ERASMUS UNIVERSITY ROTTERDAM

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Bachelor Thesis in

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The Intergenerational Transmission of High-Income Status

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Abstract

This research utilises 648 monozygotic and 1016 dizygotic twins' socio-economic outcomes observed in United States of America in 1995 to conduct a twin study on the intergenerational transmission of high-income status. The research is conducted as a unique method to address the prevalent debate of income inequality and intergenerational persistency of socio-economic status in the United States of America. In recent history, there are increasing imparity of opportunities and income immobility in the US. Using the genoeconomical approach of a twin study, the variance of socio-economic position is distributed into three factors: genetic factors, family/common environment, and unique environment. The findings of my study suggest that the variance in socio-economic status cannot be solely contributed to genetic factors and rather unique environmental elements, yet there are portions of the tendency of high socio-economic position that can be pre-dominantly assigned to genetic factors. Furthermore, it can be concluded by accounting for different characteristics, such as gender, age, ethnicity, and educational level, that the intergenerational transfer of high-income status variates heavily depending on the subsegment examined, such that an African American female will experience significantly different mechanisms of the intergenerational transfer of socio-economic status than a Caucasian male.

Contents

1. Introduction

The degree of intergenerational transmission of income status has been a perpetual topic concerning policymakers for decades, with various approaches to examine and quantify the transfer of income status from one generation to the next (Solon, 1992). Largely, it is a staple in socio-economic theory that there is a significant positive correlation between parents' and their descendants' income and socio-economic status (Corcoran et al., 1989). In the past, panel data has been the prevalent method to quantify the correlation between parental economic status and their descendants' earnings (Chadwick & Solon, 2002). However, with the surge of genoeconomics over the past decade, new methods can be utilised to analyse the mechanisms of socio-economic outcomes, such as the intergenerational transmission of income status.

Preceding research has primarily addressed the intergenerational transmission of income status by either focusing on the cycle of poverty (Corcoran, 1995) or analysing income mobility (Lee & Solon, 2009). While these are indeed important studies and issues for scholars and policymakers to address, my research will take another direction: the intergenerational transmission of high income. Income inequality has become an increasingly discussed topic in the United States of America, as the top income percentiles have been experiencing expanding levels of wealth accumulation since the 1970s while the average American has experienced wage stagnation (Piketty & Saez, 2003). The trend in the USA is diverging from other Western developed countries' trends, as France and United Kingdom have illustrated that their wealthiest populations have experienced no real growth in terms of the share in income (Piketty & Saez, 2003). Despite the clear divergent socio-economic trend that the United States of America is experiencing in comparison to countries of similar economic stature, there is not one particular reasoning that can be accredited to having caused this diverging trend. Hence, the genoeconomical approach employed in this paper classifies three factors that can have explanatory power to where the variance in socio-economic status stems from. These three factors are 1) genetic factors, 2) family/common environment, and 3) unique environment. Thus, the following research question has been concocted to address the increasing income inequality in the USA by analysing the mechanisms behind the intergenerational transmission of high-income status:

To what extent do genetic factors, family (common) environment, and unique environment contribute to the tendency of achieving high-income status in the United States of America?

Income inequality has been an economic challenge ever since the birth of the modern society. However, in recent history, economically developed countries have acknowledged it and tried to find tools to effectively redistribute wealth across the population, yet the disparity in the distribution of income seems to be rising over the past decades in certain OECD countries (Cingano, 2014). Hence, it has become a paramount part of most countries' political agendas to address the trends of income inequality and social

deprivation. There are and have been dire consequences to the inability to resolve inequality issues, with some academia citing that the one of the founding pillars of the financial crisis in 2008 was the rising income of the wealthy and the stagnant wage growth for the poorer population in the United States of America (Treeck, 2013). The current importance of income inequality trends further illustrates the relevance of the mechanisms in the intergenerational transmission of high-income status. Therefore, this research is socially relevant as it could help policymakers gain insight into the intergenerational transfer of high-income status which could help enable ideas on how to govern instruments to increase equitable wealth distribution and decrease social deprivation.

As previously mentioned, prior research has focused on the income mobility and social inequality, due to the topics' prevalence in the political agenda. However, examining the factors that contribute to transfer of high-income status between generations is a subject that is yet to be completed. There have been technical genoeconomical approaches to describe which loci[1] can be associated with income (Hill, et al., 2019) and literature that describes the intergenerational transmission of economic status and cognitive abilities (Bowles & Gintis, 2001). However, at this present moment there have been little to no literature that has depicted the intergenerational transmission of high-income status by allocating the variance to genetic factors, family (common) environment, and unique environment. Therefore, this research is scientifically relevant as it will advance the understanding of the intergenerational transfer of high-income status through a genoeconomical scope, which could advance the field of genoeconomics and further cultivate genoeconomic research with focus on social inequality, income mobility, and in general, socio-economic position.

2. Theoretical Framework

There are two main strands of existing literature I will consider as the framework for my research. Firstly, there is the economic theory regarding income inequality, income mobility, and intergenerational persistency of socio-economic status. These fields of economics provide a theoretical foundation to my research and academic reasoning to my results and discussion. Secondly, the methodology and economical approach in my study relates to the field of genoeconomics, by analysing the genetic effects and impact of environment during upbringing on the tendency to be regarded as of high-income status.

Prior to discussing the theoretical foundation of my paper, the relationship between high-income status and socio-economic status must be established. Socio-economic status is a trait given to individuals or subpopulations which is, typically, assessed through three interdependent measures (Baker, 2014).

[1] The physical location within a genome, e.g., a segment of genes or particular gene within a human's DNA string (Sidransky, 2022)

Firstly, the most important measure is income. Income and socio-economic status are essentially interchangeable, as the other two measures that define socioeconomic status are significantly, positively associated with income (Galobardes, et al., 2006). A person who is considered of high-income status should also be considered of high socio-economic position. Thus, high-income status and high socio-economic status will be used interchangeably as they capture the same effects. The second and third measure of socio-economic status is education and occupation, both of which have a palpable association with income and each other.

2.1. Income Mobility, Income Inequality and Socio-Economic Status

Solon's (1992) study of the income mobility in the United States started a wave of research of income mobility and how developed countries experienced diverging trends of income inequality and income mobility, as further examined by Lee and Solon (2009). Socio-economic position has become an increasingly important topic in the United States of America, as the USA is experiencing diverging trends of the persistency of socio-economic status given the trends of other economically developed countries (Piketty & Saez, 2003). The United States of America has shown to have less income mobility and more income inequality than countries of similar economic stature, as proven by the comparison of the US and Sweden (Björklund & Jäntti, 1997) and further emphasized by the findings suggest that socio-economic class is more than twice as intergenerationally consistent in the US compared to Sweden (Vosters & Nybom, 2017). The major reason of the diverging trends was that both the poor fared relatively low-wage growth while the rich experienced increasing levels of income in the USA in the late 20th century (Jenkins & Kerm, 2006). There are many latent reasons for the rigidity of inert income mobility in the US and scholars have researched various unique systems in the US that contribute to the intergenerational income inertia of the poor population and the intergenerational constancy of high-income status.

