \tag{34}$$

It follows that

$$\ln\left(\frac{\pi_{ia \mid yaa}}{\pi_{ib \mid yaa}}\right) - \ln\left(\frac{\pi_{ia \mid yab}}{\pi_{ib \mid yab}}\right) - \ln\left(\frac{\pi_{ia \mid \tilde{y}ba}}{\pi_{ib \mid \tilde{y}ba}}\right) + \ln\left(\frac{\pi_{ia \mid \tilde{y}bb}}{\pi_{ib \mid \tilde{y}bb}}\right) = 0. \tag{35}$$

Note that we cannot take a reference trait n_0 as pivot, in the sense that if equation (35) is true for the traits an_0 and bn_0, it does not imply that it is true for the traits ab. This is because this equation involves different subpopulations depending on the choice of the two traits:

- if we consider the property (35) for the traits a and n_0, then the subpopulation involved consists of all individuals with parents aa, an_0, n_0a, or n_0n_0;
- for the traits b and n_0, it is the individuals with parents bb, bn_0, n_0b, or n_0n_0;
- for the traits a and b, it is the individuals with parents aa, ab, ba, or bb.

Since the first two points do not involve individuals with parents ab or ba, there is no way that any combination of the two associated equations would yield results on this subpopulation, and therefore that they could imply (35) for traits a and b.

We can however take a birth cohort y_0 as pivot. That is, equation (35) is true for all a, b, y, and $\tilde{y}$, if and only if it is true for all a, b, and y, but taking $\tilde{y} = y_0$ fixed. In practice this is not useful however, as I do not have enough observations to perform the test for every cohort. This is why I consider instead the approximate test

$$\ln\left(\frac{\pi_{ia \mid aa}}{\pi_{ib \mid aa}}\right) - \ln\left(\frac{\pi_{ia \mid ab}}{\pi_{ib \mid ab}}\right) - \ln\left(\frac{\pi_{ia \mid ba}}{\pi_{ib \mid ba}}\right) + \ln\left(\frac{\pi_{ia \mid bb}}{\pi_{ib \mid bb}}\right) = 0 \tag{36}$$

where $\pi_{in \mid ab}$ is the probability that i adopts n conditional on having a mother a and a father b (but not conditioning on birth cohorts anymore).

$$\pi_{in \mid ab} = \sum_{y} \pi_{in \mid yab} \times \mathbb{P}(yab) \tag{37}$$

C.3 Observed vs. simulated transmission rates by religion and education categories

See Figure 28.

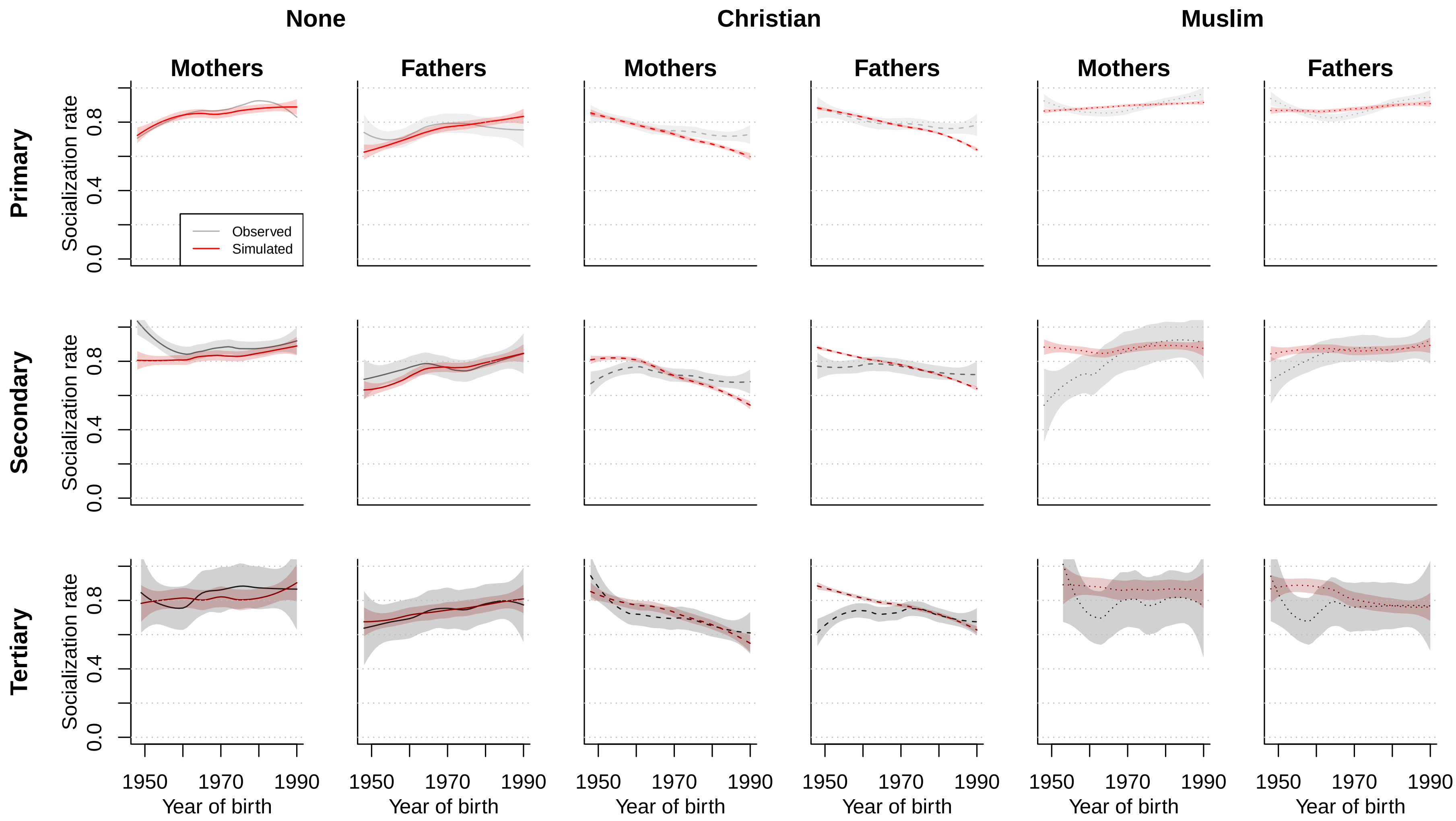

Figure 28: Conditional logit transmission, smoothed Observed vs. simulated transmission rates (by Religion & Education).

