



Sibling correlations and intergenerational mobility across immigrant groups

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Abstract

We examine intergenerational income persistence and economic assimilation among immigrant groups, focusing on sibling correlations in permanent earnings. Using Dutch administrative data and a heterogeneous income transmission model, we analyze variations across genders, ethnic backgrounds, and immigrant generations. Our results show that, while sibling correlations in income are similar across groups, the underlying factors differ. Immigrants, especially those of Turkish and Moroccan descent, display distinct intergenerational patterns, indicating slower assimilation. Our results are invariant to adjustments for neighborhood characteristics such as ethnic segregation.

Keywords Immigrant assimilation · Sibling correlation · Intergenerational transmission · Segregation

JEL Classification J15 · J61 · J62

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1 Introduction

Upon arrival in a host country, immigrants typically experience worse economic performance than natives. They often work in low-skill, low-income jobs, reside in socioeconomically or ethnically segregated neighborhoods, and experience learning and language difficulties. These disadvantages tend to be passed upon to their offspring (Borjas 1993; Dustmann 2008; Liebig and Widmaier 2009; Algan et al. 2010). Given the substantial and growing proportion of immigrants in many countries, their contribution to the host economy, and their potential challenges, it is critical to understand what drives the immigrant-native gap and its persistence across generations. This is especially important when designing immigration policies that aim to foster immigrant assimilation in the host country.

The degree of association between the social status of different members of the same household has been extensively used in the literature to investigate the role of family background in the distribution of social and economic outcomes. Following the seminal contribution of Becker and Tomes (1976, 1979), significant attention has been devoted to the analysis of vertical relations. This entails investigating the transmission of social status from parents to offspring, commonly referred to as intergenerational correlation.

At the same time, several authors have looked at horizontal relationships and, in particular, at sibling correlations. Sibling correlation is often described as an omnibus measure of family background (e.g., parental resources, aspirations, and cultural inheritance) and community effects, such as school quality, sibling interactions, and neighborhood and network influences (Björklund et al. 2002; Mazumder 2011; Jäntti and Jenkins 2015). If family and community background have little effect on economic outcomes, siblings will exhibit roughly the same resemblance as a randomly drawn pair of individuals from the same birth cohort (Solon 1999). Thus, if inequalities across groups exist, measuring sibling correlation can help to identify the extent to which these inequalities are perpetuated by differences in family and community characteristics (Solon et al. 1991; Björklund et al. 2004; Jäntti and Jenkins 2015; Björklund and Jäntti 2020). A relevant feature of sibling correlation in income is that it allows for the estimation of the importance of the intergenerational transmission of permanent income separately from other residual factors that siblings share but are orthogonal to parental income.

We exploit this approach to study and compare the earnings dynamics and the degree of intergenerational persistence for Dutch native and immigrant brothers and sisters. Specifically, we seek to address the following questions: do immigrants exhibit similar levels of sibling correlation to natives, and is their degree of intergenerational mobility comparable? And do patterns of intergenerational transmission evolve across generations? Our results suggest that sibling correlations are similar across ethnic groups. However, this similarity hides substantial heterogeneity in the relative weight of the intergenerational and the residual components across immigrant groups and across generations, which implies the existence of different assimilation dynamics.

Models estimating the importance of family background typically assume that the intergenerational transmission process is homogeneous across families (e.g., Solon et al. 1991; Björklund et al. 2002, 2009; Levine and Mazumder 2007; Mazumder

2008; Björklund et al. 2010). These studies usually find higher levels of sibling correlation in the United States (namely, 0.40–0.50) compared to European Nordic countries (ranging from 0.14 to 0.26), and that family background has limited weight on the sibling correlation. For instance, Björklund and Jäntti (2009) estimate that the intergenerational component accounts for only 6% of the sibling correlation in Denmark. By relaxing such assumption and formalizing a heterogeneous intergenerational transmission process that is family-specific, Bingley and Cappellari (2019) recently show that the role of family background may be more significant than previous studies indicate. Using Danish administrative data, they find a sibling correlation of 0.22, which originates mostly from the intergenerational transmission process (72%).

The use of a more general model, which relaxes the assumption that the intergenerational factor of the sibling effect is not a fixed proportion but varies across families, may better suit immigrant assimilation processes, given the documented role of family-specific factors in intergenerational persistence such as parental age at migration (Bleakley and Chin 2008), interethnic marriages (van Ours and Veenman 2010), and intention to return to the country of origin (Dustmann 2008). In addition, ethnic capital might play a role in the persistence of inequalities across multiple generations (Borjas 1992; Gang and Zimmermann 2000). In particular, differences in average earnings between groups may persist over several generations because the performance of the offspring will also depend on source-country characteristics (Borjas 1993). Moreover, the results by Bingley and Cappellari (2019) may imply that some immigrants may take longer to assimilate, as intergenerational mobility may be slower than what is typically believed in the literature.

In this paper, we exploit full-population Dutch administrative data across three generations to estimate sibling correlations in permanent income and to understand the relative weight of the intergenerational and the residual components in the sibling correlation in permanent earnings across different ethnic sub-groups. Our analysis relies on a model assuming a heterogeneous intergenerational income transmission process (Bingley and Cappellari 2019; Bingley et al. 2021) that we extend to jointly estimate the entire set of ethnic-group-specific parameters for sons and daughters while allowing for a differential intergenerational transmission for daughters. We also provide results based on a model assuming homogeneity across families (Solon et al. 1991; Björklund et al. 2010). We then examine differences across immigration cohorts to study whether these change over time depending on the immigrant generation and explore heterogeneities based on characteristics of the neighborhood of residence.

We consider the native Dutch population and the three largest immigrant groups in the Netherlands, namely, those arriving from or having ancestors in: (i) European (EU-15) countries; (ii) the former Dutch colonies (Indonesia, Suriname, and the Antilles); (iii) Turkey and Morocco.¹ While each of these groups accounts for roughly 5% of the current Dutch population, they differ substantially in terms of immigration history and assimilation process.

We estimate comparable levels of sibling correlation across ethnic groups (0.298–0.312 for sons and 0.264–0.329 for daughters). Immigrants of European and former

¹ EU-15 countries are Belgium, Denmark, Germany, Finland, France, Greece, Ireland, Italy, Luxembourg, Austria, Portugal, Spain, the UK, and Sweden. Turkey and Morocco are source countries of a substantial population of guest workers in the Netherlands.

colony origin exhibit a similar degree of intergenerational transmission to Dutch native sons, while for immigrants from Turkey and Morocco, this only accounts for half of the sibling correlation.² When it comes to daughters, the residual component has a substantially higher role in explaining sibling correlation across all immigrant sub-groups.

Next, we estimate sibling correlation by ethnic group and immigration generation separately, to understand whether the intergenerational transmission mechanism changes across generations, as immigrants become more assimilated to the host country. Indeed, the sibling correlation of first-generation immigrants is slightly lower than natives. Second-generation immigrants, on the other hand, align with natives. As for the role of parental income, we observe lower parental earnings transmission for all first-generation immigrant sub-groups. This gap, however, disappears when second-generation immigrant sons are compared to Dutch natives, with the sole exception of immigrants from Turkey and Morocco. For daughters, this gap persists, even if it is reduced, also for second-generation immigrants.

Our results provide evidence of an assimilation process in the intergenerational transmission mechanism of immigrants but also highlight the existence of stark heterogeneities across immigrant groups and genders. Thus, we further investigate potential channels to understand whether sibling correlations and the role played by the family component differ across community-specific characteristics. We exploit the richness of our data and compute measures of income and ethnic disparity using information about the neighborhood of the parental household when the siblings were growing up. We then re-estimate our model adjusting for the neighborhood characteristics captured by these measures. Our evidence implies that heterogeneities in the income transmission process across ethnic groups may depend on differences in factors that are unrelated to both parental income and neighborhood-specific measures of income and ethnic segregation.

With this paper, we show the existence of heterogeneous patterns in the intergenerational transmission of permanent earnings across immigrants. To our knowledge, the only analysis using sibling correlation in the context of the immigrant sub-population is the one by Schnitzlein (2012), which relies on the homogeneity assumption and finds an average sibling correlation of 0.26 among second-generation immigrants in Denmark and of 0.17 among Danish natives. We extend our contribution to analyzing sibling correlations following the recent approach by Bingley and Cappellari (2019) and estimate the importance of the intergenerational factors in sibling correlations. We also add to the literature with novel results that look into heterogeneities across genders, immigrant generations, and neighborhood-specific characteristics.