A mechanism contributing to the intergenerational persistence of high-income status is educational inequality. Education-based inequality was increasing in the late 20th century in the US, with universities getting more expensive to attend. This has led to only the parents with high incomes could afford to send their children to the best ranked universities and colleges, such that 75% of students in top American universities come from the highest socio-economic classes (Haveman & Smeeding, 2006). Additionally, educational attainment is gaining a progressively larger role in recruitment in modern times, thus the most lucrative occupational opportunities are given to graduates from top universities and colleges. Hence, a reason for the persistence of intergenerational high-income status is that parents with high-income are able to send their children to prestigious universities, which in turn enables their descendants to attain highly paid employment opportunities and advance their socio-economic status, an intergenerational cycle unobtainable by the lower income quintiles in America (Bloome, Dyer, & Zhou, 2018). The education-

based inequality could also contribute to the diverging trends of income parity between US and other economically developed countries, as European and the US are experiencing different funding practices and strategies (Rhoades & Sporn, 2002). Namely that American universities have focused on performance-based funding in terms of profitability, causing increasing tuition-premiums and higher educational inequality due to inability of the lower socio-economic status of affording the tuition fees without financial aid that could have detrimental economic repercussions later in life. Overall, the increasing educational wage difference is a cemented reason for the widening income distribution and income equality in the US (Goldin & Katz, Long-Run Changes in the U.S. Wage Structure: Narrowing, Widening, Polarizing, 2007).

The sources of income inequality and income distribution in the US has been researched for decades (Lerman & Yitzhaki, 1985). A prevailing idea of the persistency of high-income status in the late 20th century in the United States compared to countries of similar economic development, is the presence of regressive taxation in the US, which has enabled the highest income quintile to amass increasing wealth concentration (Piketty & Saez, 2003). This stems from the idea of 'trickle-down' economics, which was a political agenda in the middle of the 20th century that promoted regressive taxation schemes. These policies were based on the assumption that wealthiest population were wealthy solely through merit. Thus, giving the population situated in the highest income percentiles, the conceived most economically innate individuals, further resources would have positive effects on the rest of the economy due to the trickling-down of the resources. The trickle-down would be that the resources invested in the richest population would go through the entire population, as the rich would start and manage businesses and employ the lower socio-economic classes, thus redistributing the economic resources (Stiglitz, 2016). In theory this was a policy that could redistribute wealth without hindering economic performance, as economic performance and economic equality were considered a trade-off (Stiglitz, 2016). However, what remains from the trickle-down economics is increasing social inequality in the US, increased wealth accumulation by the top income percentile, and the realization that economic performance and equality are not mutually exclusive, but rather positively correlated.

The preceding literature suggests that the trend of increasing income inequality stem from two agreed-upon sentiments. Firstly, the wealthiest population were able to amass substantial wealth due to the late 20th century political agendas' inclination towards regressive tax regimes and tax cuts due to the misconceived idea that economic equality and economic performance is a trade-off (Stiglitz, 2016). Secondly, the wealthiest population have been able to persistently stay wealthy through generations due to educational inequality, such that the highest socio-economic class attend the best universities allowing them to secure the best employment opportunities (Bloome, Dyer, & Zhou, 2018). These two effects have caused the increase of income inequality and stagnation of income mobility in the United States interdependently.

2.2. Socio-Economic Status in Genoeconomics

Most of the existing literature has utilized panel methods to address income mobility, the correlation between inequality and economic growth, social inequality, and the increasing income inequality in the United States of America. Two specific mechanisms, economic policies favouring the wealthy and educational-based inequality, have been endorsed as the most decisive factors of the stagnant income mobility and increasing income inequality. However, the theory regarding the correlation between social inequality and national trends of high socio-economic status have followed similar methods and approaches as those adopted by Solon in 1992. Hence, a new direction on the intergenerational transmission of high-income status could be needed to further develop the theory high socio-economic status and social inequality in the United States of America.

The heritability, determinants and intergenerational transmission of income has been a subject of interest since the 1970s, with Behrman & Taubman (1976) inaugurating both the impact of genetics on the tendency of achieving socio-economic outcomes and the utilization of a twin study on income. Their findings suggested that the vast majority of variance in income and wealth could be attributed to genetic factors and family/common environment, with the reasoning that genetic structure and familial influences shape individuals' educational and occupational choices (Behrman & Taubman, 1976). In the current era of genoeconomics, research of socio-economic status and genetic formation has, obviously, advanced since the introduction of genetics in economics by Taubman and Behrman. Recent research suggests that common SNPs[2] explain 11% of variance in household income (Hill, et al., 2016). Further molecular research on genetic contributions to socio-economic status find that there are 24 genes that have significant explanatory power on household income (Hill, et al., 2019). Hence, it is evident that there is a level of genetic heritability to household income, however contemporary literature has identified particular genes but is yet to discuss the variance of each mechanism in the intergenerational transmission of high-income status.

The heritability of socio-economic status was initiated by a twin study that suggested that genetic accounted for 18 to 41 percent of the variation in income, however the study also found that at least 40% of the variation in years of schooling could be accredited to genetic factors (Taubman, 1976). A much more recent study on the association of genes and educational attainment supports the initial ideas conceived by Taubman, as the findings indicate that genetic factors account for around 12-16% of the variation in educational attainment between individuals (Okbay, et al., 2022). As previously discussed, educational

[2] An SNP is a single-nucleotide polymorphism. Described briefly, the human share 99.9% of the same DNA sequence, the last 0.1% is where the variation (polymorphism) exists. Each building block of the DNA sequence (nucleotide) in the sequence which variates is called a single-nucleotide polymorphism (SNP) (Shastry, 2002).

attainment is an important determinant in both income and socio-economic status, hence the role of genetics in socio-economic status is further cemented.

The field of genoeconomics is surging, with various socio-economic outcomes having been examined through a genoeconomical scope. Adopting a genoeconomical approach to discuss the mechanisms in the intergenerational transmission of high-income could help address the trends of income mobility, inequality, and intergenerational persistency of socio-economic status in the US from an alternative angle. Evidently, there is a correlation between genetics, environment, and socio-economic status, however, what happens to the associations when I limit it to high-income status, a definition I will conceive in the next section of this paper.

3. Methodology & Data

3.1. Methodology of the Twin Study

A, somewhat, intuitive method in the genoeconomical field, a field that can get quite complicated and intricate for a social science, is the twin study. The twin study makes assumptions about the genetic and environmental covariance present in nature. Monozygotic twins share the same genes, while dizygotic twins share half of their genes, on average, but both types of twin pairs share the same familial environment, at least this is fair to assume as they are born concurrently. These levels of relatedness of genetics and environment during juvenescence allows us to estimate models of phenotype(s) by rearing the types of twins with predisposed values of relatedness (Knopik et al., 2016).

The approach in my research is shown in *Figure 3.1*, which is a classic uni-variate ACE model, a type of structural equation modelling (SEM) based on restricting variance to each path to find values of the coefficient. The three variables, or mechanisms, are additive genetic effects (a), family (common) environment effects (c), and unique environment effects (e), illustrated by the three pathways in *Figure 3.1*. The ACE model decomposes the variance of the given phenotype, in our research that would be high-income status, of two individuals, either a monozygotic twin-pair or a dizygotic twin-pair, into the three mechanisms: *A*, *C*, and *E*, such that the uppercase letter represents the variance of the phenotype that is accredited to its respective lowercase letter. By nature, some of the correlation between twins are established. As monozygotic share the same genetical structure, the correlation of *A* (the genetic effects) is equal to 1, and dizygotic twins share, on average, half the same gene-set, a dizygotic twin-pair have a correlation of .5 in the mechanism of *A*. Similarly, twin-pair, indifferent of zygosity, share the same family environment, so *C* (the common environmental effects) should be equal to 1 (Bates, Maes, & Neale, 2019).