Transmission model. Consider a slightly different model from section 4, in which

$$\mathbb{P}(i \text{ acquires } n) = \frac{S_{in}}{\sum_{k=1}^{N} S_{ik}}, \tag{38}$$

and S_{in} is still defined according to (10).

As in the model from section 4, the probability (38) can be motivated by a random socialization model. Suppose that socialization of i to trait n is $S_{in} \times \eta_{in}$, where the η_{in} are now distributed i.i.d. Fréchet (EVII). Again, i acquires the trait to which she is socialized the most. Then she acquires n which maximizes $S_{in} \times \eta_{in}$, or equivalently, $\ln(S_{in}) + \ln(\eta_{in})$, and the $\ln(\eta_{in})$ are distributed i.i.d. Gumbel (EVI) by property of the Fréchet distribution. The expression (38) follows.

In this model, parental contributions to socialization are substitutes, in the sense that

$$\frac{\partial^2 \mathbb{P}(i \text{ acquires } n)}{\partial m_n \partial f_n} \leq 0. \tag{39}$$

As above, this model also imposes restrictions on the transmission probabilities, namely

$$\frac{\mathbb{P}(a \mid yaa)\, \mathbb{P}(a \mid ybb)}{\mathbb{P}(a \mid yab)\, \mathbb{P}(a \mid yba)} - \frac{\mathbb{P}(b \mid yaa)\, \mathbb{P}(b \mid ybb)}{\mathbb{P}(b \mid yab)\, \mathbb{P}(b \mid yba)} = 0. \tag{40}$$

Because of lack of observations for many cohorts, I again test the approximation

$$\frac{\mathbb{P}(a \mid aa)\, \mathbb{P}(a \mid bb)}{\mathbb{P}(a \mid ab)\, \mathbb{P}(a \mid ba)} - \frac{\mathbb{P}(b \mid aa)\, \mathbb{P}(b \mid bb)}{\mathbb{P}(b \mid ab)\, \mathbb{P}(b \mid ba)} = 0. \tag{41}$$

Out of 10 tests, 6 tests cannot reject the null hypothesis (None–Christian, None–Jewish, Christian–Muslim, Christian–Jewish, Christian–Other, and Muslim–Other); 2 tests reject the null hypothesis (None–Muslim, None–Other); and the 2 other tests cannot be computed.

Estimation. In this model, parameters are only identified up to multiplication by a constant. For this reason, I normalize the oblique socialization coefficient α to 1, and the vector of parameters to estimate is just $\boldsymbol{\beta} = (m_1, \ldots, m_N, f_1, \ldots, f_N)$. Estimation of $\boldsymbol{\beta}$ can again be performed by maximizing the log-likelihood (14), which now takes the form

$$\ln L = \sum_i w_i \left[\left(\sum_{n=1}^{N} \mathbf{1}_{\{i \text{ is } n\}} \ln(S_{in}) \right) - \ln \left(\sum_{k=1}^{N} S_{ik} \right) \right].$$

Standard errors are again obtained using the BHHH estimator. Results are presented in Table 12. As in the model with Gumbel errors, mothers contribute to socialization more than fathers, except among Christians. A notable difference however, is the much higher relative difference between mothers' and fathers' contributions to socialization (roughly by a factor 2 in the previous model, and by a factor 10 here). This can be explained, at least in part, by the fact that contributions are substitutes in this model, whereas they involved some complementarity in the previous model; mechanically, the disparity must be evened out when contributions are comple-

Table 12: Conditional logit transmission (Fréchet errors), Estimates.

	Estimates					
	(Cond. logit)		(Cond. logit)		(Cond. logit)	
Mother's contribution m_n						
None	4.27***	(0.32)	4.50***	(0.50)	0.87	(0.54)
Christian	0.05	(0.05)	1.82***	(0.22)	0.77***	(0.15)
Muslim	8.47***	(0.40)	23.26***	(1.72)	1.64***	(0.31)
Jewish	4.71***	(0.95)	14.17***	(3.08)	1.85**	(0.63)
Other	1.33***	(0.12)	3.36***	(0.40)	1.13***	(0.20)
Father's contribution f_n						
None	0.82***	(0.09)	1.33**	(0.27)	−0.86***	(0.21)
Christian	0.67***	(0.06)	5.36***	(0.43)	0.87***	(0.24)
Muslim	0.52***	(0.06)	1.93***	(0.25)	1.38***	(0.20)
Jewish	0.16*	(0.08)	0.62*	(0.33)	0.44	(0.24)
Other	0.38***	(0.09)	1.54***	(0.34)	0.63***	(0.18)
Interaction contribution b_n						
None					3.96***	(0.75)
Christian					8.19***	(0.66)
Muslim					32.86***	(2.75)
Jewish					51.27**	(18.76)
Other					5.31***	(0.65)
Secularization bias s_0			1.74***	(0.13)	2.32***	(0.18)
Observations	20 547		20 547		20 547	
Sampling weights	No		No		No	
Deviance ($-2 \ln L$)	23 275		22 112		21 689	
Pseudo-R^2	0.55		0.57		0.58	
LR test p-value	baseline		0.000		0.000	

Note: Standard errors in parentheses. $^{*}\ p < 0.05$, $^{**}\ p < 0.01$, $^{***}\ p < 0.001$

ments. The hierarchy of contributions to socialization across religions also changes somewhat: Muslims now contribute the most, significantly more than Jews and Nones; Others follow, and finally Christians remain the lowest socializers.

Model fit. The overall fit of this model is slightly better than for the version with Gumbel errors, with a pseudo-R^2 of 0.55 (against 0.51). As above, I use the parameter estimates to compare observed vs. simulated transmission rates by religion (Figure 29), by education (Figure 30), and by religion and education (Figure 31). This model matches the fall in Christian socialization better than the linear one. On the other hand, it predicts slower growth of None mothers' transmission rates than observed. Other predictions remain very close to those of the previous model.