The remainder of this paper is structured as follows. In Section 2, we describe the recent immigration history of the Netherlands. In Section 3, we briefly discuss the theoretical models in the literature and describe our empirical strategy and the data. Section 4 presents the main results by gender and ethnic group, while Section 5 reports heterogeneous results based on immigrant generation and neighborhood-specific characteristics. Section 6 concludes.

² Sibling correlations are slightly larger than those estimated by Bingley and Cappellari (2019) in Denmark, but the share explained by parental income is in line with their estimates (between 50 and 90%).

2 Immigration trends and policies in the Netherlands

After World War II, three significant waves of immigration occurred in the Netherlands (Fig. 1). During the first wave (1945–1963), Dutch, Indonesian, Moluccans, and Dutch-Indo families emigrated from what is today Indonesia to the Netherlands. The largest influx was registered in 1946, 1950, and the late 1950s, largely due to the uncertain recognition of Indonesia's independence in 1949 and the nationalization of Dutch-owned businesses. Despite more than 300,000 people migrating from Indonesia, the Netherlands maintained a negative immigration balance, with a net loss of approximately 7000 individuals annually over this period.

The second immigration wave in the early 1960s marked the transformation of the Netherlands into a country of immigration. Sustained economic growth led to labor shortages, particularly in labor-intensive industries such as textiles and mining, incentivizing Dutch firms to recruit guest workers from Mediterranean countries. The recruitment and settlement processes were managed by private firms, but the government took over establishing recruitment agencies and agreements by sending countries. Up until 1973, undocumented immigrants (i.e., “spontaneous guest workers”) were generally accepted (Rath 2009).

Recruitment mainly targeted workers from Italy, Spain, and Portugal, but Turkey and Morocco rapidly became the largest source of guest workers. Indeed, the Netherlands signed different agreements with Mediterranean countries' governments and allowed immigrants to seek work. The 1969 Foreign Labour Act (*Wet Arbeidsvreemdelingen*, WAV) facilitated the free labor movement within the Benelux countries. Over this period, a *laissez-faire* approach to integration predominated, with the idea that immigrants would eventually return home, making integration a non-priority for the government. Officially, labor recruitment ended in 1975 after the 1973 economic recession. Even after the recruitment period ended following the 1973 oil crisis, immigrants from Turkey and Morocco continued to settle in the Netherlands, entering either illegally or through chain migration mechanisms such as family reunification (Van Meeteren et al. 2013).

The third wave began in the 1970s, with a peak inflow of immigrants from Suriname around 1975. Before this, most arrivals from Suriname were elite youth who migrated to the Netherlands for education. However, political and economic instability following the independence of Suriname in 1975, along with ethnic tensions, prompted many Creoles (African-Surinamese) and Hindostanis (descendants of Indian indentured workers) to move. This resulted in an exodus of around 150,000 people, about one-third of Suriname's population at the time. The period between the 1970s and 1980s is named as the “years of tolerance,” with relatively liberal immigration policies. The Nationality Allocation Agreement (*Toescheidingsovereenkomst*) between the Netherlands and Suriname, for example, led to a significant increase of 110,000 Surinamese between 1974 and 1980. During this period, integration policies focused on supporting immigrants' cultural identities, encouraging self-organization, and offering education in their native languages and traditions.

Following this period of liberal policies, the Netherlands began tightening restrictions, particularly on irregular migration. The 2000 Aliens Act made the country less attractive to asylum seekers in response to the surge of refugees during the 1990s.

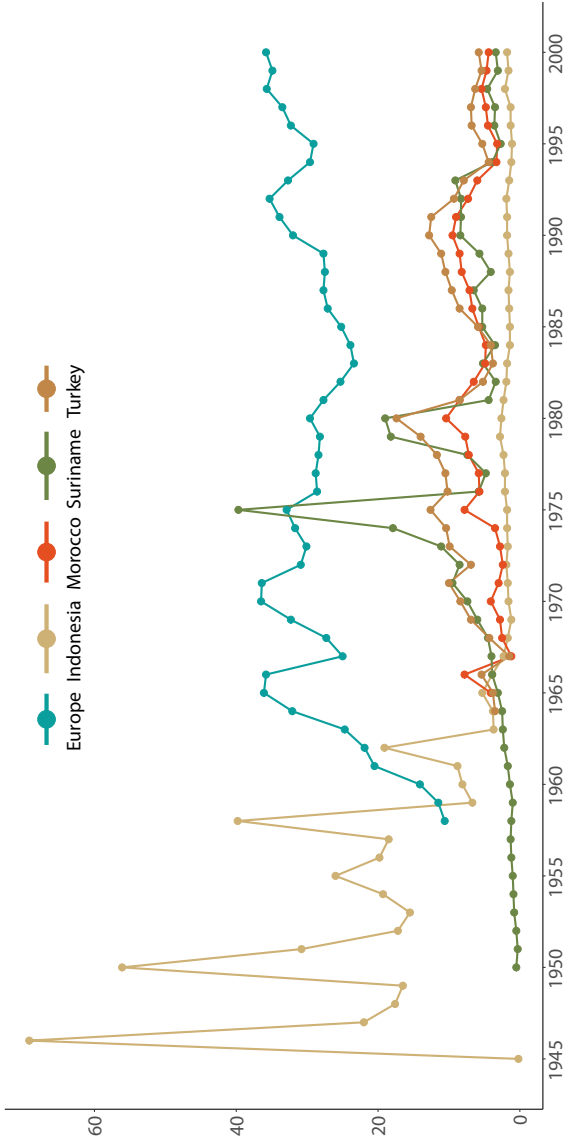


Fig. 1 Immigration to the Netherlands: 1945–2000. Note: Number of immigrants (in '000 s) arriving in the Netherlands, by country of origin and year of first arrival. Data from Statistics Netherlands (CBS)

Additional measures, such as linking social security and tax identification numbers (1991) and the Benefit Entitlement (Residence Status) Act (1998), were implemented to challenge illegal residency while making family migration more stringent.

Immigrants from former Dutch colonies, along with those from Turkey and Morocco, remain the largest non-EU immigrant groups in the Netherlands. While these groups are comparable in size, their experiences with settlement and assimilation differ. Immigrants from the former colonies were often familiar with Dutch culture, law, education, and political systems, particularly those who arrived before or during the decolonization period. In contrast, most immigrants from Turkey and Morocco arrived as guest workers without plans to settle permanently, leading to slower social, linguistic, and cultural integration.

As for immigration from other European countries, the Netherlands has attracted around 30,000 immigrants per year since the mid-1960s, although numbers have skyrocketed since the first enlargement of the European Union in 2004. Our analysis considers individuals from a Dutch background separately, those with a migration history from European countries, former colonies (Indonesia and Suriname), Turkey, and Morocco.

After 2000, migration policy became increasingly selective. The 2004 Highly Skilled Migrants Scheme and the 2006 “Towards a Modern Migration Policy Act” emphasized the need for selective migration. Procedures for student immigrants, for instance, were simplified. Although asylum and family migrations are defined by international treaties and EU directives, which limit national selectivity, the 2006 Civic Integration Abroad Act required family immigrants to pass a civic integration exam before entering the country, making arrivals more difficult. This more selective approach significantly reduced migration from Morocco and Turkey, less attached to linguistic and cultural similarity.³

3 Methods and data

3.1 Sibling correlation and its decomposition(s)

Sibling correlations capture the influence of factors that siblings share in their socio-economic status (most often their earnings). These influences originate both from intergenerational factors and other components orthogonal to them.

Models of sibling correlations assume log earnings in deviation from the mean (w) at time t for individual i in family j as the sum of a permanent component (y) and an orthogonal, white noise, transitory shock (v). The permanent component is divided into two parts: f_j represents the component shared by the siblings, and a_{ij} captures the individual-specific deviation from f_j (i.e., a component unique to the individual i).

$$\begin{aligned} w_{ijt} &= y_{ij} + v_{ijt}, & v_{ijt} &\sim (0, \sigma_v^2) \\ y_{ij} &= f_j + a_{ij}, & a_{ij} &\sim (0, \sigma_a^2), & f_j &\sim (0, \sigma_f^2) \end{aligned} \quad (1)$$

³ Jennissen et al. (2023) provide more details on the changing Dutch models for integration policy and migration regulations during the period 1960–2010.

