Variations of wealth resemblance by family relationship types in modern Chinese families

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This contribution is part of the special series of Inaugural Articles by members of the National Academy of Sciences elected in 2017.

Contributed by C. Y. Cyrus Chu, February 4, 2019 (sent for review July 31, 2018; reviewed by Josh Goldstein and Yu Xie)

For a long time, social scientists have used correlations in social status, measured by such characteristics as schooling, income, or occupation, across family members to capture family resemblance in social status. In this study, we use millions of records from a public registry to estimate the wealth correlations among Taiwanese kinship members, from the closest parent–child pairing to the farthest kinship ties, with only 1/32 genetic relatedness. Based on this wealth correlation, we present a complete picture of economic similarity among kin members. These correlations give us a better grasp of the hitherto obscure Chinese family structure than that of mechanical genetic relatedness. We obtain statistical evidence to support the following hypotheses: Family members' wealth resemblance to male egos is stronger than to female egos, wealth correlations are larger along patrilineal lines than along matrilineal counterparts, wealthy families have larger correlations within the nuclear family members but smaller correlations outside it, and adopted children have weaker wealth resemblance with close relatives.

family network | kinship | intergenerational wealth correlation

Social scientists often use the correlation coefficient of family members' socioeconomic status to characterize the status resemblance between them using survey data; a larger correlation often reveals a closer family relationship in the background. Both the achievement indexes and the family members being studied are usually limited by the coverage of survey questionnaires (e.g., availability of measures of socioeconomic status and information on kin network members). These limitations may have constricted our understanding of the family structure in question.

Studies on family members' resemblance in economic outcomes focus on the parents–children correlation in early ones and correlations between siblings in later ones (1, 2) and on correlations between multigenerational or extended family members in more recent ones (3–5). The reasons why such correlation measures capture the idea of family members' connection may be due to material and affective support (6), cognitive and emotional interactions (7), experience and information sharing, or the heredity of intelligence or other traits. The general conceptual idea of the correlation analysis is similar both to that of Sahlins (8), which involves capturing the nature of kinship as "mutuality of being," and to measuring the resemblance in performance among kinship members (9, 10). Because the family structure is time variant and has dynamic social contexts, it is important to see how such dynamic correlations change as modern Chinese family structure evolves (11).

The standard way of measuring genetic relatedness between any two family members was first proposed by Wright (12) and has been broadly used by evolutionary anthropologists. Another time-invariant measure of relatedness is the degree of relationships defined by the Roman civil law. It is now adopted by most countries, including France, Germany, Japan, Switzerland, and Taiwan (13). The Roman law approach consists of counting

from the ego up to the first common ancestor then down to the corresponding relative, and the sum of counts is the degree of relationship.

The advantage of the correlation measure, compared with the genetic relatedness or the Roman law measure, is that it captures the dynamics of complicated social institutions and forces. The disadvantage, however, as noted by Mare (4), is that the data beyond grandparents are rarely available. In this paper, we try to analyze what are perhaps the best family network data in the world to study what are arguably among the closest family relationships in the world—Chinese families in Taiwan. Relations among members of Chinese families are known to be strong, and their interactions are frequent and affectionate. Their interactions often involve provision of emotional and material support to each other. [Evidence in previous studies (11, 14) shows that the intensity of interaction among family members in Taiwan is higher than in their Western counterparts. For example, while 72.4% of individuals in Taiwan gave cash to parents (14), only 44.2% of black individuals and 28.5% of white individuals in the United States gave financial support to a family member (15).]

Our empirical analysis, along the lines of Solon (16, 17) and Mare (3, 4), sets out to calculate the correlation of family members' wealth while controlling their personal characteristics. Because of the huge number of observations available to us from the registry observations available to us from the registry records and our efforts in identifying the relatives from the records, we are able to trace an ego's family members, according to the Roman law criteria, from the most direct line, which is parents–children, to aunts/uncles, great aunts/uncles, first cousins, second cousins, etc. (Fig. 1), and the farthest point of kinship in our observation can have only a 1/32 genetic

Significance

This study uses millions of records from a public registry in Taiwan to estimate wealth correlations among kinship members. This wealth correlation as a measure of kinship resemblance is shown to capture much more information about the modern Chinese family than that of mechanical genetic relatedness or the correlations among immediate family members. We are able to see from our proposed measure the variations of family members' resemblance between males and females, between paternal and maternal lines of relatives, between rich and ordinary families, and between adoptees and other children.