Extensions. I extend the baseline model in the same way as in section 4, first by introducing a secularization bias, and second by allowing complementarities between the parents' religious traits. See columns 2 and 3 of Table 12 for the estimation results.

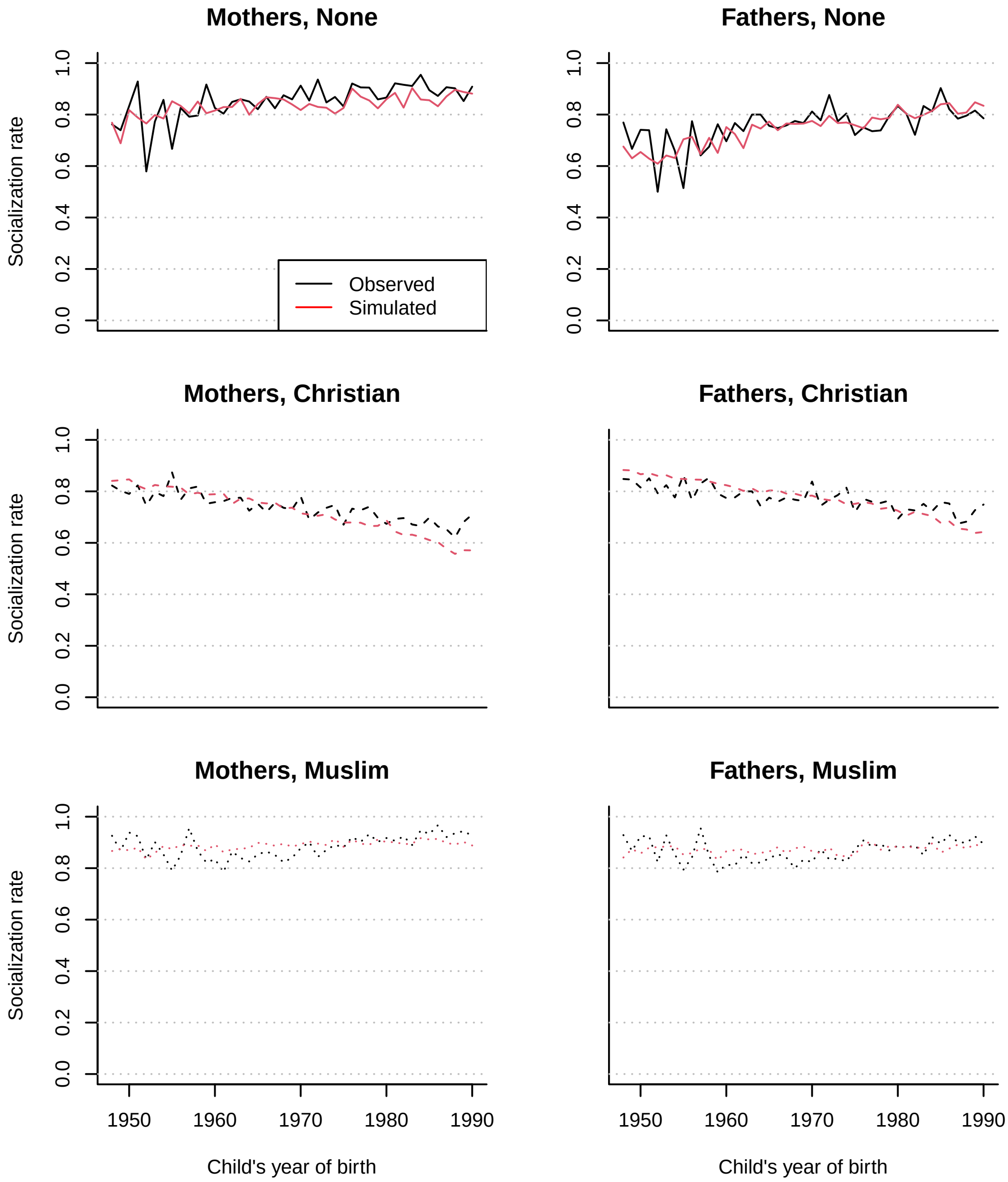

Figure 29: Nonlinear conditional logit transmission, Observed vs. simulated transmission rates (by Religion).