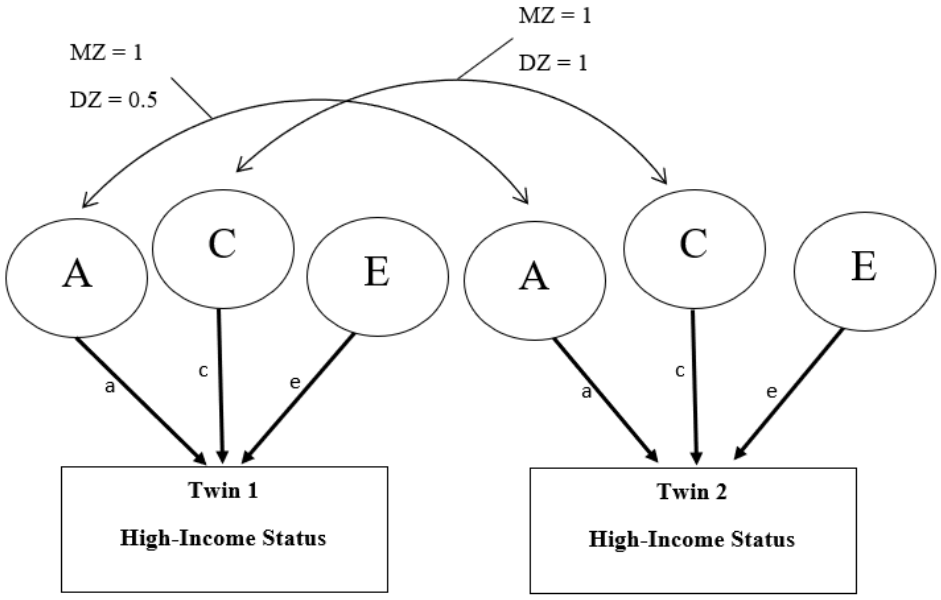

Figure 3.1 – ACE Path Model of High-Income Status

Figure Notes: The additive genetic effects (A) have a correlation of 1 for monozygotic twins, as identical twins share the same genetic formation, and 0.5 for dizygotic twins, as like any other normal sibling pair, they share on average 50% of the same genetic formation. The common (family) environment (C) is the same for each twin-pair, no matter the zygosity.

The entire ACE modelling process has been simplified and automated through the usage of the *umxACE* function, a package that gives immediate access and precise syntax to the field of behaviour genetics (Bates, Maes, & Neale, 2019). The *umxACE* package feature used in my research models the basic ACE Cholesky Model using three inputs; the sample of monozygotic twins, the sample of dizygotic twins, and the phenotype of interest, which will present the coefficients of the multivariate paths (Bates, Maes, & Neale, 2019). Therefore, the *umxACE* feature will compute the statistical methods on the basis of my inputs on the sample and observed phenotype, but also allow me to restrict my sample to sub-groups, such as potential confounders, and ultimately, present the coefficient of each pathway/mechanism in the ACE model of the given sample. The *umxACE* outputs the lowercase "a", "c", and "e" values, which are then squared to give the decimal-value of the variance that can be attributed to each mechanism.

After the multivariate pathways' coefficients have been estimated and the model generated, the model is re-classified, such that the first model estimates all the mechanisms, a^2, c^2, and e^2, are considered, however in the second model only c^2 and e^2 are considered to see the fit of the model. Then, a chi-square goodness-of-fit test is run to test the compatibility of the model, and to further evaluate each mechanism's contribution to variance in high-income status, each of the mechanisms are removed in a sub-model, e.g.,

the first model is ACE, and then the models AE and CE are tested to see the goodness-of-fit compared to the overall ACE model.

Finally, the ACE-model has some assumptions for it to have internal validity. Firstly, there is an equal environment assumption, the family environment for dizygotic twins is just as similar as it is for monozygotic twins. Secondly, there should be no assortative mating based on the socio-economic outcome in question, such that there should be not assortative mating based on high-income status for our research. While it is fair to assume that monozygotic twin families are not intrinsically different to dizygotic twin families, the last assumption of assortative mating based on high-income status is harder to justify. In the current social and cultural landscape, it is common for individuals to mate with individuals of same socio-economic status, either due to proximity of alike individuals in one's social sphere or preferences due to lifestyle and personal background. However, findings suggest that assortative mating is not based on income but rather determines it, as there is significant assortative mating based on educational attainment, and there is a clear correlation between high-income status and educational attainment. In other words, individuals are more prone to reproduce with individuals from similar educational backgrounds and individuals with higher educational attainment are more likely to be considered of high-income status (Eika, Mogstad, & Zafar, 2019). However, this should be still considered when conducting the analysis, as it might overestimate our results and the discussion of whether this assumption truly holds will be conducted in a later section. Lastly, this model assumes the three mechanisms, genetically additive effects (A), common environment (C), and unique environment (E), are uncorrelated, such that there is no interaction effect between genes and environment. The assumptions' validity and implications in case the assumptions do not hold will be further discussed in Section 5.

3.2. Sample

The sample used in this research is from the MIDUS twin study research. MIDUS is the "**M**idlife **I**n **T**he **U**nited **S**tates", a national longitudinal study of health and well-being. The first sample MIDUS collected had 7.108 participants in 1995/1996, however all observations used in this research were surveyed in 1995, and one of the subsamples was a national sample of twin pairs of 1.918 participants between the ages of 25 to 74, non-institutionalised, and English speaking. The subsample of twins included variables such as the zygosity of twins, wage bracket, household income, and gender among numerous other variables (Brim, et al., 2020). The data in MIDUS was collected through both a phone interview and a follow-up questionnaire.

This sample has then been further manipulated, such that there were 11 individuals who had retired and thus, should not be considered in the working force, and were removed from the sample. Similarly, anyone who had not filled-out their income were removed from the sample. Lastly, each twin came from a unique household, and information members of each twin's household was also gathered, such as household

partner income, number of children, number of household members, etc. Thus, the final sample consisted of 1.664 twins, of which 648 were monozygotic and 1.016 dizygotic.

3.3. Measures of High-Income

High income status can be assigned to many different levels of demography, but there is no "true" definition of what is considered "high income". There have been attempts to create a universal definition, such as World Bank definition of high-income that an income of over 12.965 USD is of high-income status (Hamadeh, Rompaey, & Metreau, 2021). However, if this definition were to be used most of the American population would be considered of high-income status, thus high-income status needs to be specifically defined in this research for the analysis to be coherent.

Socio-economic status is a trait that is ascribed to a household, thus the most accurate variable of income that describes socio-economic position is household income (Hill, et al., 2016). Furthermore, household income is also the primary income variable used by governmental institutions, such as identifying income deciles and quintiles (U.S. Bureau of the Census, 1996), as household or family income is a better indicator of standard of living (Ferrer-i-Carbonell, 2005). As household income is the dependent variable, the variable in which I will base high-income status upon, I ensure that no observations from the same household were used, such that each twin examined resided in different households.

To capture the entire spectrum of the intergenerational transfer of high-income status, three definitions of high-income status are established: the high-income, the super high-income, and the uber high-income. The distinction between these three is important to make for multiple reasons. From 1983 to 1989, the average wealth of all households increased by 23%, however 99% of this increase was accrued by the top income-quintile, and close to 50% by the top income-percentile (Wolff, 1994). Furthermore, the top 1% population in household income experienced an increase of income share from 10% in 1979 to 21.5% in 2000 (Kaplan & Rauh, 2013). There has been a unique intergenerational change for the highest socio-economic classes in the USA in terms of income share, however, there are still vast differences within in the top 20%. Hence, it is very plausible that the importance of genetics, family environment, and unique environment on the tendency of achieving high-income status significantly differ depending on how high the income threshold is to be considered high-income. Ultimately, high-income status is a more of an indication for socio-economic status rather than income, as household income is used for high-income status, thus this paper's research principally addresses the intergenerational transfer of different levels of socio-economic statuses and the intergenerational transmission of income or wealth, and the constituents of income such as wage and capital gains, are secondary to socio-economic status. Therefore, computing a twin study using three definitions of high-income statuses could contribute to how different levels of socio-

economic class are intergenerationally transmitted, as there could be vast differences in the explanation of intergenerational transfer of high income versus highest income.