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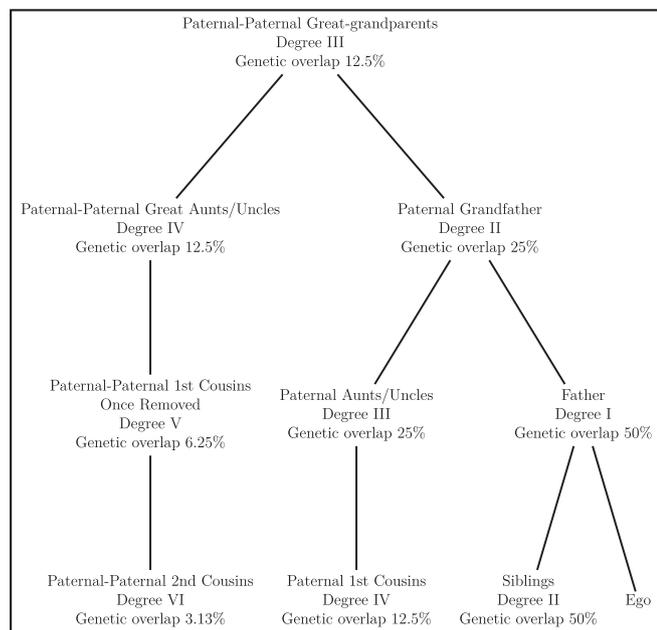
Fig. 1. Patrilineal descents covered in this study. This could also be applied to the paternal–maternal line by changing paternal grandfather to paternal grandmother and to maternal lines by changing father to mother and the corresponding relatives.

relatedness with the ego. We therefore obtain correlation coefficients for almost the whole family network, which helps us to identify just how closely or how remotely family members resemble each other in economic status. Moreover, the correlation coefficients are estimated separately for paternal and maternal lines, males and females, etc., to test whether some traditional social science hypotheses on Chinese family patterns really can be supported by the data.

Data and Estimation Method

Data. Our analyses are based on de-identified administrative records of income and wealth in Taiwan provided by the Financial Information Agency (FIA), Ministry of Finance, Taiwan. These records are open to the public and available to all researchers, but any operations involving the data have to be undertaken in the FIA's on-site data center.

To calculate individual wealth, we use three sets of individual wealth records—stock shares, housing, and land. We also derive the total amount of savings deposits based on "interest income" in the income tax records. The FIA originally recorded

stock shares at their face value; we measure their market price using the closing prices at the stocks' respective ex-right dates or, in the absence of an ex-right date for the companies in question, their closing price on July 31. For unlisted stocks, we use their net value or face value if their net values are unavailable. The value of housing and land is assessed by the registration authorities for tax purposes. The assessed value is understated by 40–60% compared with the market value. We adjust the land value by the yearly county-level percentage of undervaluation as assessed by the authorities. To avoid short-term fluctuations, we take the 3-y average wealth level for the period 2013–2015.

Taking those who were 25–45 y old in 2015 as egos, we trace their parents, grandparents, and great-grandparents from the FIA records. [These egos were all born after 1970, long after the end of the Second World War, and were exposed to 9 y of compulsory education, which was launched in 1968, affecting people born after 1956. They have experienced the period when Taiwan's income inequality began to deteriorate (after 1980). Other things being equal, the wealth variations of these egos are likely to be larger and are more susceptible to the influence of their family background.] It is then possible, from the lineal tree, to identify three generations of collateral relatives: the ego's parents, siblings, first cousins, second cousins, parents' siblings (aunts/uncles), parents' first cousins (first cousins once removed), and grandparents' siblings (great aunts/uncles). Here, great-grandparents are not included because most of them had passed away as of 2015.

We have a total of 7,682,140 egos; among them 5,147,035 had both parents alive in 2015, and 886,056 had both (paternal or maternal) grandparents alive. The average age of the ego sample was 35.27 y old in 2015. Their parents and grandparents, respectively, were 61.42 y old and 81 y old on average. Their fathers were on average 3.5 y older than their mothers, and grandfathers were about 2.64 y older than grandmothers.

As the paternal and maternal lines of relatives have different roles in the Chinese kinship system, in the estimation we first control the lineage fixed effects and then estimate a separate correlation coefficient with a relative for each lineage. To clarify the notations referring to different lineages, we start from the ego and put the closer lineage first; for example, for the paternal grandmother's siblings, we refer to them as paternal–maternal great aunts/uncles. Fig. 1 shows the structure of the kinship members covered by our dataset, taking patrilineal descendants, only for the sake of simplicity.