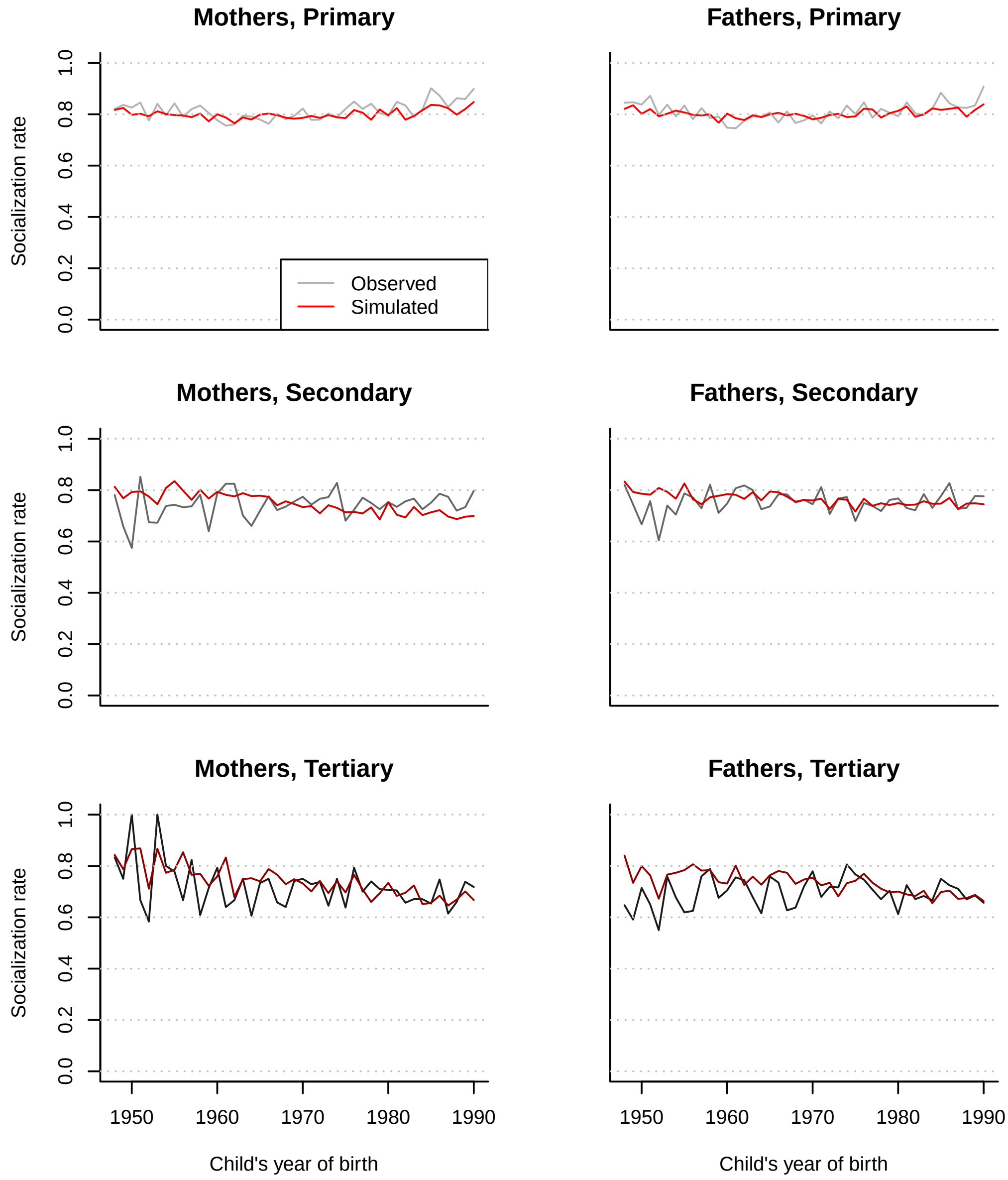

Figure 30: Nonlinear conditional logit transmission, Observed vs. simulated transmission rates (by Education).

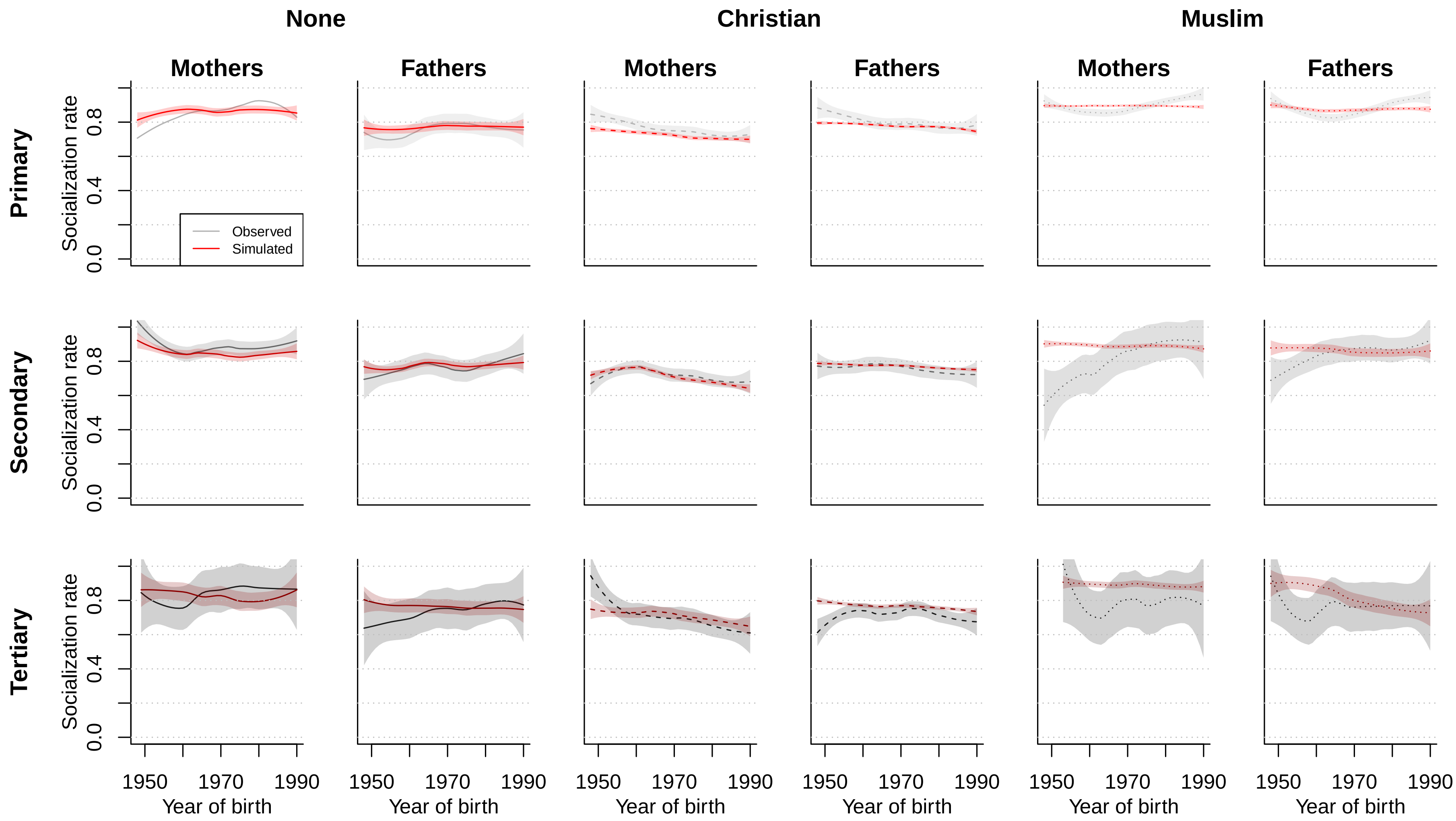

Figure 31: Nonlinear conditional logit transmission, smoothed Observed vs. simulated transmission rates (by Religion and Education).