Now, the high-income status has been categorised in three definitions all based on the U.S. Census Bureau's and the Current Population Survey's (CPS), a joint project by the US Census Bureau and the US Bureau of Labor Statistics, calculation of the threshold of the highest quintile, vigintile, and percentile of household income. Thereupon, the definitions are as follows: 1) the top 20% income status 2) the top 5% income status and 3) the top 1% income status.

Firstly, definition of high-income status was that if the observation were included in the top income quintile. Thus, to be considered of high-income status in this secondary definition, an observation's income had to equal or exceed 65.125 1995-US dollars, as that is the lower level of the top income quintile or 80^{th} percentile of household income (U.S. Bureau of the Census, 2022). This is the top 20% income status definition.

To gain a wider perspective of the intergenerational transmission of high-income status, the second definition of high-income status considers the individuals who belong in the top 5% income bracket in 1995 in the US. In other words, this definition includes all the individuals who have attained a higher household income than the lower threshold for the top vigintile income bracket. In 1995, the lower threshold for the top 5% income bracket was 113.000 1995-US dollars (U.S. Bureau of the Census, 2022). That means to be considered of high-income status, by this definition, an individual would have to have a higher household income than 113.000 1995-US dollars in this sample. Henceforth, this definition will be referred to as the top 5% income status.

The last definition is essentially no longer the individuals with high-income status, but the individuals with the highest-income status in the US: the 99^{th} percentile income bracket, the highest possible percentile. However, as the top 1% is not provided by the US Census Bureau, I have computed my own definition of the top 1% household income threshold by utilising both The Current Population Survey's (CPS) data collection and thresholds for 1995 and 1996. In 1996 the CPS created a threshold for the top 1% household income-percentile, in which the lower threshold to be in the top 1% was 262.042 1996-US dollars (Flood, et al., 2021). As I needed the threshold for 1995, I calculated the growth level between 1995 to 1996 for the CPS' thresholds of the lower household income threshold of the top 5%. This threshold had grown by 6.985% between the years 1995 and 1996 in the CPS. Therefore, dividing 262.042 by the growth, I obtain the rounded number of 245.000 US-dollars. Hence, the top 1% high-income status definition will be attributed to the individuals in this sample who have a higher income than 245.000 1995-US dollars.

4. Results

4.1. Intergenerational Mechanisms of High-Income Status

To initiate the analysis of heritability of high-income, *Figure 4.*1 presents correlations of household income by twin-pairs. However, the difference in correlation of household income for the type of zygosity is essentially unintelligible. Therefore, to ensure that monozygotic and dizygotic twins are not inherently different, a balance test of the available social characteristics is made to test if the mean is similar in both. This includes their age at time of the interview, their employment status, their ethnicity and gender, their US citizenship, and whether they are married and number of children. It also includes the percentage of the sample who are considered of high-income status based on each definition alluded to in Section 3.3. The summary statistics illustrated in the *Table 4.1*, show that there is only one variable that are statistically significant at the 5% level: age. While the average age in each twin group might be significantly different, that is of no concern, as the averages are still close enough such that each zygosity sample has roughly the same age brackets, as can be seen on the average age in *Table 4.1*, and therefore should have no significant impact on the high-income status.

Figure 4.1 – Household Income Correlation between Twin Pairs

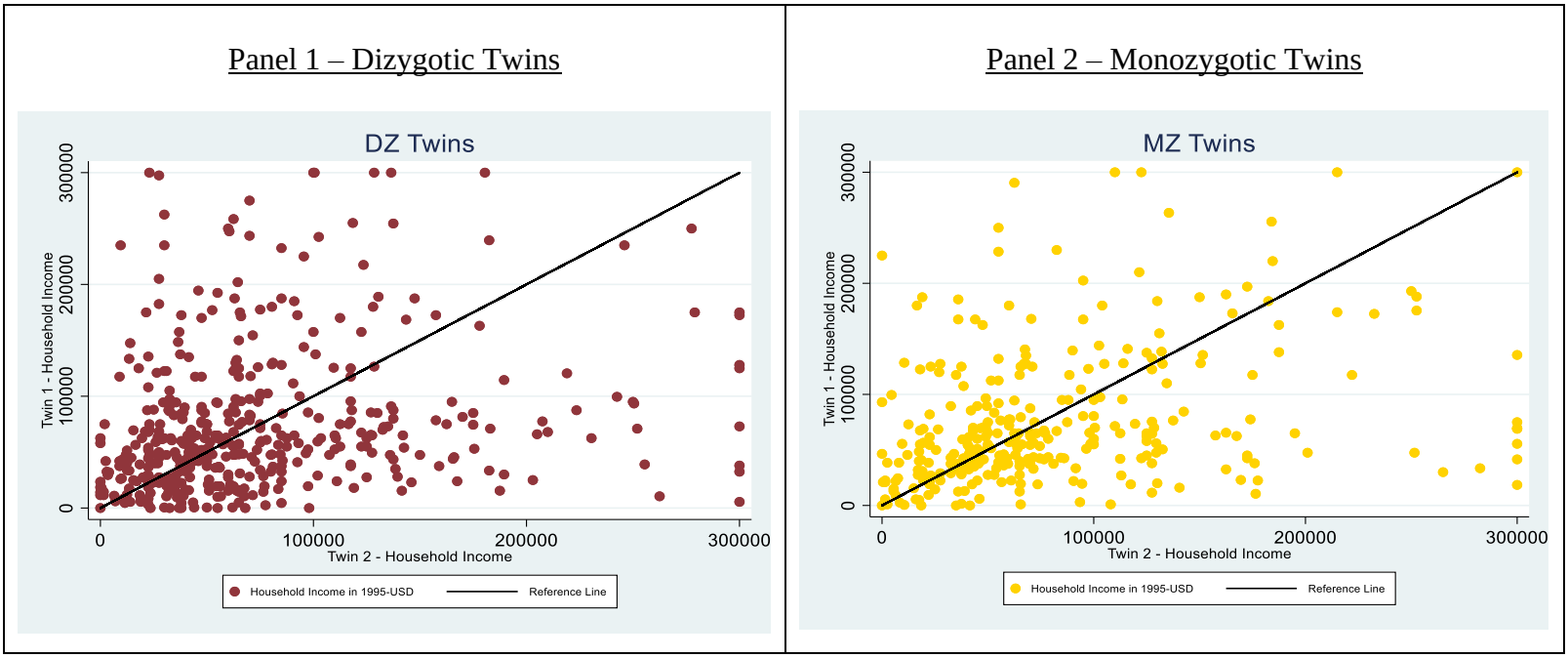

Figure Notes: Twin 1 is located on the Y-axis and Twin 2 on the X-axis in both panels. The reference line refers to complete equal income, e.g., if both twins had accumulated the same household income, then the observation would be right on the reference line.