Measurement of Resemblance. In the literature, the father–child wealth correlation or the coefficient of father's wealth in the regression model of children's wealth is the most commonly used indicator of intergenerational mobility. It is often interpreted as a measure of direct transmission of wealth from parents to

Table 1. Wealth correlations

| Relative degree | Genetic overlap | Kin type | All | | Male relatives | | Female relatives | | Difference |
			1) Wealth correlation	2) Sample size	3) Male egos	4) Female egos	5) Male egos	6) Female egos	7) Paternal vs. maternal
1	0.5	Parents	0.304***	5,147,035	—	—	—	—	—
2	0.5	Siblings	0.305***	13,667,901	0.403***	0.242***	0.275***	0.300***	—
2	0.25	Grandparents	0.131***	886,056	—	—	—	—	0.0160***
3	0.25	Aunts/uncles	0.117***	38,480,347	0.135***	0.106***	0.113***	0.107***	0.0118***
4	0.125	1st cousins	0.0931***	52,878,902	0.105***	0.0804***	0.0938***	0.0875***	0.0230***
4	0.125	Great aunts/uncles	0.0547***	7,604,802	0.0627***	0.0553***	0.0504***	0.0485***	0.00958***
5	0.0625	1st cousins once removed	0.0495***	26,556,522	0.0551***	0.0429***	0.0485***	0.0470***	0.0178***
6	0.0313	2nd cousins	0.0341***	31,174,165	0.0351***	0.0299***	0.0369***	0.0334***	0.0150***

*,**, and *** denote statistical significance at the 10%, 5%, and 1% levels. Except for parents and siblings, the paternal/maternal lineage fixed effects are controlled in columns 1 and 3–6. Results in column 7 are for Eq. **2**, where the group dummy is for paternal/paternal–paternal lineage. Relative degrees follow those of the Roman law measures.
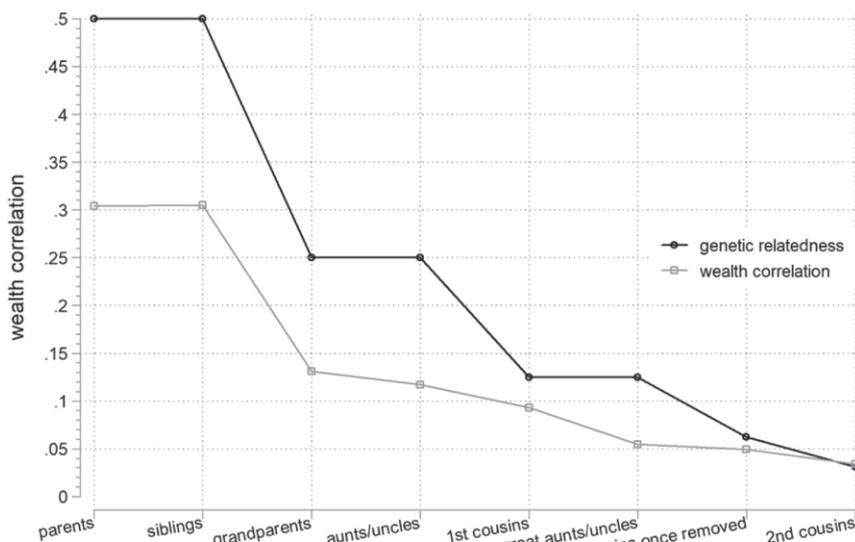
Fig. 2. Wealth correlation and genetic relatedness.

their children, plus the indirect passage of other advantages, such as investment in their children's human capital (17) and provision of opportunities. Here we do not want to overinterpret the meaning of the correlation to imply any causality of kinship behavior toward the ego. Just as the sibling correlation is seen as the embodiment of family factors shared among siblings (1, 2), one could imagine such correlations with his/her kinship members as being forged over time by a variety of different factors and through multiple channels. Thus, a static, contemporaneous wealth correlation could be seen as a useful way of capturing the pattern of egocentric similarity among kin members (4).