D Household formation and population dynamics

Household formation. The next step is to embed the collective household model into a matching framework, in which men and women match on the two characteristics {religion, education}. In the classical framework, women and men meet on a bilateral, frictionless marriage market. Households are formed endogenously based on the indirect utility provided by the match to each of the spouses. The associated equilibrium concept is stability: a matching is stable if and only if no two individuals would rather match together than stay in their current match.

The matching models usually fall in one of three categories: transferable utility (TU), imperfectly transferable utility (ITU), and non-transferable utility (NTU) (Chiappori 2017). Here, the homogamous household problem has the NTU property (under the assumption that the individual value of culture is homogeneous within a given culture), while the heterogamous household problem has the ITU property. The NTU case is well-documented (Roth and Sotomayor 1990). Recent works provide both theoretical and empirical results for the ITU case (Galichon et al. 2019, Galichon and Salanié 2022).

The first step to analyze matching in the ITU framework is to describe the Pareto frontier of the household by expressing the utility of parent 1 as a decreasing function of the utility of parent 2,

$$u_1 = \Phi(\theta_1, \theta_2, u_2)$$

where $\theta_i = (n_i, h_i) \in \Theta$ is the bidimensional type of parent i, and Φ is decreasing in u_2. A match is then characterized by a measure ψ over Θ^2 and utility functions $u_1(\theta_1)$ and $u_2(\theta_2)$ such that

$$u_1(\theta_1) = \Phi(\theta_1, \theta_2, u_2(\theta_2)) \qquad \forall (\theta_1, \theta_2) \in \operatorname{supp} \psi.$$

Stability requires

$$u_1(\theta_1) \geq \Phi(\theta_1, \theta_2, u_2(\theta_2)) \qquad \forall (\theta_1, \theta_2) \in \Theta^2$$

which implies

$$u_1(\theta_1) = \max_{\vartheta_2} \Phi(\theta_1, \vartheta_2, u_2(\vartheta_2))$$

and similarly for $u_2(\theta_2)$. One can then use first-order conditions to analyze the matching problem.

In my case, even though the function Φ exists, I cannot find a closed-form expression for it. Instead, I can parametrize the Pareto frontier by the power μ,

$$\begin{aligned} u_1 &= \Phi_1(\theta_1, \theta_2, \mu) \\ u_2 &= \Phi_2(\theta_1, \theta_2, \mu), \end{aligned}$$

where Φ_1 is increasing and Φ_2 is decreasing in μ. A match must then be characterized by a measure ψ over Θ^2, utility functions $u_1(\theta_1)$ and $u_2(\theta_2)$, and a power function $\mu(\theta_1, \theta_2)$ such that

$$\begin{aligned} u_1(\theta_1) &= \Phi_1(\theta_1, \theta_2, \mu(\theta_1, \theta_2)) \\ u_2(\theta_2) &= \Phi_2(\theta_1, \theta_2, \mu(\theta_1, \theta_2)) \end{aligned}$$

for all $(\theta_1, \theta_2) \in \operatorname{supp} \psi$. Stability requires

$$u_1(\theta_1) \geq \Phi_1(\theta_1, \theta_2, \mu(\theta_1, \theta_2))$$
$$u_2(\theta_2) \geq \Phi_2(\theta_1, \theta_2, \mu(\theta_1, \theta_2))$$

for all $(\theta_1, \theta_2) \in \Theta^2$, implying

$$u_1(\theta_1) = \max_{\vartheta_2} \ \Phi_1(\theta_1, \vartheta_2, \mu(\theta_1, \vartheta_2))$$
$$u_2(\theta_2) = \max_{\vartheta_1} \ \Phi_2(\vartheta_1, \theta_2, \mu(\vartheta_1, \theta_2)).$$

First-order conditions with respect to h_2 and h_1 write

$$\frac{\partial \Phi_1}{\partial h_2}(\theta_1, \theta_2, \mu(\theta_1, \theta_2)) + \frac{\partial \mu}{\partial h_2}(\theta_1, \theta_2) \times \frac{\partial \Phi_1}{\partial \mu}(\theta_1, \theta_2, \mu(\theta_1, \theta_2)) = 0$$
$$\frac{\partial \Phi_2}{\partial h_1}(\theta_1, \theta_2, \mu(\theta_1, \theta_2)) + \frac{\partial \mu}{\partial h_1}(\theta_1, \theta_2) \times \frac{\partial \Phi_2}{\partial \mu}(\theta_1, \theta_2, \mu(\theta_1, \theta_2)) = 0$$

which is a partial differential equation for μ.

The following issues arise compared to the usual framework:

- There is no explicit form for the function Φ which allows to describe the Pareto frontier with u_1 as a function of u_2. As a consequence, I have to rely on parametrizing the Pareto frontier by the Pareto weight μ, thus introducing a new function into the equilibrium. A consequence is that μ must be recovered using a system of partial differential equations, rather than a standard differential equation for recovering utilities.
- The type of individuals is bidimensional, with the first dimension discrete. This means that the solution cannot be characterized entirely by first-order conditions.

The empirical analysis might however be easier. The bidimensional type is now (n, e), which takes a finite number $N \times E$ of values. Index these types by I for women and J for men. The goal is to find the Pareto weights μ^{IJ} which best explain the empirical matching patterns, according to the discrete choices of the individuals. Denoting women by $i \in I$ and men by $j \in J$, these discrete choice problems are

$$u_i = \max_{j} \left\{ \Phi_1(I, J, \mu^{IJ}) + \alpha_i^J \right\}$$
$$u_j = \max_{i} \left\{ \Phi_2(I, J, \mu^{IJ}) + \beta_j^I \right\}$$

where α_i^J and β_j^I are random shocks which depend exclusively on the type of the partner, as in the Choo and Siow (2006) framework. These translate into probability for each individual i or j to marry with a partner of type J or I. In this case, estimation has to be performed simultaneously on marriage patterns and transmission patterns to jointly estimate the Pareto weights μ^{IJ} and the parameters of the utilities and production functions that I estimated previously.

Population dynamics. The last contribution of this paper will be to study the population dynamics implied by the model. This can be done either empirically or theoretically. Empirically: once the model's primitive parameters are estimated, one can iterate the model to simulate the evolution of the population along the two dimensions of interest (religion and education). This simply requires to solve for the ITU matching equilibrium, for which a solution was proposed by Galichon and Salanié (2022). From the matching equilibrium, we can infer the joint distribution of religious traits and educational levels in the next generation using the collective household model. It might be possible to do the same exercise theoretically for distributions of traits which are simple enough.