Given that the family component f_j and the individual-specific component a_{ij} are orthogonal, in the long run, the income variance is the sum of their variances (Solon et al. 1991). Therefore, the sibling correlation can be written as follows:

$$r = \frac{\sigma_f^2}{\sigma_f^2 + \sigma_a^2}.$$

Here, r can be thought of as a comprehensive measure of family background and community effects (Björklund et al. 2002; Mazumder 2011; Jäntti and Jenkins 2015). It contains intergenerational components, such as parental income, cultural inheritance, and parental-driven community effects, as well as individual-specific components, e.g., genetic traits not shared by the siblings, time-specific community effects, and differences in parental involvement in the offspring's education. Not all family and community effects are captured by the sibling correlations. Indeed, all factors not shared by the sibling, such as changes across time in school and neighborhood quality, differences in parental involvement in the offspring's education, and idiosyncratic genetic traits are not captured by sibling correlations. Thus, sibling correlations may underestimate the importance of family background and community effect (Björklund and Jäntti 2020).

Estimating the degree to which r is driven by intergenerational components does not only help to understand the channels behind between-family differences but also the role of other factors such as neighborhood and network effects (Benabou 1994; Durlauf 1994; Chetty et al. 2014; Chetty and Hendren 2018a). One way to decompose the sibling correlation in its intergenerational and residual components follows the original contribution in Solon (1999). The family component f_j can be decomposed linearly as follows:

$$f_j = \beta y_j^F + \mu_j^R, \quad \mu_j^R \sim (0, \sigma_{\mu R}^2), \quad (2)$$

where y_j^F represents parents' earnings, β is the intergenerational elasticity (IGE) assumed constant across families, and μ_j^R is an orthogonal residual sibling effect. The sibling correlation and the implied intergenerational share become the following:

$$r = r_I + r_R = \frac{\beta^2 \sigma_{yF}^2}{\sigma_f^2 + \sigma_a^2} + \frac{\sigma_{\mu R}^2}{\sigma_f^2 + \sigma_a^2} = \beta^2 + r_R \quad \quad \frac{r_I}{r} = \frac{\beta^2}{\beta^2 + r_R} \quad (3)$$

where the last equality relies on a stationarity assumption across generations. This decomposition is typically obtained in two steps. Estimates of β (the coefficient of a linear regression between sons' and fathers' log earnings) and of the sibling correlation are obtained first. The above equation is then used to retrieve the residual component r_R .

The decomposition in Eq. 3 implicitly assumes that the intergenerational component is homogeneous in the population. Bingley and Cappellari (2019) relax this homogeneity assumption and argue that the role of the intergenerational component is much higher than what previous studies usually find. Their analysis is focused on men and relies on the joint estimation of permanent income parameters of three types of family

members: fathers (F), first-born sons (S_1), and second-born sons (S_2). As in Eq. 1, the model of Bingley and Cappellari (2019) assumes that, for each family member, w_{ijt} consist of a permanent and a transitory component. However, instead of assuming that the intergenerational component f_j is homogeneous in the population, they allow it to vary across families, so that:

$$f_j = \mu_j^I + \mu_j^R$$

where μ_j^I is the family-specific intergenerational component and μ_j^R is the family-specific residual component capturing those attributes shared by the siblings which do not depend on fathers' earnings. Therefore, they re-write Eq. 1 as follows:

$$\begin{aligned}
 y_{ij} &= a_{ij} + \mu_j^I + \mu_j^R, \quad \forall i : m(i) = S_1, S_2, \\
 a_{ij} &\sim (0, \sigma_{am}^2), \quad \mu_j^R \sim (0, \sigma_{\mu R}^2), \quad \mu_j^I \sim (0, \sigma_{\mu I}^2)
 \end{aligned}
 \tag{4}$$

The above equation describes permanent income for first-born (S_1) and second-born (S_2) sons. Similarly, permanent income for fathers is described by the following:

$$y_{ij} = a_{ij} + \mu_j^I, \quad a_{ij} \sim (0, \sigma_{am}^2), \quad \forall i : m(i) = F \tag{5}$$

Notice that the above equation does not include the residual component μ_j^R . This is because it is assumed that this component is only shared by siblings within family j . Importantly, both Eqs. 4 and 5 allow for family-member m -specific distributions of the individual-specific components a_{ij} . In light of the above formalization, the sibling correlation in permanent earnings and the implied intergenerational share can be written as follows:

$$r = r_I + r_R = \frac{\sigma_{\mu I}^2 + \sigma_{\mu R}^2}{\sqrt{\sigma_{\mu I}^2 + \sigma_{\mu R}^2 + \sigma_{aS_1}^2} \sqrt{\sigma_{\mu I}^2 + \sigma_{\mu RS}^2 + \sigma_{aS_2}^2}} \quad \frac{r_I}{r} = \frac{\sigma_{\mu I}^2}{\sigma_{\mu I}^2 + \sigma_{\mu R}^2} \tag{6}$$

Although estimation of family-specific components (e.g., μ_j^I) is infeasible, the quantities of interest—sibling correlation and intergenerational share—are a function of the second moments of the distributions of each component. Bingley and Cappellari (2019) show that the entire set of parameters θ can be estimated by minimum distance

imposing restrictions on the joint covariance structure of fathers and offspring' log earning residuals w_{ijt} .

Evidence in the literature on sibling correlation decompositions based on homogeneous intergenerational transmission shows that sibling correlation in permanent earnings typically ranges between 0.14 and 0.26 in Scandinavian countries and is around 0.45 in the USA (Björklund et al. 2002; Mazumder 2008; Björklund and Jäntti 2012; Schnitzlein 2014). Parent-to-child transmission does not appear as the main driver of the sibling correlation in earnings, but similarities among siblings are primarily driven by factors they share other than parental earnings (Solon et al. 1991; Björklund et al. 2004; Jäntti and Jenkins 2015).

Using Danish administrative data and assuming a heterogeneous income transmission process, Bingley and Cappellari (2019) estimate a sibling correlation of 0.22, which is rightly within the range established in the previous literature. However, according to their decomposition, 72% of this correlation is explained by the intergenerational transmission process. This is in contrast with previous studies, and in particular with the estimates for Denmark by Björklund and Jäntti (2009), where the intergenerational component accounts for only 6% of the sibling correlation. The authors also show that one could simply relax the homogeneity assumption in Eq. 2 by considering a transmission process of the type $\beta_j y_{Fj}$ and assume independence between β_j and y_{Fj} . They conclude that this independence assumption plays a crucial role in explaining differences between their decomposition and the one based on homogeneous β . This also has implications for standard IGE estimates.

Notably, two important results derive from the well-established literature assuming a constant transmission process. First, while most works focus on males when siblings of different genders are compared, sisters tend to display a similar, yet lower, sibling correlation than brothers, and analogous magnitudes in the variation attributable to family features and other factors (see, e.g., Björklund and Jäntti 2012; Björklund et al. 2004; Schnitzlein 2014). Second, the literature highlights a much greater importance of institutions over cultural background.⁴ For instance, Schnitzlein (2012) shows that brother correlation in earnings in Denmark is remarkably similar across (relatively distant) immigrant sub-groups, supporting the hypothesis that cultural background plays a negligible role in determining the degree of intergenerational mobility.

In light of the results obtained by Bingley and Cappellari (2019), our goal is to investigate potential differences in sibling correlations and the role of the intergenerational and residual components across sons and daughters and between natives and individuals from different ethnic backgrounds. Thus, we provide separate estimates of decompositions based on homogeneous and heterogeneous intergenerational processes for sub-groups of the population defined by the sex of the offspring pair and ethnic background.