Following Chetty et al. (18) and Boserup et al. (19), we measure an individual's wealth using his/her relative position (i.e., his/her rank, in the range 0–1) in the sample instead of its level. To estimate wealth correlation β_k between an ego and his/her relatives belonging to kinship relationship k, we regress his/her wealth rank on that of his/her relatives while controlling for age (using a fourth-order polynomial) and whether the relative is a matrilineal or patrilineal one. (It is noted that the regression

coefficient β_k is not exactly equal to the correlation coefficient of wealth, but is close to it. It is identical to the correlation coefficient if the standard deviations of the ego's and his/her relatives' wealth ranks are the same after controlling for age and other factors in the regression model, which is likely to be the case.) The following is the regression model,

$$R_i = \alpha + \beta_k R_{ikj} + \sum_{a=1}^{4} \gamma_a^m A_{ikj}^a M_{ikj} + \sum_{a=1}^{4} \gamma_a^f A_{ikj}^a (1 - M_{ikj})$$

$$+ \sum_{a=1}^{4} \delta_a (A_i - 40)^a + \sum_{a=1}^{a} \theta_a R_{ikj} (A_i - 40)^a + \lambda P_{ikj} + \epsilon_{ikj},$$

[1]

where R_i is ego i's wealth rank, R_{ikj} is the wealth rank of member j of i's kinship relationship k, A_{ikj} and A_i denote the age, M_{ikj} is a binary variable indicating j is male, P_{ikj} is a binary variable indicating that j is a patrilineal relative, and ϵ_{ikj} is an error term.
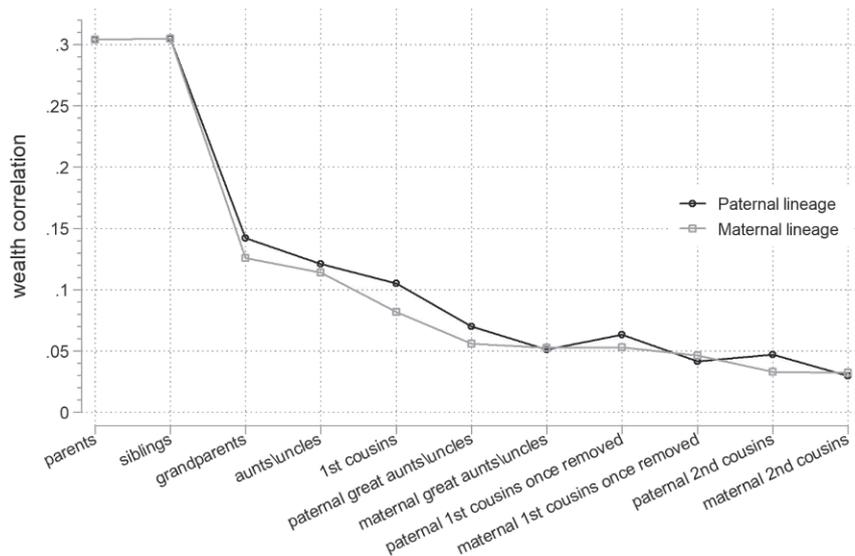

Fig. 3. Paternal and maternal lineages.

Table 2. Group differences by paternal/maternal lineage: gender, parental wealth, and biological family