The dynamic implications could be interesting. For instance, if the cultural minority starts with lower average human capital than the majority (as is for instance the case with immigrants in many countries), the need to safeguard their culture could happen at the expense of their human capital development, so that the human capital gap between cultural minority and majority could widen with time. (Or at least, this mechanism could delay the catch-up of the minority with the majority, compared to the baseline case wherein people do not care about cultural transmission.) Intuitively, this could lead to a higher-educated, little-socialized cultural majority on one side, and a lower-educated, highly-socialized cultural minority on the other side.

E Educational homogamy: local log odds ratios analysis

In this section I follow the methodology of Siow (2015) to study educational homogamy using local log odds ratios. As pointed out by Siow, simply computing correlations of spouses' education levels remains a weak test of homogamy since we don't know how high the correlation should be to infer that the data indeed exhibits homogamy. A stronger tests consists in verifying that all local log odds ratios are positive.

To begin with, Table 13 provides the sample distribution of marriages according to the spouses' education levels. The repartition of marriages is thus represented by a 3×3 matrix $(n_{ij})_{1\leq i,j\leq 3}$, for a total number of observations N. The local log odds ratios are defined for $i, j \leq 2$ as

$$\ln\left(\frac{n_{ij}\, n_{i+1,j+1}}{n_{i,j+1}\, n_{i+1,j}}\right) \tag{42}$$

which constitutes a measure of local homogamy in the submatrix $\begin{pmatrix} n_{ij} & n_{i,j+1} \\ n_{i+1,j} & n_{i+1,j+1} \end{pmatrix}$. In particular if random matching is occurring, one should expect all these log odds ratios to be equal to 0.

Siow (2015) shows that supermodularity of the marital surplus implies that all local log odds ratios should be positive, i.e. that the matrix $(n_{ij})_{1\leq i,j\leq 3}$ should be totally positive of order 2, or TP2 for short. I test this TP2 criterion statistically by following the method prescribed by Garre et al. (2002), which Siow (2015) also follows. First define three different hypotheses: H_0 corresponds to the restricted model where all local log odds ratios are equal to 0; H_1 the model where they are positive; and H_2 the unrestricted model. Hypothesis H_0 also means that the matrix $(n_{ij})_{1\leq i,j\leq 3}$ is totally null of order 2, which I call TN2 for short. Call L_0, L_1, and L_2 the models' respective likelihoods: for instance,

$$L_1 = \max_{\nu_{ij}} \sum_{ij} n_{ij} \ln(\nu_{ij}) \tag{43}$$

subject to the constraints

$$\ln\left(\frac{\nu_{ij}\ \nu_{i+1,j+1}}{\nu_{i,j+1}\ \nu_{i+1,j}}\right) \geq 0 \qquad (\forall i, j \leq 2) \tag{44}$$

and

$$\sum_{ij} \nu_{ij} = N. \tag{45}$$

The likelihood L_0 is obtained by using an equality constraint in (44), and L_2 by removing

Mother's education	Father's education			Total
	Primary or less	Secondary	More than secondary	
Primary or less	8998	1968	298	11264
Secondary	1136	3428	1023	5587
More than secondary	97	428	1417	1942
Total	10231	5824	2738	18793

Table 13: Parental education and homogamy.

	Father's education					Local log odds ratios	
Mother's education	Pri	Sec	Sec+	Total		Pri, Sec	Sec, Sec+
	TP2 probabilities					TP2 log odds	
Pri	0.479	0.105	0.016	0.600	Pri, Sec	2.624	0.678
	(0.004)	(0.002)	(0.001)			(0.039)	(0.068)
Sec	0.060	0.182	0.054	0.296	Sec, Sec+	0.380	2.406
	(0.002)	(0.003)	(0.002)			(0.119)	(0.061)
Sec+	0.005	0.023	0.075	0.103			
	(0.001)	(0.001)	(0.002)		LR_{01} statistic: 10 352		
Total	0.544	0.310	0.145	1	p-value: 0		
	TN2 probabilities						
Pri	0.326	0.186	0.087	0.599			
	(0.003)	(0.002)	(0.002)				
Sec	0.162	0.092	0.043	0.297			
	(0.002)	(0.001)	(0.001)				
Sec+	0.056	0.032	0.015	0.103			
	(0.001)	(0.001)	(0.000)				
Total	0.544	0.310	0.145	1			

Note: Standard errors in parentheses (parametric bootstrap, 100 replications).

Table 14: Estimated probabilities and local log odds ratios – full sample.

constraint (44) entirely. The statistics of interest are log-likelihood ratio (LR) test statistics,

$$\mathrm{LR}_{01} = 2(L_1 - L_0) \qquad \text{and} \qquad \mathrm{LR}_{12} = 2(L_2 - L_1). \tag{46}$$

The statistic LR_{12} indicates to what extent TP2 fits the data, and LR_{01} tests whether positive local log odds ratios are a better fit than if they are null. When samples obey TP2, I test H_1 versus H_0. When they do not, I test H_1 versus H_2. I report estimates of the probabilities $p_{ij} = \frac{\nu_{ij}}{N}$ for a marriage observation to fall in the ij category. The p-values and standard errors are obtained by parametric bootstrap with 100 replications.

Analysis on the full sample. Table 14 presents the estimated probabilities and the associated local log odds ratios for the full sample. The local log odds ratios are all positive, so the data obeys TP2. For this reason, the estimates from the unrestricted problem are the same as the TP2 estimates, which is why I only report the latter. In this case, the relevant hypothesis test is H_1 versus H_0: is there evidence for positive local log odds ratios, rather than them being all zeros? The associated test statistic is LR_{01}.

The value of the LR_{01} test statistic is very large in this case, at 10 352. Accordingly, the p-value is extremely small – in fact, it cannot be differentiated from 0 at the precision level which I use. This provides strong evidence to reject the null hypothesis H_0 that local log odds ratios are all zeros, in favor of H_1 and TP2. In turn, this provides strong evidence of homogamy and of the supermodularity of the marital surplus in the full sample.