In the context of homogeneous intergenerational transmission, the decomposition described in Eq. 3 is obtained by estimating β and the sibling correlation within each ethnic group g , separately for sons (S) and daughters (D), thereby resulting in the

⁴ The extremely important role of institutions is also proved by the fact that sibling correlation estimates are lower in contexts with a stronger welfare state, with evidence-based on both cross-country (Björklund et al. 2009) and within-country comparisons (Björklund et al. 2002).

following:

$$\begin{aligned}
 r_{Sg} &= \beta_{Sg}^2 + r_{RSg} & \frac{r_{ISg}}{r_{Sg}} &= \frac{\beta_{Sg}^2}{\beta_{Sg}^2 + r_{RSg}} \\
 r_{Dg} &= \beta_{Dg}^2 + r_{RDg} & \frac{r_{IDg}}{r_{Dg}} &= \frac{\beta_{Dg}^2}{\beta_{Dg}^2 + r_{RDg}}
 \end{aligned}
 \tag{7}$$

In the heterogeneous case, separate estimation for each ethnic group g allows for heterogeneity in the full set of model parameters θ_g underlying the decomposition in Eq. 6. This introduces an additional layer of potential heterogeneity among groups. For instance, by allowing σ_{amg}^2 to differ from $\sigma_{amg'}^2$, different groups are not constrained to share the same distribution of the individual component a_{ij} . This might be particularly relevant when analyzing groups defined by ethnicity and immigrant generation.

Unlike the homogeneous case, parameters specific to sons and daughters cannot be estimated using separate samples. The reason is that this decomposition is based on joint modeling of each member’s permanent income process. Separate estimation for sons and daughters would amount to specify a different earnings process for fathers in each sample. We modify the setup in Bingley and Cappellari (2019) to include also sister pairs in the analysis and jointly estimate the entire set of ethnic-group-specific parameters for sons and daughters. Similar to Eq. 4, permanent income for first- and second-born daughters (D_1 and D_2) is described by the following:

$$\begin{aligned}
 y_{ij} &= a_{ij} + \lambda\mu_j^I + \mu_j^{RD}, \quad \forall i : m(i) = D_1, D_2, \\
 a_{ij} &\sim (0, \sigma_{am}^2), \quad \mu_j^{RD} \sim (0, \sigma_{\mu RD}^2), \quad \mu_j^I \sim (0, \sigma_{\mu I}^2)
 \end{aligned}
 \tag{8}$$

The parameter λ is a factor loading that enables the modeling of differential intergenerational transmission for daughters. Values of λ greater or less than unity indicate that the intergenerational component has greater or lesser importance for daughters compared to sons. Importantly, this parameter also enters the equation for the group-specific sibling correlation and intergenerational share of daughters:

$$\begin{aligned}
 r_{Sg} &= \frac{\sigma_{\mu Ig}^2 + \sigma_{\mu RSg}^2}{\sqrt{\sigma_{\mu Ig}^2 + \sigma_{\mu RSg}^2 + \sigma_{aS1g}^2} \sqrt{\sigma_{\mu Ig}^2 + \sigma_{\mu RSg}^2 + \sigma_{aS2g}^2}} & \frac{r_{ISg}}{r_{Sg}} &= \frac{\sigma_{\mu Ig}^2}{\sigma_{\mu Ig}^2 + \sigma_{\mu RSg}^2} \\
 r_{Dg} &= \frac{\lambda_g^2 \sigma_{\mu Ig}^2 + \sigma_{\mu RDg}^2}{\sqrt{\lambda_g^2 \sigma_{\mu Ig}^2 + \sigma_{\mu RDg}^2 + \sigma_{aD1g}^2} \sqrt{\lambda_g^2 \sigma_{\mu Ig}^2 + \sigma_{\mu RDg}^2 + \sigma_{aD2g}^2}} & \frac{r_{IDg}}{r_{Dg}} &= \frac{\lambda_g^2 \sigma_{\mu Ig}^2}{\sigma_{\mu Ig}^2 + \sigma_{\mu RDg}^2}
 \end{aligned}
 \tag{9}$$

3.2 Data and sample selection

We use administrative data from the Dutch *Centraal Bureau voor de Statistiek* (CBS). CBS collects information on all individuals who reside or have resided, in the Netherlands. We use 2020 municipal population registers, which contain anonymized

demographic information on all persons ever appearing in the municipal population registers starting 1 January 1995. By merging this information and those of the legal parents of each person appearing in the register, we recreate family lineages for the entire Dutch population up to their earliest available ancestors and identify the ethnic background of each family.⁵

We classify *first-generation* immigrants as individuals recorded as being born outside the Netherlands, while *second-generation* immigrants are defined as those born in the Netherlands with at least one parent born abroad. Based on the categorization outlined in Section 2, we further divide first- and second-generation immigrants into three mutually exclusive groups according to the birthplace of the individuals or their parents: *EU-15*, *Ex-colonies*, and *Turkey-Morocco*. Lastly, *Dutch* individuals are defined as those with exclusively Dutch-born ancestors up to the third generation (i.e., all grandparents are Dutch-born).⁶

As outlined above, we categorize family members into the following types: fathers (F), first-born sons (S_1), second-born sons (S_2), first-born daughters (D_1), and second-born daughters (D_2).⁷

Subsequently, we link individuals to their income data, available from 2003 onwards. This income microdata is compiled from several Dutch public administrations, with the primary source being the Tax and Customs Administration. Our analysis utilizes what CBS defines as gross personal income, encompassing income from employment, self-employment, and income insurance benefits, along with social security benefits. Excluded from this measure are income from property, child-related transfers, and housing benefits.

Modeling intergenerational income dynamics can present two related measurement challenges. First, annual income data includes both permanent and transitory components (Solon 1992; Zimmerman 1992). A reliable proxy of permanent earnings would require taking several annual observations. A second issue arises from the fact that, in any given year, children and parents are at different stages of their life cycle. This typically results in an underestimation of the children's permanent income and an overestimation of the parents' permanent income (Haider and Solon 2006; Nybom and Stuhler 2016). We address these issues by selecting only individuals aged between 28 and 60 who have at least three non-missing income entries from 2003 to 2019.⁸

⁵ We use the wording *ethnic background* and not *place of birth* following the Dutch government official reporting, which distinguishes between *allochtonen* and *autochtonen*. *Allochtonen* are officially defined as persons who have at least one parent who was born outside the Netherlands. We exclude return immigrants (i.e., foreign-born first-generation immigrants who have an all-Dutch lineage) and those whose legal parents change (usually due to adoption).

⁶ For individuals with two or more non-Dutch ethnic backgrounds, we assign the ethnic group based on the patrilineal lineage. Individuals with other non-Dutch backgrounds are excluded from the sample. Additionally, we exclude from the Dutch sample those individuals for whom complete information on all four grandparents is unavailable, even if the known grandparents are all Dutch.

⁷ First- and second-born sons are identified as the eldest and second-eldest male children within a family, conditional on the observation of at least two male children, irrespective of the presence of female siblings. A similar criterion applies to the identification of first- and second-born daughters.

⁸ As in the earnings dynamics and sibling correlations literature, we exclude zero earnings observations and assume that earnings are missing at random (Björklund and Jäntti 2009; Bingley and Cappellari 2019).

Our final sample consists of 355, 708 triads of fathers, first-born sons, and second-born sons, and 327, 190 triads of fathers, first-born daughters, and second-born daughters. Table 1 reports the average year of birth, average gross income, the average number of years used to model income for each member of the triads in our sample, and the number of observations. The first column refers to the overall sample, the following columns refer to each ethnic group separately. Fathers on average are born in 1953 and have a gross income of around 56,000 EUR. However, while fathers of Dutch descent earn a higher-than-average income, those originating from Turkey and Morocco tend to have a substantially lower income (around 28,000 EUR). A similar pattern, although with lower variability, is also observed in the case of both sons and daughters. Moreover, first- and second-born sons always earn a lower income than their fathers, except in the case of the Turkey/Morocco group, where children on average earn more than the previous generation. As for the daughters, they earn a substantially lower income in comparison to their male counterparts.