Relative degree	Genetic overlap	Kin type	Eq. 1		Eq. 2: group difference (β_k^D)			
			1) Wealth correlation	2) Sample size	3) Male egos	4) Top 25% parental wealth	5) Top 1% parental wealth	6) Adoptee egos
1	0.5	Parents	0.304***	5,147,035	0.0170***	0.645***	8.686***	−0.0586***
2	0.5	Siblings	0.305***	13,667,901	0.0616***	0.125***	0.160***	−0.168***
2	0.25	Paternal grandparents	0.142***	363,917	0.0137***	0.00974**	−0.101***	−0.0154
2	0.25	Maternal grandparents	0.126***	522,139	−0.00412	0.00792**	−0.0609***	0.0171
3	0.25	Paternal aunts/uncles	0.121***	17,376,356	0.0192***	−0.0187***	−0.109***	−0.000727
3	0.25	Maternal aunts/uncles	0.114***	21,103,991	0.00445***	−0.00533***	−0.0892***	−0.0119***
4	0.125	Paternal 1st cousins	0.105***	25,223,873	0.0223***	0.0150***	−0.0407***	−0.0276***
4	0.125	Maternal 1st cousins	0.0820***	27,655,029	0.00247***	0.00166***	−0.0502***	−0.00728***
4	0.125	Paternal–paternal great aunts/uncles	0.0701***	1,066,118	0.0103***	−0.0160***	−0.0501***	0.0273
4	0.125	Paternal–maternal great aunts/uncles	0.0511***	2,121,057	0.00274*	−0.00359*	−0.0480***	0.00609
4	0.125	Maternal–paternal great aunts/uncles	0.0559***	1,513,377	−0.00137	−0.00272	−0.0441***	0.00189
4	0.125	Maternal–maternal great aunts/uncles	0.0528***	2,904,250	−0.00235*	−0.00474***	−0.0349***	0.0110
5	0.0625	Paternal–paternal 1st cousins o/r	0.0634***	4,594,690	0.0151***	−0.0133***	−0.0838***	−0.0100
5	0.0625	Paternal–maternal 1st cousins o/r	0.0415***	6,710,593	0.00276***	−0.0100***	−0.0691***	−0.000124
5	0.0625	Maternal–paternal 1st cousins o/r	0.0531***	6,282,853	0.000337	−0.00369***	−0.0528***	0.00558
5	0.0625	Maternal–maternal 1st cousins o/r	0.0465***	8,968,386	−0.000231	−0.00594***	−0.0480***	−0.00312
6	0.0313	Paternal–paternal 2nd cousins	0.0471***	5,425,001	0.0105***	0.00576***	−0.0393***	−0.00286
6	0.0313	Paternal–maternal 2nd cousins	0.0296***	8,368,383	0.0000877	−0.000704	−0.0440***	0.0143**
6	0.0313	Maternal–paternal 2nd cousins	0.0330***	7,004,836	0.000996	0.000260	−0.0185***	−0.00777
6	0.0313	Maternal–maternal 2nd cousins	0.0325***	10,375,945	−0.000593	−0.00159*	−0.0207***	−0.00567

*, **, and *** denote statistical significance at the 10%, 5%, and 1% levels. o/r, "once removed." In estimating results in columns 4 and 5 we include only egos who had both parents alive in 2015. About 67% of egos have both parents alive. About 1% of egos were adoptees.

We allow age to have different effects for males and females because men and women may have distinct life-cycle paths for wealth. We follow Lee and Solon (20) by normalizing an ego's age to 40 y.

Features of the Wealth Correlation. Table 1 presents the estimation results. Results in column 1 show that the wealth correlation decreases with consanguinity. Parents and siblings are the closest relatives, as they share the most genetic and socioeconomic factors with the ego and are the most likely to have mutual influence on wealth accumulation. Grandparents come next for similar reasons. The fact that this correlation is larger than the square of the ego–parent correlation suggests that direct multigenerational transmission of wealth is nontrivial. Wealth correlations with aunts and uncles are lower than those with grandparents but higher than those with first cousins. The patterns of correlation with more distant relatives are similar and are not further discussed here. Results in columns 3–6 control for the gender of the relatives and the ego and show patterns similar to those in column 1. For male egos, the wealth correlation with male relatives is higher than that with female ones. For female egos, same-sex correlation is higher only for siblings. In general, the correlation declines with distance of relationship.

Note that for both the Roman law approach and the genetic relatedness approach, the degree of kinship relationship is established and counted through parents. For wealth correlations, kinship relationship going through parents implies that the correlation depends on parents' closeness with their relatives. An individual's correlation with his/her cousins, for instance, may be related to how the ego's parents interact with their own siblings. If the parents' siblings are not close in general, then the cousins in question tend to have a smaller correlation. Thus, the higher the Roman law kinship degree is, the larger is the variation in correlation. This explains why the wealth correlation declines as the distance in kinship of Roman law increases (Table 1 and Fig. 2). However, an ego's siblings and his/her cousins are of the same generation as the ego, and their background and peer groups are likely similar, which increase their correlation. This explains why same-generation relatives (such as siblings in the second degree and first cousins in the fourth degree) generally have larger correlations than relatives of different-generation ones (such as grandparents and great aunts/uncles, who are also the second- and fourth-degree relatives). In fact, the ego's wealth correlation with the first cousin once removed is very close to that with great aunts/uncles, even though the great aunts/uncles are tighter in relationship to the ego in terms of genetic relatedness and the Roman law.