Table 4.1 – Summary Statistics

Model	Monozygotic	Dizygotic	P-value	Sample	1995 Census in the US
No. of Observations	648	1.016		1,664	263,464
Top 5% Income Status	23%	20%	0.112	21.5%	5.0%***
Median Income (1995-USD)	60,750	56,000	0.150	58,000	33,178***
Top 20% Status	45%	41%	0.120	42.5%	20.0%***
Top 1% Income Status	3.8%	3.6%	0.820	3.7%	1.0%***
Age in years	44.3	45.7	0.041**	45.1	34.0***
Female	54%	56%	0.373	55.3%	51.0%***
Unemployed	2.2%	1.8%	0.567	1.9%	5.6%***
Self-Employed	12.3%	10.4%	0.219	11.2%	8.4%***
Caucasian	93%	94%	0.375	93.6%	82.9%***
African American	4.5%	4.2%	0.725	4.3%	12.6%***
Native American	0.1%	0.1%	0.936	1.3%	
Other Ethnicity	2.0%	1.3%	0.241	0.8%	4.5%***
US Citizen	96%	97%	0.240	96%	
Married	73%	73%	0.886	73%	72%
No. of Children	1.9	2.0	0.372	2.0	1.3***

Table Notes: ***1% significance level, **5% significance level, *10% significance level. Median income is preferred over average income, as income is typically right-skewed, consequently the average income would give an unrepresentative estimate of income for the sample. Data gathered from MIDUS and U.S. Census Bureau. Sources: (Brim, et al., 2020), (U.S. Bureau of the Census, 1996)

In addition to a balance test between twin types, a test of representativeness to entire American population was also included. It becomes evident that the sample does not represent the American population, as the sample is older, significantly higher income, and more Caucasian. The twin sample only includes twins from age 25 to 74, thus, some of the difference in income, age, and number of children could be explained by this. The implications of this will be addressed in Section 5.2.

Using the MIDUS sample of twins, *Table 4.2* illustrates the variance explained by each mechanism. The results provided in *Table 4.2* show that each definition of the income have vastly different values of each mechanism, further establishing the importance of conducting varying high-income status definitions and thresholds. The best-fitting model is found using the chi-squared value, and unlike other statistical

evaluation methods, the higher the *p-value* the more fitting the model is. *Table 4.2* depicts that 25% of the variance in the Top 5% highest-income status can be explained by genetic additive effects while unique environmental explains around 75%, and family (common) environment is inconsequent in describing the tendency of being considered in the top 5% highest incomes in the US in 1995.

Table 4.2 – High-Income Status

Income Definition	**Model**	a^2	c^2	e^2	χ^2	ρ-value
Top 20%	ACE	0.00	0.23	0.77		
	CE	-	0.23	0.77	0.00	1.00
	AE	0.00	-	1.00	42.52	0.00
Top 5%	ACE	0.25	0.00	0.75		
	CE	-	0.18	0.82	4.32	0.04
	AE	0.25	-	0.75	0.00	1.00
Top 1%	ACE	0.05	0.01	0.94		
	CE	-	0.04	0.96	0.01	0.75
	AE	0.06	-	0.94	0.00	0.95

No. of Twin Pairs	**MZ Twin Pairs**	**DZ Twin Pairs**
	301	436

Table Notes: The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment. The last row describes the number of twins pairs, of each zygosity, included in the ACE model.

While the Top 5% definition shows that family (common) environment is insignificant, the variance of abiding in the Top 20% in the US in 1995 can be substantially be explained by the family environment. Additionally, unlike the top 5% definition, none of the variance of being considered within the highest income quintile can be attributed to genetic additive effects, while similarly, the unique environment is the predominant factor in the variance of this high-income status definition. Estimates for the genetic and environmental factors for the final definition of high-income status, the top 1% in the US, exhibit only around 5% and 1% of the variance can be explained by the genetic effects and family (common) environment, respectively. Though, roughly 94% of the variance can be attributed to unique environmental effects. Overall, the tendency of achieving high-income status is predominantly accredited to the unique environment, across all definitions of high-income status.

Before any discussion regarding the coherency and implications of these results can transpire, there are concerns of potential confounders in this analysis. These are characteristics that could alter the

importance of genes and environment's impact on socio-economic status, while these characteristics are also genetically influenced. In this sample, the potential confounders that are possible to adjust for include educational achievement, gender, ethnicity, and age.

4.2.1. Accounting for Educational Attainment

The role of education on income and socio-economic status is quite clear, as fundamental economic theory suggests that 1) increasing national educational level decreases national income inequality (Tinbergen, 1972) and 2) additional investment in educational attainment is economically beneficial as there is a net life-time income effect, such that longer school attendance increases income on average (Houthakker, 1959). However, in more recent economic history, using a genoeconomical molecular approach it was found that 11-13% of the variance in educational attainment could be attributed to polygenic scores (Okbay, et al., 2022). Therefore, it becomes evident that educational level has a considerable relationship with both income and genetical structure, making educational attainment a possible confounder in my study.

Table 4.3 – ACE Model Adjusting for Educational Level

	Twins with College Degree or Higher Educational Graduate			**Twins with Highschool as Highest Educational Degree**		
Model	a^2	c^2	e^2	a^2	c^2	e^2
Top 20% Status	0.33	-	0.67	-	0.22	0.78
Top 5% Status	0.32	-	0.68	-	0.16	0.84
Top 1% Status	0.07	-	0.93	-	0.03	0.97

No. of Twin Pairs	**MZ Twins**	**DZ Twins**	**MZ Twins**	**DZ Twins**
	109	138	54	53

Table Notes: Twins with College Degree include all the observations that had more than 4 years of college education and/or a bachelor's, master's, or Ph.D. degree. The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment. The full table can be found in the Appendix, *Table A.2*.

4.2.2. Analysis of Accounting for Educational Attainment

Table 4.3. shows that the mechanisms for individuals with varying educational attainment is vastly different. The estimates when adjusting for educational attainment shows that the model predicts income-status using genetical additive effects and no family (common) environmental effects for individuals with college/university degrees. While for individual with no further education than high school the tendency of high-income status was better predicted using family (common) environment and no genetic additive effects. This is coherent with the theoretical foundation, as 1) genoeconomical theory argues that educational attainment is influenced by genetic formation and 2) income inequality findings suggest that education is a

primary factor of socio-economic status. Therefore, if genes affect educational tendencies, and education explains life-time income, then a part of the variance in high-income status is genetically influenced, coherent with the results in *Table 4.3*.

Moreover, as insinuated in the description of the theoretical discussion of the persistency of intergenerational socio-economic status it was stated that education is the main approach to ascend in socio-economic status. However, if little to no experience of institutionalised higher education is achieved, then it is fair to assume it becomes near impossible to achieve high-income status, if not born into a family that is of high socio-economic status. Hence, it is logical that twins', with no higher-level degree, tendency of procuring high-income status would be heavily reliant on growing up in a high-socioeconomic positioned family.

4.3.1. Accounting for Gender

Historically, and currently, there has been a documented gender gap in both wage and employment in most of the world, including the economically developed countries such as the United States of America, as females have experienced less wage and less presence in the workforce (Fortin, 2008). Let me dissect the two phenomena: the wage gap and the employment gap. Firstly, the gender wage gap has been researched across three cohorts in 1979, 1986, and 2000, and found that while there are significant noncognitive personality traits that explain some of the variance in the wage between men and women, it is still culturally systemic aspects that account for most of the gender wage gap (Fortin, 2008). Secondly, due to antecedent culture there have been historically developed gender roles ingrained in culture, causing a gender gap in employment in addition to wage, such that the workforce is predominantly male (Fortin, 2008). While the gender gap in employment seems to be diminishing in the United States, men still dominate (Lyness & Grotto, 2018), thus it is important to consider twins by gender, especially given that the data was collected at a time where women were more disadvantaged in the workforce, hence there might exhibition of different values for the mechanisms of the intergenerational transfer of high-income between male and female. Therefore, this next section will use rear the twin pairs where the twins share the same gender.

To adjust for the gender in the ACE-model, two separate models are created. Firstly, an ACE model is created for the female twin pairs, such that only female dizygotic and female monozygotic twins are considered. Secondly, an identical model is conducted for male twin pairs, e.g., male dizygotic and male monozygotic twins.