Table 1 Descriptive statistics

	Overall	Dutch	EU-15	Ex-col	Tur/Mor
<u>Fathers:</u>					
Year of birth	1953.15	1953.01	1952.70	1952.77	1956.21
Gross income	56,180.91	58,193.05	55,876.08	47,064.80	27,719.11
Income observability	10.50	10.45	9.89	9.93	12.20
N	648,346	575,971	12,609	28,221	31,545
<u>First-born sons:</u>					
Year of birth	1980.27	1980.31	1980.24	1978.95	1980.62
Gross income	48,564.13	49,852.23	45,905.32	41,941.99	34,897.31
Income observability	13.47	13.52	13.18	13.85	12.63
N	355,708	312,670	6780	15,729	20,529
<u>Second-born sons:</u>					
Year of birth	1983.68	1983.65	1983.74	1982.85	1984.74
Gross income	44,180.49	45,313.65	40,776.69	37,687.20	33,020.67
Income observability	11.20	11.28	10.90	11.49	9.82
N	355,708	312,670	6781	15,728	20,529
<u>First-born daughters:</u>					
Year of birth	1980.30	1980.33	1980.19	1978.95	1981.03
Gross income	32,757.57	33,217.81	32,512.60	32,645.91	25,233.43
Income observability	13.19	13.22	13.10	13.92	12.09
N	327,190	289,188	6175	14,555	17,272
<u>Second-born daughters:</u>					
Year of birth	1983.73	1983.70	1983.69	1982.87	1985.07
Gross income	31,880.03	32,296.40	31,055.79	30,911.15	26,020.14
Income observability	11.01	11.07	10.94	11.54	9.49
N	327,190	289,188	6172	14,557	17,273

Note: This reports the average year of birth, average gross income, the average number of years used to compute the permanent income for each member of the triads in our sample, and cell size, by ethnic origin

Importantly, We observe reasonably long income spells across all samples. The average number of yearly income observations per individual ranges is in most cases above 10 for all member types and ethnic groups.

3.3 Estimation

The building block of the entire analysis is individual log annual earnings net of time and age effects: w_{ijt} . Log residuals are obtained regressing income for individual i in family j in year t from group g on year dummies and a second-degree polynomial in age. Residuals are computed separately for each group g and each type of family member (F, S_1, S_2, D_1, D_2).

As noted in Section 3.1, the homogeneous decomposition (i.e., the one assuming that the intergenerational transmission process is constant across families) of the sibling correlation requires estimates of β and the sibling correlation itself. Based on the decomposition in Eq. 7, we first estimate β_{Sg}, β_{Dg} by regressing the average individual log residuals of sons and daughters on the average individual log residuals of fathers separately for each group. Similarly, we separately estimate the sibling correlation (r_{Sg}, r_{Dg}) via REstricted Maximum Likelihood (REML) (Levine and Mazumder 2007; Mazumder 2008; Björklund et al. 2010; Bingley and Cappellari 2019).

The heterogeneous decomposition based on family-specific intergenerational transmission process in Eq. 9 requires estimates of the full set of parameters θ_g . Bingley and Cappellari (2019) show that θ_g can be estimated imposing restrictions on the covariance structure of log earnings residuals w_{ijt} . For instance, the covariance of log earnings residuals between two sisters of a given group g and for two generic years t and s —i.e., $\text{Cov}(w_{D_1gt}, w_{D_2gt})$ —identifies $\lambda_g^2 \sigma_{\mu I_g}^2 + \sigma_{\mu RD_g}^2$. Similarly, the covariance between fathers and first-born daughters—i.e., $\text{Cov}(w_{D_1gt}, w_{Fgt})$ —identifies $\lambda_g \sigma_{\mu I_g}^2$. The full set of identifying restrictions imposed on the covariance structure is provided in Table A.1 in the Appendix. The vector θ_g contains 14 parameters, which correspond to an equal number of moment restrictions.⁹

We first compute each type of moment for every possible combination of years (t, s), separately for each group g . We only consider moments obtained using at least 50 observations. Moments are subsequently stacked and parameters are estimated via equally weighted minimum distance (EWMD) as in Bingley and Cappellari (2019). The quantities of interest, namely, sibling correlation and intergenerational share, are then computed as nonlinear combinations of the estimated parameters following Eq. 9.

4 Results across gender and ethnic groups

We study the patterns in sibling correlation in permanent earnings across immigrant groups and further decompose it to estimate the extent to which this is due to intergenerational components. We consider both the homogeneous and the heterogeneous

⁹ Parameter vector θ_g is defined as $\theta_g = \left\{ \sigma_{\mu I_g}^2, \sigma_{\mu RS_g}^2, \sigma_{\mu RD_g}^2, \lambda, \sigma_{\mu F_g}^2, \sigma_{a S_1 g}^2, \sigma_{a S_2 g}^2, \sigma_{a D_1 g}^2, \sigma_{a D_2 g}^2, \sigma_{v F_g}^2, \sigma_{v S_1 g}^2, \sigma_{v S_2 g}^2, \sigma_{v D_1 g}^2, \sigma_{v D_2 g}^2 \right\}$.

decomposition of the sibling correlation discussed in Section 3.1. We show results for Dutch natives, which we take as a benchmark, immigrants originating from EU-15 countries, former colonies, and Turkey and Morocco separately. Table 2 reports our main results for sons and daughters. For each group, and separately for sons and daughters, we display the estimated sibling correlation r , the intergenerational share r_I/r , and the *IGC*.¹⁰ To simplify notation, we omit the subscripts S_g and D_g for all estimated quantities. For example, r represents r_{S_g} in the “sons” column and r_{D_g} in the “daughters” column of the table. The complete set of estimated parameters used for the heterogeneous decomposition is reported in Table A.2 in the Appendix.

Our estimates of the sibling correlation assuming a heterogeneous income transmission process are similar across ethnic groups and gender, and range between 0.264 and 0.329 (Table 2 (a)). Importantly, the patterns are in line with the estimates for the group of Dutch natives, for whom the sibling correlation is 0.312. In comparison to the Danish context, our estimates of the sibling correlation are slightly larger than the 0.22 estimate by Bingley and Cappellari (2019).

As described in Eqs. 4 and 8, the sibling correlation depends on the total variance of permanent earnings. One legitimate question when comparing the correlation across groups and between sons and daughters is whether the observed similarity in the sibling correlation hides potential differences in the magnitude of each component. We provide a graphical representation of the member-specific decomposition of the variance of permanent earnings (σ_{ym}^2 , $m = \{F, S_1, S_2, D_1, D_2\}$), as implied by Eqs. 4 and 8 for the heterogeneous decomposition, separately for each ethnic group.

The results are displayed in Fig. A.1 in the Appendix. For Dutch natives, daughters exhibit bigger variances for each component for sons, although the relative size is almost identical. The size of the individual components is larger for immigrant sons compared to Dutch natives, whereas no clear pattern emerges for daughters. Notably, the intergenerational component is significantly larger for Dutch native daughters than for daughters of different ethnic origins. Conversely, the estimated residual component is larger for immigrant sons and daughters compared to their Dutch counterparts.¹¹

Turning to the comparison between the two types of decomposition, Table 2 (b) shows that assuming homogeneity in the intergenerational transmission process results in similar estimated sibling correlations. Differently from Schnitzlein (2012), who estimates sibling correlations equal to 0.165 for Danish natives and to 0.263 for second-generation immigrants, and regardless of the model used, we do not observe substantially larger values of r for immigrants than for natives.

Next, we investigate whether the fact that sibling correlation in income is very similar across sons and daughters and ethnic groups also implies that the relative importance of parental permanent income is comparable. As reported in Table 2 (a),

¹⁰ Notice that, as discussed above, the parameters used in the heterogeneous decomposition for brothers and sisters, within each ethnic group, are estimated jointly.

¹¹ Figure A.1 also shows that the estimated individual component for fathers is bigger for each immigrant group with respect to Dutch natives. The individual component of fathers implicitly includes a residual component that fathers share with their siblings. However, since the siblings of the fathers are not included in the sample, we are unable to estimate this shared component.

Table 2 Main results

	Dutch		EU-15		Ex-Colonies		Turkey-Morocco	
	Sons	Daughters	Sons	Daughters	Sons	Daughters	Sons	Daughters
(a) Heterogeneous decomposition								
<i>r</i>	0.312 (0.003)	0.312 (0.004)	0.304 (0.020)	0.325 (0.026)	0.305 (0.012)	0.264 (0.014)	0.298 (0.012)	0.329 (0.014)
<i>r₁/r</i>	0.833 (0.022)	0.810 (0.036)	0.893 (0.084)	0.466 (0.084)	0.803 (0.047)	0.374 (0.051)	0.537 (0.033)	0.193 (0.033)
<i>IGC</i>	0.220 (0.005)	0.213 (0.004)	0.223 (0.016)	0.158 (0.013)	0.225 (0.010)	0.144 (0.009)	0.161 (0.008)	0.100 (0.008)
(b) Homogeneous decomposition								
<i>r</i>	0.258 (0.002)	0.256 (0.002)	0.233 (0.011)	0.256 (0.012)	0.250 (0.007)	0.214 (0.008)	0.242 (0.007)	0.218 (0.007)
<i>r₁/r</i>	0.084 (0.002)	0.145 (0.003)	0.085 (0.015)	0.090 (0.014)	0.161 (0.012)	0.088 (0.010)	0.093 (0.010)	0.065 (0.009)
<i>IGC</i>	0.147 (0.002)	0.192 (0.002)	0.140 (0.012)	0.152 (0.011)	0.201 (0.007)	0.137 (0.007)	0.150 (0.008)	0.119 (0.008)

Note: Estimates of the heterogeneous decomposition reported in Panel (a) are obtained using EWMD; Panel (b) reports estimates of the homogeneous decomposition. Standard errors are in parentheses. In each panel: *r* represents the sibling correlation in permanent earnings, *r₁/r* is the intergenerational share and IGC is the intergenerational correlation

in the case of sons, we observe quite high values for European immigrants and those from former colonies (0.893 and 0.803, respectively). These are largely in line with the estimate referred to Dutch natives, for whom 83% of the sibling correlation is attributable to the intergenerational component r_I .