Fig. 2 compares the patterns of wealth correlation and genetic overlap. The two measures decrease at a similar rate in the first three relationship categories: parents, siblings, and grandparents. However, genetic overlapping fails to account for the difference between grandparents and aunts/uncles, as well as first cousins and great aunts/uncles in our results. This highlights the fact that genetic relatedness cannot capture the top-to-bottom mode of relatedness outside of the nuclear family, and the Taiwanese family network does not work simply by consanguinity. These two indexes reach a similar near-zero level as the genetic relatedness reaches a very low level, though. For instance, the wealth correlation between an ego and his/her kins of 1/32 genetic similarity (second cousins) is 0.0341, which is remarkably close to 1/32.

Overall, our results suggest that the family members' resemblance depicted by the wealth correlation is far more intricate than what the Roman law system and genetic relatedness predict. It provides the numeric distances, rather than the ordinal rankings, of each kinship member.

Wealth Resemblance of Chinese Family Networks

Patrilineal and Matrilineal Differences. We conduct a simple statistical test, which is illustrated shortly, on the differences between the paternal and maternal lineages. The test shows that the correlations with paternal (and paternal–paternal) relatives score consistently higher than those with the maternal counterparts (Table 1, column 7). This result still stands even after we control

for the gender of ego and that of his/her relatives. (The test is conducted using Eq. **2**, where D_i is replaced with the paternal or paternal–paternal lineage dummy, conditional on the genders of ego and the corresponding relative.) In Fig. 3 we separate the two lineages from parents, demonstrating the stronger relations with the paternal (and paternal–paternal) side. The exact numbers can be found in Table 2, column 1. One may wonder whether the male/female difference is intertwined with the paternal/maternal difference. To disentangle these two factors we separate the groups and do a refined analysis. In Fig. 4, we observe the particular characteristic of a patrilineal society in that males are more resembled to their paternal relatives and that there is little gender difference in relations with maternal relatives.

In rural societies, according to the anthropology literature, the existence of a distinctively patrilineal system is due to efficiency concerns. For instance, if males are more efficient in a hunting society, then a patrilineal system secures more returns and thus facilitates more family collaboration (9, 21). It is interesting to see that in a developed industrial society like Taiwan, where people are not reliant upon family cooperation for their living, the patrilineal tendency is still present.

Now we conduct some subgroup analyses to investigate further the characteristics of wealth resemblance of members of the Chinese family. We use an interaction term for a group dummy and the wealth rank of the kinship member to test for subgroup differences in wealth correlation. We let D_i be a group dummy and run the following regression:

$$R_i = \alpha + \delta D_i + \beta_k R_{ikj} + D_i \cdot \beta_k^D R_{ikj} + age\ controls + \epsilon_{ikj}. \quad [2]$$

For group dummies, we consider gender, parental wealth (whether in the top 25% and whether in the top 1%), and whether the ego is an adoptee or not. (We rely on income tax records to find gender, and therefore some observations are lost if they have never reported income taxes. Over 95% of observations have the gender information.)