Table 4.4 – Summary of High-Income Status by Twins Reared Together by Gender

	Female Twins			Male Twins		
Model	a^2	c^2	e^2	a^2	c^2	e^2
Top 20% Status	-	0.28	0.72	-	0.19	0.81
Top 5% Status	-	0.16	0.84	0.36	-	0.64
Top 1% Status	-	-	1.00	0.08	0.08	0.84

No. of Twin Pairs	MZ Twins	DZ Twins	MZ Twins	DZ Twins
	163	108	128	151

Table Notes: The full table can be found in the Appendix. Only the best-fitting model for each high-income definition is included. The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment. The full table can be found in the Appendix, *Table A.1*.

4.3.2. Interpretation of ACE Model with Gender Accounted for

There are clear differences for male and female when considering the intergenerational transmission of high-income status, as the results in *Table 4.*4 indicate that for this sample the genetic effects are significant for the males, while the family (common) environment effects are significant for the females. Thus, it is plausible, as this sample is based on a generation that, on average, was born in the 1950s, that a family environment that incentivizes career ambitions and further education is needed for women to attain a high socio-economic status. This is coherent with research on female graduation rate from longer educations, as only 10% of first-year medicine and law students were female in 1970 (Goldin & Katz, 2008); which is around the time that this sample would have attended university. Thence, the environmental factors, whether unique or familial, are the conditions that should be considered when discussing the intergenerational transmission of socio-economic status for females, in this era of time.

Men experience a similar intergenerational transfer of high-income status as the whole sample does, such that 20% variance in Top 20% status is attributed to family factors, 36% of the variance in Top 5% status is accredited to genetic, and the variance in Top 1% status is nearly exclusively attributed to unique environmental factors. The intergenerational persistency of socio-economic status is somewhat shown by the Top 20% status, as family environment factors are attributed a substantial share of the variance. But more interesting, genetics is accredited an even larger portion of the variance of the variance in Top 5% income status. This indicates that genetics play an increased role in the tendency of achieving high-income status for men. Perhaps, this is indirectly due to the relationship between genetics, education, and socio-economic status. As previously described, genetics has significant explanatory power on educational

attainment (Okbay, et al., 2022), and if it was primarily men that partook in further education at this point of time, then the enhanced role of genetics in Top 5% status for men, respective to women, could be explained through the existing educational inequality in this era between the genders.

4.4.1. Ethnicity

Research of the economic reality between ethnicities in the United States over the last four decades have found that certain minorities have experienced significantly lower rates of upward income mobility and higher rates of downward mobility in comparison to Caucasian Americans, causing an intergenerational economic disparity. Especially significant is the stark difference in socio-economic outcomes between African Americans and Caucasian Americans, as Caucasian Americans who grow in similar economic conditions to African Americans still experience much higher income (Chetty et al., 2020). Furthermore, in a more biological perspective, there are significant differences in the patterns of genetic variations between races, thus the intergenerational transmission of socio-economic outcomes might vary depending on the ancestry of the individual observed (Bamshad et al., 2004). Therefore, it becomes eminent that the ACE model accounts for ethnicity.

Table 4.5 – ACE Model Adjusting for Ethnicity

	Caucasian Twins			**Twins of Other Ethnicities**		
Model	a^2	c^2	e^2	a^2	c^2	e^2
Top 20% Status	-	0.18	0.82	-	0.23	0.77
Top 5% Status	0.25	-	0.75	-	0.18	0.82
Top 1% Status	0.06	-	0.94	-	0.04	0.96

No. of Twin Pairs	**MZ Twins**	**DZ Twins**	**MZ Twins**	**DZ Twins**
	280	423	21	13

Table Notes: Twins of Other Ethnicities include the following ethnicities: African American, Native American, Asian, and Other Ethnicity. The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment.

4.4.2. Ethnicity

Table 4.5 illustrates that there is clear difference in the intergenerational transmission of high-income between ethnicities, however given the sample is over 90% Caucasian the illustrated results could be different. *Table 4.5* depicts that the variance in high-income for ethnicities other than Caucasian in the US, regardless of definition, genetic additive effects were insignificant, and it was the family (common) environment that had significant value in the explanatory variance.

If I consider the results as being indicative of the true differences in the intergenerational transmission of high-income status, then it could be stated that minority-ethnicities could have experienced systemically less opportunities, as exhibited by the discrimination in the American labour market (Bertrand & Mullainathan, 2004). Thus, it is conceivable that for a minority-individual to attain high-income status, it is not genetically determined cognitive abilities nor characteristics that are consequential to obtain economic opportunities, but the socio-economic status of one's family that enables betterment of economic opportunities.

4.5.1. Accounting for Age

The last potential confounder that is accounted for is age. Similarly to education, the correlation between age and income has been researched for years, with the conclusions becoming a constitutional economic idea. Most famously, this relationship was described in the Heckman's (1974) research on income throughout the life cycle, in which formula was fabricated to show the correlation between age, income, and consumption. The life-time cycle seems to change around the age of forty, with income, saving, and consumption patterns changing for households, as household have experienced income growth for a couple of years, and now change their consumption pattern to fit a sustainable saving pattern to enable future consumption (Gourinchas & Parker, 2003). Given these findings, it seems that there are stark increases in income around the age of 35, as individuals enter the ascension to the pinnacle of their careers in terms of income. Thereupon, this sample is split into two groups with a threshold age of 35 such that this adjustment is through pairing twin-pairs aged 35 or less and pairing twin-pairs older than 35.

Table 4.5 – ACE Model Adjusting for Age

	Twin Pairs Younger than 36			**Twin Pairs Older than 35**		
Model	a^2	c^2	e^2	a^2	c^2	e^2
Top 20% Status	-	0.25	0.75	0.245	-	0.755
Top 5% Status	-	0.18	0.82	0.246	-	0.753
Top 1% Status	-	0.09	0.91	0	-	1

No. of Twin Pairs	**MZ Twins**	**DZ Twins**	**MZ Twins**	**DZ Twins**
	78	105	223	331

Table Notes: The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment. The full table can be found in the Appendix, *Table A.3.*

4.5.2. Analysis of Age Accounted ACE Model

Alike the adjustment for education, one segment illustrates estimates of only family (common) environmental effects and the other only genetic additive effects, as shown in *Table 4.5*. Equivalently, the results are consistent with the expected outcome. The younger twin-pairs are yet to reach the peak of their careers, and hence the feasible access to high socio-economic status is if born into it, and thus family (common) environment explains around 20% of the variance in high-income status for the younger segment. For the older segment, it would be expected that there would be similar effects as for the overall model, the one depicted in *Table 4.2*, which it does, except for the Top 20% Status definition, in which family environment has negligible attribution of the variance in Top 20% income status.

4.6.1. Wage as an Alternative Measure of Income

High-income status is typically defined through household income, as socio-economic statuses is usually based on the status of a family or household, as a family/household constitutes a singular economy or economic state. However, household income is not an ideal method to measure the intergenerational transmission of income, and better exemplifies an individual's socio-economic status. Thus far, the variance has been predominantly attributed to the unique environment. A plausible reason of this is that household income includes all household members, and thus the ACE model captures not just the difference between twins, but also the differences between the twins' partners and/or other possible household members. Therefore, I will use personal wage to address the intergenerational transmission of income, rather than the intergenerational transmission of high-income status.