Conversely, for individuals originating from Turkey and Morocco, r_I only contributes to around half of the sibling correlation.¹² These results confirm those by Bingley and Cappellari (2019), as heterogeneously distributed intergenerational transmission accounts for a large fraction (between 50 to 90 percent) of the overall sibling correlation of permanent earnings. Moreover, our estimates indicate that the sub-groups of immigrants who are more similar to Dutch natives due to historical and institutional reasons (i.e., Europeans and those from former colonies) also tend to have comparable patterns in parental influence. Other immigrants, including guest worker immigrants—typically sourced from Turkey and Morocco—while displaying analogous levels of sibling correlation, owe half of this to factors independent of parental income. As they have lower average levels of income (see Table 1), it seems reasonable to expect that their higher degree of mobility translates into less transmission of poverty across generations.

Interestingly, this pattern does not occur in the case of daughters: while, similarly to males, the intergenerational component accounts for 81% of the sibling correlation in earnings for native sisters, this ratio is much lower for immigrants of European and ex-Colonies descent (47% and 37%) and drops to less than 20% for those of Turkish or Moroccan origin.

When we assume homogeneity in intergenerational transmission, the share of the sibling correlation attributable to the intergenerational component ranges between 8 (for Dutch native sons) and 16% (for sons of former colonies' origin). Similarly, the figures for the females range between 7 and 15% (Table 2 (b)). These results are in line with the previous literature adopting the same approach, which finds a relatively low contribution of father's traits to the sibling correlation (Björklund et al. 2009; Björklund and Jäntti 2012). They also point to the existence of fairly similar intergenerational patterns across all groups. However, this might be due to the fact that estimates in the homogeneous decomposition model are relatively compressed, thus also cross-group differences are less noticeable.

Finally, we consider the intergenerational correlation in income (IGC), or father-to-child correlation.¹³ The pattern of the estimated IGC resembles the one found on the intergenerational share r_I/r . In particular, all immigrant males are aligned to the point estimate of 0.220 for Dutch natives, with the exception of the immigrants from Turkey and Morocco (Table 2 (a)). In the case of females, natives display a substantially higher estimate (0.213) than all immigrant sub-groups, who experience a relatively less important role of parental influence.

¹² These patterns are also evident in the bottom panel of Fig. A.1 in the Appendix, which reports the relative importance of each component of the total variance.

¹³ Note that Table 2 (a) reports the IGC of the first child. The IGC of the second child is reported in Table A.2 and leads to similar conclusions.

5 Results across generations and neighborhood characteristics

In the previous section, we show that Dutch natives and immigrants have comparable levels of sibling correlation, and this occurs for both men and women. In the case of brothers, the intergenerational component and the father-to-child correlation for most ethnic groups are similar to those of natives. Estimates for male immigrants of Turkish and Moroccan descent are instead considerably lower, suggesting a less relevant role of the intergenerational component (i.e., parental earnings) and a more influential role of the residual component in explaining the sibling correlation. In the case of sisters, all ethnic groups display lower estimates than their native counterparts. These differences in intergenerational transmission dynamics across ethnic groups might hide heterogeneous patterns in the assimilation mechanism over immigrant generations. Here, we explore the existence of separate paths across sub-groups.

When addressing the evolution of intergenerational transmission in income for immigrants, we might expect that ethnic disparities fade as families settle and acquire host country-specific human and social capital. Thus, second-generation immigrants would behave more similarly to natives, and so would their intergenerational transmission mechanism.

Figure 2 reports our estimates of the sibling correlation in permanent earnings (r) and the fraction of r explained by the intergenerational component (r_I/r) by immigrant generation. Point estimates of the sibling correlation are fairly similar across generations and ethnic groups, although those referred to as first-generation immigrants are slightly lower than those of natives.¹⁴

When we compute intergenerational shares, however, estimated parameters suggest a large heterogeneity in the contribution of the intergenerational component to the sibling correlation across immigrant generations. In particular, the residual component has a substantial role for first-generation immigrants. When considering second-generation immigrants, estimated values align with the ones referred to by the Dutch natives. The only exception is given by immigrants of Turkish and Moroccan origin, who maintain the same degree of importance of the intergenerational component as the previous generation.

These results seem to confirm the hypotheses mentioned above. If the intergenerational transmission mechanism tends to assimilate across generations, this might be because the characteristics of the parental and residual components become similar to those of natives and so does their relative weight in explaining the sibling correlation. Our estimates suggest that this process occurs within the span of just two generations for immigrants from EU countries and former Dutch colonies, possibly due to the shared history and institutions with the native population. On the other hand, the ethnic group that does not share such strong ties with the Dutch native population seems to experience a slower assimilation process.

We further investigate the potential reasons behind these heterogeneities. Over the last decades, a large literature has investigated the drivers of intergenerational mobility differences and the role of mediating factors such as neighborhood and school quality (Bügelmayer and Schnitzlein 2018; Hedman et al. 2019; Hedman and Ham

¹⁴ We exclude the group of first-generation EU-15 immigrants due to its small sample size.

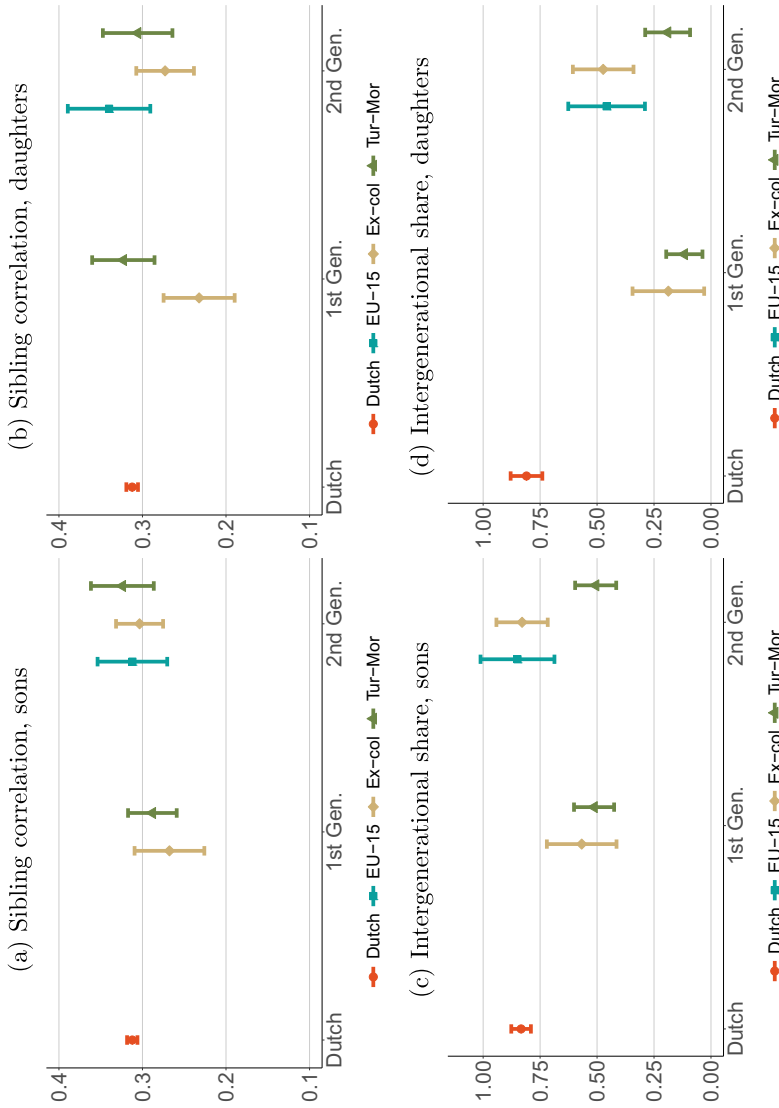


Fig. 2 Sibling correlation and intergenerational shares: results by immigrant generation. Note: Each plot reports point estimates and corresponding confidence intervals at 95% level. **a** and **b** Results on the brother and sister correlation in income (r). **c** and **d** Those on the share of the sibling correlation that is due to intergenerational components (r_I/r), separately for sons and daughters