Gender Difference. The results of estimating Eq. **2** are reported in Table 2, columns 3–6. Column 3 contains the coefficient estimates of the male dummy. They are mostly positive and statistically significant for the paternal lineage relatives, while mostly smaller or insignificant for the maternal lineage relatives, which is consistent with the discussion in *Patrilineal and Matrilineal Differences*.
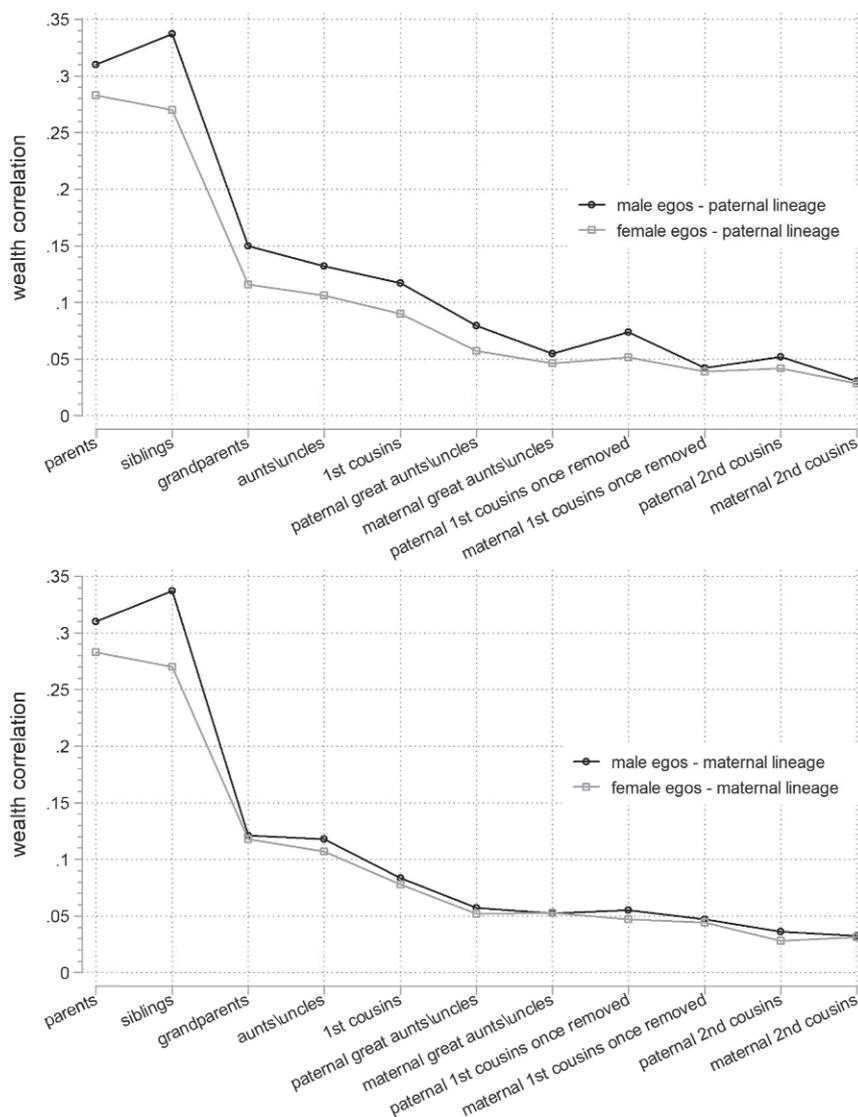

Fig. 4. Paternal and maternal lineages by gender.

Difference by Parental Wealth Rank. A strong wealth correlation within a family network or a subset of this network is an indicator of economic exchange and offers potential insights into the social relations within a family. There is no consensus on how people may relate to their kinship differently as they become wealthier. Some studies find that an individual's wealth weakens reciprocal altruism with relatives, and thus the wealthier are less keen to help kinship members (10, 22), while others suggest that the wealthier people become, the more they hold onto family ideals (23). We frame our question as follows: "When people have wealthy parents, does their wealth correlation structure change?"

In Table 2, column 4 we separate egos by whether their parents' wealth is in the top 25% among all parents in our sample. It appears that those who have top-25% parents do have a smaller wealth correlation with more distant kinship members and their parents' siblings, except for first cousins and paternal second cousins. Column 5 shows that having extremely wealthy parents—in the top 1%—leads to a larger (smaller) correlation with members inside (outside) of the nuclear family. This pattern suggests that extremely wealthy families have tightly knitted "inner circles," but are more loosely linked with the distant kin members.

Difference Between Adopted and Biological Relations. Taiwan's tax registration records show whether a child is an adoptee or not for tax purposes. Adoption, by definition, breaks the genetic correlations between the child and the parents, as well as the rest of the kinship. Therefore, we expect to see a weaker status correlation with relatives for adoptees, especially with closer relatives. This is exactly what we observe in Table 2, column 6. But more distant relatives do not correlate in wealth with adoptees differently than with nonadoptees, likely because the resemblance among distant relatives is weak anyway.

Prospect

In this paper, we provide a measure of family members' resemblance based on analyses of wealth correlation. We find that in Taiwan, an industrialized society, gender gap and a tight patrilineal line still prevail, as indicated by the fact that male-line correlations are larger than their female-line counterparts. Furthermore, these correlations are also influenced by wealth status and adoptee status. Against the background of a time-invariant genetic relatedness measure, our measure using wealth correlation captures the various time-variant social contexts. Using this approach, we expect more interesting dynamics in this measure to be discovered in future studies.

Compared with other countries, wealth correlations with parents in Taiwan are higher than those observed in Denmark [0.234 (19)], but lower than in the United States [0.371 (24)]. On the other hand, our wealth correlations with grandparents are lower than those of both Denmark and the United States [0.162 for the former (19) and 0.194 for the latter (24)]. We believe that further studies along this line would be useful, not only to compare the pattern of income or wealth mobility, but also to develop a cross-culture understanding of the determinants and behavioral patterns of family structure.

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