Table 4.6 – ACE Model of Wage, with All Possible Confounders Accounted for Included

Model	a^2	c^2	e^2	**No. of Twin Pairs**	
				MZ	**DZ**
Wage	0.64	-	0.36	301	436
Wage Female Twins	0.53	-	0.47	163	108
Wage Male Twins	0.32	0.30	0.39	128	151
Wage Caucasian Twins	0.64	-	0.36	280	423
Wage Other Ethnicity Twins	-	0.45	0.55	21	13
Wage for College Graduate Twins	0.63	-	0.37	109	138
Wage for Twins with Less Educational Attainment than College	-	0.44	0.56	54	53
Wage for Twins Older than 35	0.58	-	0.42	223	331
Wage for Twins Younger than 36	-	0.48	0.52	78	105

Table Notes: Wage is the monthly mean wage over the last year. The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment.

4.6.2. Discussion of Heritability of Wage

The values of the mechanisms in the ACE model are significantly different, yet very similar, as depicted in *Table 5.1*, as each ACE model for Wage has the same significant types of factors for Top 5% income status, except for Female Twins ACE model. However, it seems like the attribution of the variance to genetic factors is enlarged by 100% across nearly all models. Even for the gender-rendered ACE model, in which the variance of high-income status for female twins was accredited predominantly to family environment and unique environment factors, in the model with wage as the dependent variable, over 50% of the variance is now attributed to genetic factors. While for male twins, wage is now associated with family (common) environment, a factor which had no role in any model of high-income status. Overall, the ACE model on wage, also having adjusted for potential confounders, indicates that there is a large level of heritability in wage, though for men and minorities in the US the common environmental effects explain a significant portion of the variance in wage, with little or no genetic effects for this sub-populations. This is consistent with research of employment preferences for twins, as 50% of variance in interests and occupational choices is associated with genetic variation (McGue & Bouchard, 1998). Therefore, if identical twins are more likely to partake in similar occupational choices, then they are more likely to achieve similar wage-levels, and therefore, variance in wage is more associated with genetic variation than high-income status.

5. Discussion

Using genetic techniques to compare income of an American sample of mono-and dizygotic twins, I have been able to model how much variance in high-income status, based on 3 different definitions, can be attributed genitive additive effects, family (common) environment, and unique environment in this sample. These results are summarised in Table 5.1.

Table 5.1 - Summary of Results

Model	a^2	c^2	e^2
Top 20% Status	-	0.24	0.77
Top 5% Status	0.25	-	0.75
Top 1% Status	0.05	0.01	0.94

No. of Twin Pairs	**MZ Twin Pairs**	**DZ Twin Pairs**
	301	436

Table Notes: The table illustrates is the variance of the phenotype in question that can be attributed to column 1) (a^2) additive genetic effects, column 2) (c^2) common environment, 3) (e^2) unique environment.

In this section, I will discuss the implications of my findings, and lastly, present the validity and limitations of my study as well as ideas for future research. Prior to discussing the implications, validity, and future research of my study I will interpret the summarised results that are presented in *Table 5.1*. Quite surprisingly, the variance in high-income status accredited to each mechanism significantly varies depending on the definition of high-income status. While I was expecting the values to be different given the definition of high-income status, the results show changing the definition of high-income status entirely changes which factor is significant. However, this is accordant with theory surrounding socio-economic status. Firstly, I have already established the notion that America is experiencing an intergenerational persistency of earnings, and thus, high-income status. There were multiple reasons for that, two main ones were educational inequality and regressive economic policies. Therefore, the descendants of families situated in the top 20% of income are prone to achieve high socio-economic status themselves, primarily due to the family's ability to invest in quality education for their descendants (Restuccia & Urrutia, 2004). Though, when considering the variance in Top 5% income status, none of the variance is associated with family (common) environment, however a significant portion is now associated with additive genetic factors. I would have expected some of the variance to be explained by variation in family (common) environment, however research on the highest earners show that there is an overrepresentation of the academically gifted and high level of cognitive abilities in the highest socio-economic classes (Wai, 2014). Given that a significant portion of the variation in educational attainment is associated with genetic structure (Okbay, et al., 2022) and that heritability of IQ, a proxy of cognitive ability, was around 80% (Wright, et al., 2009), this could be a reason that the variance in the higher income statuses, both the top 5% and top 1% income status, is more associated with additive genetic factors. Ultimately, to answer the research question, the results indicate that family environment will contribute to the tendency of achieving high socio-economic status at top 20% income status, however certain genotypes contribute to the tendency of achieving top 5% income status, and the tendency of achieving top 1% income status is best explained by unique factors.

5.1. Implications

Income inequality and social mobility have been researched for decades, especially given the equality of incomes has worsened (Stiglitz, 2016). It was generally believed that as societies reached a service-based economy that income per capita would increase and inequality would decrease, as illustrated by the Kuznets' curve, however, that has not happened in the United States of America (Piketty & Saez, 2003). Research has shown various mechanisms of the inert social mobility and trends of increasing income inequality in the USA, predominantly using panel data of income and socio-economic outcomes. While there clearly are economic conditions that hinder upwards mobility and parity of opportunities in the US, a

part of the intergenerational persistency of the higher socio-economic could be attributed to genetic formation and family environment, as suggested by my findings. Thereupon, my findings imply that the theory behind social mobility and income inequality should be extended to examining, or at least considering, the implications of genetic structure in the intergenerational transfer of high socio-economic status.

Furthermore, following the modelling of wage as the phenotype of interest, the results indicated that wage was significantly more inheritable, especially for female twins. Occupational choices are obviously affected by the environment; however, research suggests that the genetic effects should not be underestimated. Findings suggest that identical twins are more inclined to pursuit similar occupations and career choices (McGue & Bouchard, 1998), and my results would indicate the same, as wage is significantly more associated with additive genetic factors than high-income status. Therefore, the variation in intergenerational transmission of socio-economic status accredited to additive genetic factors could be primarily contributed to the heritability of wage.

Lastly, these findings further develop the ongoing research on the divergent conditions' different communities and societies of America encounter. The United States of America have been extending the present political division, perhaps due to the different directions the economic state is heading based on ethnoracial demography and the increasing "Laissez Faire Racism" in American politics in recent times (Bobo, 2017). There is systemic racism integrated in the American society, with research illustrating the prevalence of discrimination and imparity of opportunities in the labour market (Bertrand & Mullainathan, 2004). Consistent with existing research illustrating that different subsegments experience vastly different economic conditions, my findings clearly suggest that the mechanisms are contingent on the age, ethnicity, educational attainment, and gender of the observations. While these findings cannot be attributed to systemicity in the culture or socio-economic state of America, it does suggest that research on systemic racism, discrimination, and ethnoracial imparity of opportunities should be broaden into the intergenerational transmission of socio-economic outcomes.

As previously described, the mechanism of significance changes dramatically from the Top 20% income status model to the Top 5% income status model. First impression of this would be that this is peculiar as the intergenerationally persistency of high-income and socio-economic class is well-documented in the US (Solon, 1992), thence there is an expectation that family (common) environment would be perpetual throughout all models. However, it must be mentioned, that the variable of interest is income, and not wealth, and there is a substantial difference in the mechanisms that determine each. Wealth is directly distributed through familial ties whereas income is attained predominantly through occupational choices and personal abilities, hence familial relations have little direct impact, other than

through nepotism, network opportunities, and inheritance customs such as primogeniture (Dunn & Holtz-Eakin, 2000). The role of family environmental factors of income is less than the first impression simply because, colloquially, we immediately combine income and wealth into the same classification: rich. When bundled together they become indistinguishable, even though wealth and income, and how they are achieved, are vastly different. However, what is expected is that the highest income brackets would be subdued to family (common) environment effects, as especially the children of families that reside in the highest socio-economic class acquire acceptance at top universities either due to financial capabilities or legacy, which allows them to achieve the same income bracket as their ancestors (Bloome, Dyer, & Zhou, 2018). This can also be seen in the results, as while the family environment explains none of the variance in the top 5% high-income definition, it explains some of the variance in the top 1% income status, albeit extremely little at 1%. This implies that income is not the best variable to discuss the intergenerational persistency of the top 1% richest in America, but that it would be reasonable that wealth should be considered in this case.