2021). Above all, neighborhood effects have been proven to be crucial for long-term outcomes such as earnings, via their temporal dimension (Chetty and Hendren 2018a). Thus, the differences in intergenerational mobility between natives and immigrants of different ethnic backgrounds uncovered in Fig. 2 might mask some heterogeneities deriving from these long-term exposures. Indeed, Kleinepiper et al. (2018) find that non-Dutch children, especially Turkish and Moroccan, are more likely to live in poor neighborhoods than their native counterparts, not only at a specific point in time during their childhood but also throughout their entire youth.¹⁵

To explore the role of neighborhood influences, we match families in our sample to a set of neighborhood-level (*buurt*) and municipality-level (*gemeente*) characteristics. CBS records the address spells for each individual appearing in the municipal population registers. We identify the most recurrent location of residence of fathers in the sample between 1980 and 1995.¹⁶ We then assign to each address a neighborhood and a municipality and compute a set of income and ethnic segregation indicators, which might impact the intergenerational transmission process (Chetty et al. 2014; Chetty and Hendren 2018a).

Figure A.2a, in the Appendix, shows the neighborhood-level share of non-Dutch residents (ϕ_E), highlighting regions with significant immigrant populations, particularly in urban areas such as Amsterdam, Rotterdam, and The Hague, as well as in South Holland and Limburg. Next, we compute a measure of ethnic segregation (H^E) for each municipality using the Theil Index as in Chetty et al. (2014).¹⁷ This index, H^E , measures the degree to which the distribution of ethnic groups in each neighborhood deviates from that of the municipality. Figure A.2b displays distinct clusters of larger segregation closeby to major urban centers, especially in cities like Amsterdam, Rotterdam, and The Hague, where ethnic groups tend to be more spatially concentrated.

To capture poverty segregation, we use a Theil index, H^P , based on the share of individuals (in the municipality and neighborhood) with income below the 25th percentile. In Fig. A.2c, warmer colors indicate neighborhoods with a higher proportion of low-income residents, which are common in urban centers and peripheral regions around the largest cities. This pattern suggests an economic divide within metropolitan areas, where low-income households are often clustered in specific neighborhoods.

¹⁵ With Swedish data, Manley et al. (2020) also find that childhood neighborhood has long-lasting effects on residential careers, but these are attenuated by family effects.

¹⁶ Note that, on average, reference individuals in our sample are born in the early 1980s, and their fathers in 1953 (see Table 1).

¹⁷ H^E is computed as follows:

$$H^E = \sum_n \left[\frac{pop_n}{pop_{TOT}} \frac{E - E_n}{E} \right]$$

where pop_n is the population of neighborhood n , and pop_{TOT} is the total population of the municipality. E is an entropy index for the municipality, calculated as $E = \sum_g \phi_g \log \frac{1}{\phi_g}$, with ϕ_g representing the share of individuals of ethnic origin g in the municipality. Similarly, $E_n = \sum_g \phi_{gn} \log \frac{1}{\phi_{gn}}$, where ϕ_{gn} is the share of individuals of ethnic origin g in each neighborhood.

Finally, we construct an indicator for income segregation (H^I) again using the Theil Index as in Chetty et al. (2014).¹⁸ Figure A.2d shows income segregation across neighborhoods. The spatial pattern is similar to that of low-income clustering, suggesting a correlation between income level and income segregation in the Netherlands.

Considering the potential impact of neighborhood influences on assimilation processes, alongside the observed patterns of sibling correlations and their decomposition across immigrant generations, a key question is whether the distributions of the considered characteristics vary across different ethnic groups and immigrant generations.

Figure 3 presents the distribution of ethnic and income segregation at the municipality level, separated by ethnic group and immigrant generation, in comparison to the Dutch native population. Three considerations arise. First, the two measures appear to be strongly correlated. Second, the distribution of both characteristics for the EU-15 group closely resembles that of Dutch natives, in contrast to the other two groups. Third, a clear generational pattern is evident for both the Ex-Colonies and Turkey-Morocco groups. In both cases, the proportion of households on the right side of each distribution is significantly higher than that for natives, and it decreases from the first to the second generation, except for those of Turkish and Moroccan origin. Figure A.3 in the Appendix shows similar patterns for the neighborhood-level share of immigrants, the neighborhood-level share of low-income households, and the municipality-level degree of low-income segregation.

Together with the evidence in Fig. 2, this suggests a link between assimilation patterns, the degree of segregation (and other neighborhood characteristics), and the relative weight of the parental component of the income transmission process. In particular, neighborhood characteristics might be relatively less persistent for the groups that quickly assimilate the intergenerational dynamics of the native population. Conversely, immigrants on a slower assimilation path, for whom the transmission of neighborhood status is more persistent across generations, seem to experience a lower influence of the parental transmission into their sibling correlation in income. This suggests that neighborhood dynamics might contribute to explaining the intergenerational transmission mechanism for the latter immigrant group.

Thus, we turn to directly assessing the importance of living in ethnically or economically segregated areas by considering five measures of spatial heterogeneity: income, poverty, and ethnic segregation, the share of low-income households, and the share of non-Dutch residents in the neighborhood. To do so, we employ a re-weighting approach.¹⁹ First, we discretize the distribution of the generic characteristic c (e.g., income segregation) into ten deciles. Next, for each ethnic group, we calculate the proportion of the group's population within each decile, $\phi_{cg}(d)$. We then define a set of weights for each immigrant group as $\kappa_{cg}(d) = \phi_{c,Dutch}(d)/\phi_{cg}(d)$. These weights are applied to re-estimate the heterogeneous decomposition. Specifically, the full set of moments for each group, as described in Section 3.3, is computed by replacing the

¹⁸ H^I is computed according to Reardon (2011): $H^I = 2 \log(2) \sum_p E(p)H(p)$, where $E(p)$, the entropy index in each municipality, is defined as $E(p) = p \log(2) \frac{1}{p} + (1-p) \log(2) \frac{1}{1-p}$, with p representing the p -th ventile of the income distribution. $H(p)$ is the Theil Index for the p -th ventile, weighted by segregation at each income level.

¹⁹ We thank an anonymous referee for this suggestion.