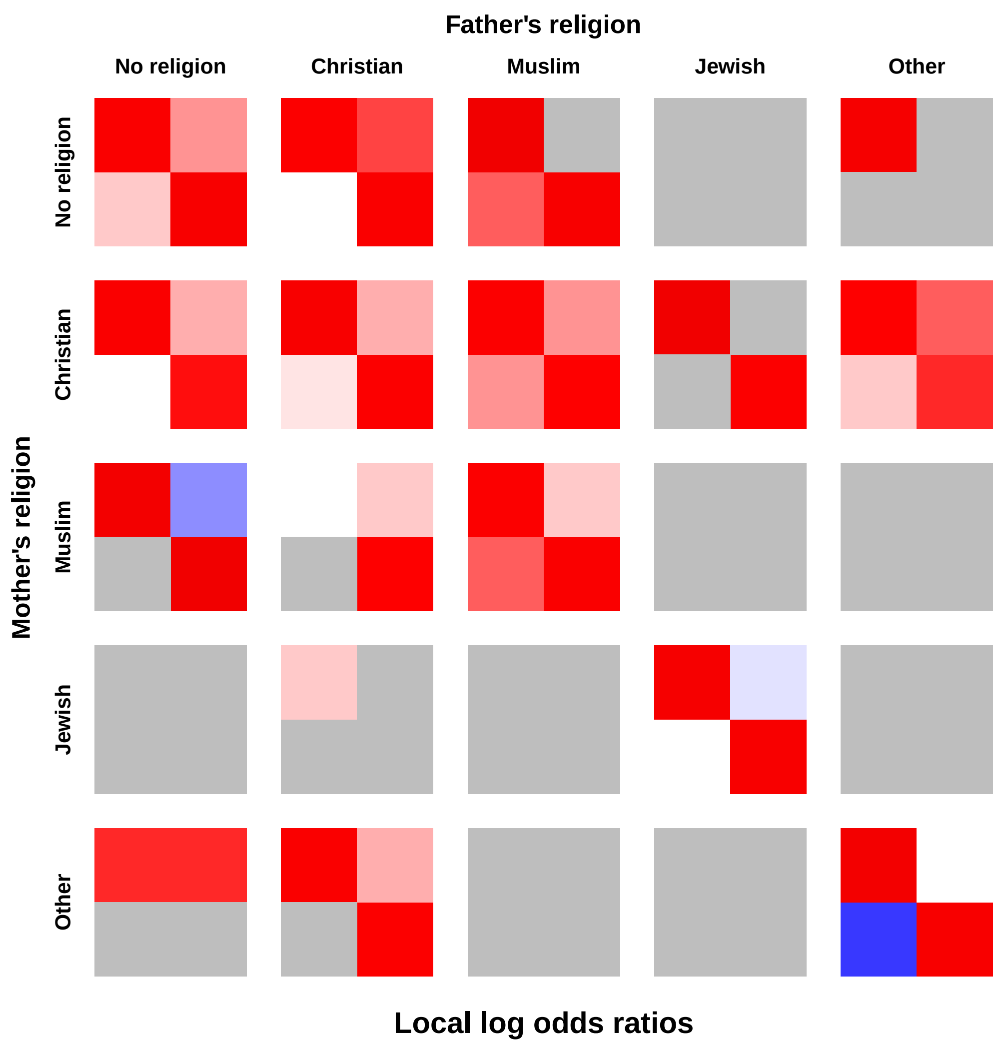

Figure 32: Local log odds ratios conditional on spouses' religious affiliation. Red indicates positive values, and blue negative ones. Lighter shades indicate values closer to 0. Gray indicates missing values.

Analysis conditional on spouses' religious affiliations. Figure 32 presents the empirical local log odds ratios conditional on spouses' religious affiliation using a color chart. Red indicates positive values, and blue negative ones (gray indicates missing data). A glimpse at the figure shows that most of the local log odds ratios which can be computed are positive. I test TP2 for each configuration of the spouses' religious affiliation, using the same method as for the full sample.

Mother: No religion Father: No religion						
	Father's education				Local log odds ratios	
Mother's education	Pri	Sec	Sec+		Pri, Sec	Sec, Sec+
	Unrestricted probabilities				Unrestricted log odds	
Pri	0.342	0.094	0.009	Pri, Sec	2.425	0.860
	(0.011)	(0.007)	(0.002)		(0.134)	(0.300)
Sec	0.085	0.264	0.059	Sec, Sec+	0.531	2.657
	(0.006)	(0.010)	(0.006)		(0.322)	(0.162)
Sec+	0.006	0.034	0.107			
	(0.002)	(0.004)	(0.007)			
	TP2 probabilities				TP2 log odds	
Pri	0.342	0.094	0.009	Pri, Sec	2.425	0.860
	(0.011)	(0.007)	(0.002)		(0.119)	(0.301)
Sec	0.085	0.264	0.059	Sec, Sec+	0.531	2.657
	(0.006)	(0.009)	(0.005)		(0.318)	(0.161)
Sec+	0.006	0.034	0.107			
	(0.002)	(0.004)	(0.006)			
	TN2 probabilities			$N = 2033$		
Pri	0.193	0.175	0.078	LR_{12} statistic: 0		
	(0.007)	(0.005)	(0.004)	p-value: 1		
Sec	0.176	0.160	0.071	LR_{01} statistic: 1 211		
	(0.005)	(0.005)	(0.004)	p-value: 0		
Sec+	0.064	0.058	0.026			
	(0.004)	(0.004)	(0.002)			

Note: Standard errors in parentheses (parametric bootstrap, 100 replications).

Table 15: Estimated probabilities and local log odds ratios – No religion, No religion.