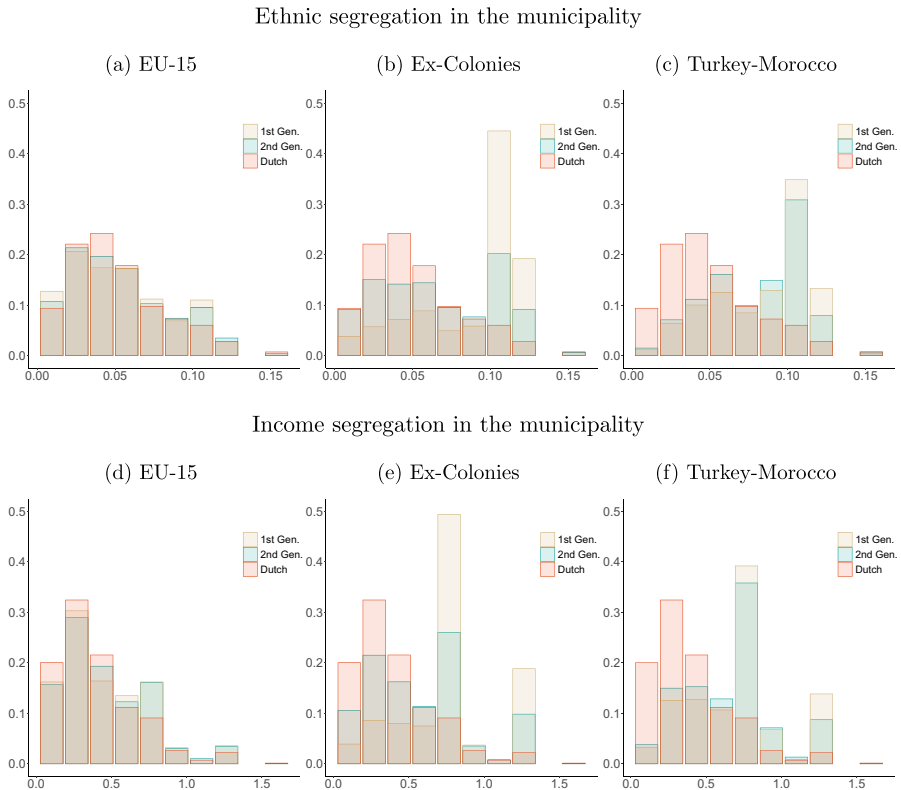


Fig. 3 Distribution of neighborhood/municipality characteristics across ethnic groups and immigrant generations. Note: Each plot reports the distribution of a given neighborhood/municipality characteristic across ethnic groups and immigrant generations compared to the distribution for the Dutch native population. The top panel refers to the ethnic segregation of immigrants in the municipality; the bottom panel refers to income segregation

sample covariances with weighted sample covariances using $\kappa_{cg}(d)$. In other words, we re-weight each ethnic group’s distribution of characteristic c to match the distribution of natives. Thus, estimated parameters should be netted out of the average effect of the neighborhood characteristic c , assuming homogeneous effects of c across ethnic groups.

Figure 4 reports the results of this exercise on the estimation of sibling correlation and intergenerational share for both sons and daughters. In each plot, the group of estimates on the left is the one of Table 2 (a) and is reported as a benchmark. The horizontal line is the point estimate referred to the corresponding Dutch native siblings.

The findings indicate that sibling correlation and the relative importance of its intergenerational and residual components remain stable when adjusted for neighborhood characteristics, indicating that neighborhood factors are unlikely to be the primary drivers of the observed differences across ethnic groups. In other words, these factors do not seem to largely affect the contribution of family background to the overall inequality for any of the ethnic groups considered. This aligns with

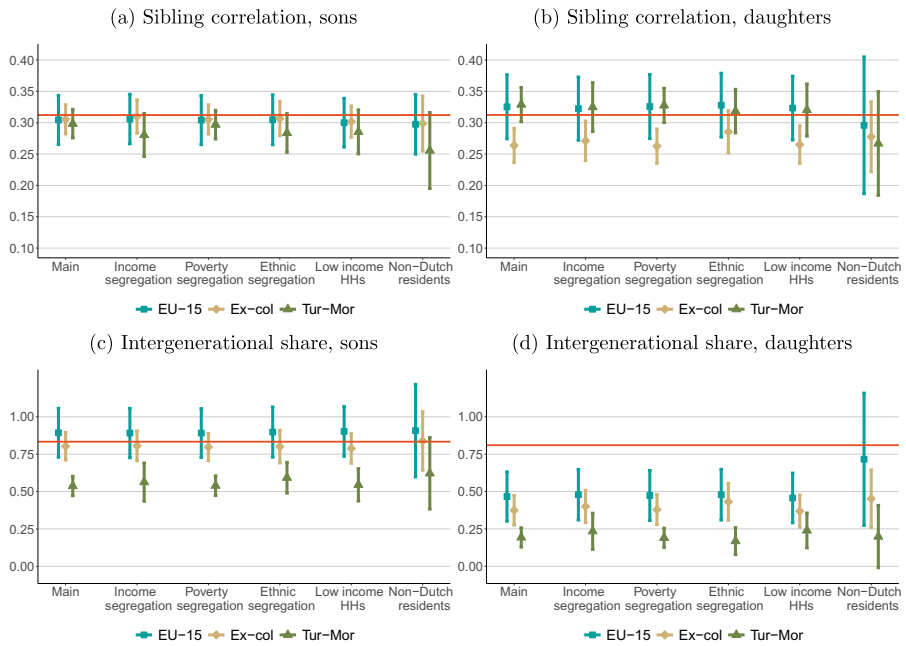


Fig. 4 Sibling correlation and intergenerational shares: re-weighting the distribution of neighborhood characteristics. Note: Each plot reports point estimates and corresponding confidence intervals at 95% level across all re-weighted specifications of the model. The horizontal line is the corresponding point estimate for the native group. **a** and **b** Results on the brother and sister correlation in income (r). **c** and **d** Those on the share of the sibling correlation that is due to intergenerational components (r_I/r), separately for sons and daughters

prior research on sibling correlation, which identifies neighborhood characteristics as having a limited influence (Björklund et al. 2010). However, as noted by Bingley and Cappellari (2019), while most of the sibling correlation in earnings is explained by the intergenerational component, many determinants of the offspring outcomes—including neighborhoods—are correlated with parental earnings. Thus, the gap in the estimated intergenerational share between native sons and those of Turkish and Moroccan descent, as well as between native daughters and those of immigrant background, may reflect differences in characteristics that pertain to the residual component of the sibling correlation (i.e., factors shared by siblings but not correlated to their father’s income) and, in turn, are unrelated to neighborhood measures of income and ethnic disparity.

6 Conclusions

For decades, the variation in earnings shared by siblings was believed to be mostly due to factors uncorrelated with parental earnings (Solon et al. 1991; Björklund et al. 2010). The recent contribution by Bingley and Cappellari (2019) shows that when one assumes heterogeneity in intergenerational transmission between families, intergen-

erational persistence accounts for more than two-thirds of the sibling correlation in permanent earnings. It is not trivial, however, whether this new evidence applies also to the immigrant population and to what extent it may explain differences in immigrant assimilation paths across groups and generations.

We follow the approach of Bingley and Cappellari (2019) to decompose the sibling correlation of permanent earnings into intergenerational and residual sibling components. Our strategy extends that of Bingley and Cappellari (2019) in that we jointly estimate the parameters of interest for both sons and daughters, while allowing a different intergenerational transmission process for daughters, and across ethnic groups.

Using Dutch administrative data, we find that a substantial fraction of the sibling correlation, indeed, derives from parental influences. When considering sub-populations of sons on the basis of ethnic origin, immigrants from Europe and former Dutch colonies are very similar to natives, while the role of parental influences is sensibly lower for those originating from Turkey and Morocco, who moved to the Netherlands mainly as guest-workers and share different characteristics with respect to Dutch natives and other immigrants. When looking at daughters, we find a marked gap between natives and immigrants, regardless of ethnic origin.

When we analyze individuals by immigrant generation, two important results emerge. First, sibling correlation in earnings is slightly lower for first-generation immigrants compared to second-generation ones, who tend to align with Dutch natives. Second, the weight of parental income in the sibling correlation in earnings is lower for immigrants compared to natives, although in the case of sons it does return to values comparable to the native population for second-generation immigrants from Europe and former colonies.

These heterogeneities suggest that different assimilation mechanisms might be at work. Thus, we consider a set of measures of neighborhood ethnic and income segregation as potential mediating factors that could explain such discrepancies across groups (Bügelmayer and Schnitzlein 2018; Chetty and Hendren 2018b; Hedman and Ham 2021). Our analysis reveals that the patterns observed in our main results are mostly invariant to adjustments for neighborhood characteristics.

We conclude that, while the sibling correlation in income is fairly similar across native and immigrant groups, this correlation does not appear to be explained by the same factors. As immigrants assimilate into the native population, their intergenerational transmission mechanisms also become similar to the ones experienced by natives. However, such an assimilation mechanism is not homogeneous across groups. Our results imply that differences in the relative weight of parental influence may stem from residual factors shared by siblings but unrelated to neighborhood characteristics. Future research should investigate these determinants in greater detail.

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Data Availability The data that support the findings of this study are available from the Centraal Bureau voor de Statistiek, (CBS). Restrictions apply to the availability of these administrative data, which are not publicly available and accessible only directly through CBS via a secure connection. Additional information is available at <https://www.cbs.nl/en-gb/onze-diensten/customised-services-microdata/microdata-conducting-your-own-research>. The code used in the preparation of this study is available on the authors' GitHub page.

Declarations

Conflict of interest The authors declare no competing interests.

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