Mother: No religion Father: Christian						
	Father's education				Local log odds ratios	
Mother's education	Pri	Sec	Sec+		Pri, Sec	Sec, Sec+
	Unrestricted probabilities				Unrestricted log odds	
Pri	0.175	0.079	0.005	Pri, Sec	2.212	1.427
	(0.026)	(0.021)	(0.005)		(0.462)	(38.636)
Sec	0.069	0.286	0.079	Sec, Sec+	0.042	2.454
	(0.020)	(0.028)	(0.017)		(7.964)	(0.404)
Sec+	0.016	0.069	0.222			
	(0.010)	(0.018)	(0.027)			
	TP2 probabilities				TP2 log odds	
Pri	0.175	0.079	0.005	Pri, Sec	2.212	1.427
	(0.031)	(0.021)	(0.005)		(0.496)	(23.882)
Sec	0.069	0.286	0.079	Sec, Sec+	0.042	2.454
	(0.019)	(0.033)	(0.017)		(13.175)	(0.389)
Sec+	0.016	0.069	0.222			
	(0.007)	(0.019)	(0.030)			
	TN2 probabilities			$N = 189$		
Pri	0.067	0.112	0.080	LR_{12} statistic: 0		
	(0.011)	(0.015)	(0.013)	p-value: 1		
Sec	0.112	0.188	0.133	LR_{01} statistic: 109		
	(0.015)	(0.022)	(0.017)	p-value: 0		
Sec+	0.080	0.133	0.094			
	(0.012)	(0.019)	(0.015)			

Note: Standard errors in parentheses (parametric bootstrap, 100 replications).

Table 16: Estimated probabilities and local log odds ratios – No religion, Christian.

Mother: No religion Father: Muslim						
	Father's education				Local log odds ratios	
Mother's education	Pri	Sec	Sec+		Pri, Sec	Sec, Sec+
	Unrestricted probabilities				Unrestricted log odds	
Pri	0.375	0.011	0.000	Pri, Sec	3.561	+Inf
	(0.057)	(0.012)	(0.000)		(20.911)	(20.160)
Sec	0.170	0.182	0.045	Sec, Sec+	1.322	2.639
	(0.038)	(0.042)	(0.022)		(22.206)	(9.429)
Sec+	0.011	0.045	0.159			
	(0.012)	(0.024)	(0.043)			
	TP2 probabilities				TP2 log odds	
Pri	0.375	0.011	0.000	Pri, Sec	3.561	26.579
	(0.049)	(0.013)	(0.000)		(13.546)	(5.671)
Sec	0.170	0.182	0.045	Sec, Sec+	1.322	2.639
	(0.043)	(0.045)	(0.021)		(14.614)	(0.914)
Sec+	0.011	0.045	0.159			
	(0.011)	(0.022)	(0.043)			
	TN2 probabilities			$N = 88$		
Pri	0.215	0.092	0.079	LR_{12} statistic: 0		
	(0.036)	(0.022)	(0.022)	p-value: 1		
Sec	0.221	0.095	0.081	LR_{01} statistic: 71		
	(0.042)	(0.023)	(0.019)	p-value: 0		
Sec+	0.120	0.052	0.044			
	(0.027)	(0.017)	(0.013)			

Note: Standard errors in parentheses (parametric bootstrap, 100 replications).

Table 17: Estimated probabilities and local log odds ratios – No religion, Muslim.

Mother: No religion Father: Jewish						
	Father's education				Local log odds ratios	
Mother's education	Pri	Sec	Sec+		Pri, Sec	Sec, Sec+
	Unrestricted probabilities				Unrestricted log odds	
Pri	0.250	0.000	0.000	Pri, Sec	–	–
	(0.163)	(0.000)	(0.000)		(9.925)	(11.615)
Sec	0.375	0.000	0.125	Sec, Sec+	–	–
	(0.190)	(0.000)	(0.115)		(4.953)	(14.785)
Sec+	0.000	0.000	0.250			
	(0.000)	(0.000)	(0.162)			
	TP2 probabilities				TP2 log odds	
Pri	0.250	0.000	0.000	Pri, Sec	7.410	13.921
	(0.132)	(0.000)	(0.000)		(3.095)	(5.022)
Sec	0.375	0.000	0.125	Sec, Sec+	15.385	8.021
	(0.161)	(0.000)	(0.123)		(4.501)	(8.117)
Sec+	0.000	0.000	0.250			
	(0.000)	(0.000)	(0.144)			
	TN2 probabilities			$N = 8$		
Pri	0.156	0.000	0.094	LR_{12} statistic: 0		
	(0.105)	(0.000)	(0.079)	p-value: 0.750		
Sec	0.312	0.000	0.187	LR_{01} statistic: 6.086		
	(0.139)	(0.000)	(0.103)	p-value: 0.010		
Sec+	0.156	0.000	0.094			
	(0.114)	(0.000)	(0.074)			

Note: Standard errors in parentheses (parametric bootstrap, 100 replications).

Table 18: Estimated probabilities and local log odds ratios – No religion, Jewish.

	Mother: No religion		Father: Other			
	Father's education				Local log odds ratios	
Mother's education	Pri	Sec	Sec+		Pri, Sec	Sec, Sec+
	Unrestricted probabilities				Unrestricted log odds	
Pri	0.250	0.000	0.000	Pri, Sec	–	–
	(0.163)	(0.000)	(0.000)		(9.925)	(11.615)
Sec	0.375	0.000	0.125	Sec, Sec+	–	–
	(0.190)	(0.000)	(0.115)		(4.953)	(14.785)
Sec+	0.000	0.000	0.250			
	(0.000)	(0.000)	(0.162)			
	TP2 probabilities				TP2 log odds	
Pri	0.250	0.000	0.000	Pri, Sec	7.410	13.921
	(0.132)	(0.000)	(0.000)		(3.095)	(5.022)
Sec	0.375	0.000	0.125	Sec, Sec+	15.385	8.021
	(0.161)	(0.000)	(0.123)		(4.501)	(8.117)
Sec+	0.000	0.000	0.250			
	(0.000)	(0.000)	(0.144)			
	TN2 probabilities			$N = 24$		
Pri	0.156	0.000	0.094	LR_{12} statistic: 0		
	(0.105)	(0.000)	(0.079)	p-value: 1		
Sec	0.312	0.000	0.187	LR_{01} statistic: 25.125		
	(0.139)	(0.000)	(0.103)	p-value: 0		
Sec+	0.156	0.000	0.094			
	(0.114)	(0.000)	(0.074)			

Note: Standard errors in parentheses (parametric bootstrap, 100 replications).

Table 19: Estimated probabilities and local log odds ratios – No religion, Other.