5.2. Validity of and Limitations to the Research

This research is a twin study, and even though it has a biological element due to the role of genetics in the intergenerational transmission of high-income status, no conclusion regarding which genes matter nor how much they matter for high-income can be reached. However, the twin study can work as a motivation for a genotypic profiling research, as if there is significant variance that can be attributed to genetic effects, then it would be interesting to create a molecular genetic method to identify and analyse the relevant genes that have explanatory power on high-income status. Thus, it cannot be stated which or whether social abilities, cognitive skills, ambitions, nor non-cognitive skills are the most important genetic component in the tendency of being high-income status.

Our research could have pertained selection bias, as the MIDUS sample is not an accurate representation of the US. Firstly, the median income in the US in 1995 was 34.076 (U.S. Bureau of the Census, 1996) which is over 20.000 less than the median in this sample, as provided in *Table 4.1*. Secondly, the sample is 93% Caucasian American and only roughly 5% of the sample is African American, however in 1995, the American population was roughly 80% and 13% Caucasian and African American, respectively. Thus, there is a fair argument that the results in this research only pertain to a sub-segment of the American population, specifically the Caucasian urban-resided Americans as most of the sample was gathered from the five biggest metropolitans. Even if that confines the study's external validity, it is still a good perspective of the how the mechanisms in the intergenerational transmission of socio-economic status can be quantified for the richer, Caucasian American population.

The observations used in this paper were sampled in 1995, which is, to this day, 27 years ago. While many elements have stayed the same overall, no one can state that there are not vast differences between the modern era we currently reside in and the time prior to the 21st century. Over these 27 years, there have been two economic crises in the US, firstly the financial crisis in 2008 and the economic crisis caused by the pandemic in 2020. Economic crises of this magnitude have previously significantly altered the determinants of high socio-economic status (Piketty & Saez, 2006) and thus, potentially the recent crises have transformed the mechanisms in intergenerational transmission of high-income. If the economic realities in the United States of America have permanently transformed, the determinants and tendencies of socio-economic status could have potentially permanently transformed. Furthermore, American workers have experienced larger inequality in educational attainment due to rising college premiums, in addition to a narrowing gender gap and increasing wage volatility, predominantly due to a changing wage structure causing various macroeconomic and welfare implications (Heathcote, Storesletten, & Violante, 2010). Hence, due to the macroeconomic trends, some of my models that adjusted for potential confounders could give dissimilar values if administered on socio-economic status of twins over the last few years. Ultimately, due to changing economic climate and social development, there is concern that my study is not generalisable for the modern population of the US.

There are some questions about the validity of my study due to the assumptions of my method, as some of my assumptions of the twin study might be unlikely to hold. Firstly, I assume that there is no assortative mating, however, as made quite clear throughout this paper, high-income status and socio-economic status are very similar. Thus, as mating based socio-economic status and educational attainment is present in today's world (Eika, Mogstad, & Zafar, 2019), the assumption of non-assortative mating could hold untrue. If parents mate based on the phenotype of socio-economic status, the variance accredited to additive genetic factors would be overstated, as the genetic characteristics of the parents would be positively correlated which increases the presence of homozygosity (Carey, 2003).

Secondly, I assume there to be no gene-environment interaction effect, such that the children of highly socio-economic positioned parents do not have increased tendencies of procurement of similar socio-economic status due to exposure to high-income in childhood. This assumption is unlikely to hold, as existing research explicitly shows that there are gene-environment interactions between socio-economic status during juvenescence and variation in phenotypes, which is now known as the Scarr-Rowe hypothesis (Tucker-Drob & Bates, 2015). Hence, it is likely that there is a not accounted for gene-environment effect in my research too if there is a well-documented relationship between the socio-economic status during upbringing and IQ in America. Although the existence of a gene-environment interaction is probable, whether this would over-or underestimate my results cannot be concluded as it

depends on the gene-environment interaction effect, but it seems logical that exposure to a high-income status environment could help enable cognitive abilities, ambitions, and other genotypes that increase tendency of achieving high-income status which would mean my results are overestimated.

Lastly, I assume that the twin environment has the similar effects, such that monozygotic twins are not more or less likely than dizygotic twins to imitate their twins beyond genetic reasons. If monozygotic twins are more likely to imitate their twin for non-genetic reasons, then my results of the heritability of high-income status would be overstated. However, there is no empirical evidence that would suggest that monozygotic twins have significant different non-genetic tendencies to imitate their twin-sibling's socio-economic status than dizygotic twins have.

5.3. Future Research

Typically, a twin study could work as a motivation for a genotypic profiling of a phenotype, such that I would advocate for a genome-wide association study (GWAS) of high-income status, however that has already been conducted and found both particular significantly genes associated with on household income and socio-economic position (Hill, et al., 2019) and been able to attribute 11% of the variance in household income to the molecular genetic profile (Hill, et al., 2016). Although, there are proven to be large genetic differences depending on ethnicity, but also how genes affect socio-economic outcomes through genes interaction with the environment, thus geographical, demographical, and cultural context becomes important (Bamshad et al., 2004). Hence, it could be interesting to conduct a genome-wide association study in the US to research if there are differences between in the association between SNPs and income in the US in comparison to the UK.

More importantly, this research was initiated as a unique and unprecedented way to confer the trends of intergenerationally persistency of socio-economic outcomes, inert income mobility, and increasing income inequality in the US. However, to fully understand the diverging trends of income equality and distribution between the US and nations of similar economic stature, the genetic interactions with the intergenerational transmission of high-income status should be researched in other economically developed countries in the Western world to compare to the results of my twin study based in the US in 1995.

Furthermore, the research in this paper was based on the socio-economic outcomes of twin in 1995, however since 1995 there have been two economic crises, the financial crisis in 2008 and the economic crisis caused by the pandemic in 2020. Plausibly the socio-economic realities in the US might have significantly altered since 1995 which potentially could have caused the factors that contribute to the tendency of high socio-economic status to be distinctly different. Additionally, evolution of the society

and policies regarding parity of opportunities have caused upwards trends of female and minority presence in management positions (Blau & Kahn, 2013) which could have altered the income spectrum implicating the mechanisms of socio-economic status. Therefore, due to changes in the economic situation and social development in terms of parity of opportunities the tendencies and determinants of high-income status could have reshaped, and a twin study based on current, as of 2022, socio-economic outcomes of twins could provide more perspective and different results.

6. References

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7. Appendix

Table A1 – Full Model Adjusting for Gender

		Female Twins					Male Twins				
Income Definition	**Model**	a^2	c^2	e^2	χ^2	**ρ-value**	a^2	c^2	e^2	χ^2	**ρ-value**
Top 5% Income Status	ACE	0	0.16	0.84			0.36	0	0.64		
	CE	-	0.16	0.84	0	1.00	-	0.26	0.74	5.97	0.01
	AE	0.17	-	0.83	1.11	0.29	0.36	-	0.64	0	1.00
Top 20% Income Status	ACE	0	0.28	0.72			0.00	0.19	0.81		
	CE	-	0.28	0.72	0	1.00	-	0.19	0.81	0	1.00
	AE	0.30	-	0.72	4.51	0.03	0.22	-	0.78	1.17	0.28
Top 1% Income Status	ACE	0	0	1.00			0.08	0.08	0.84		
	CE	-	0	1.00	0.67	0.41	-	0.14	0.86	0.01	0.75
	AE	0	-	1.00	0	1.00	0.18	-	0.82	0.20	0.07

Table A2 – Table Adjusting for Educational Level

		Twins with University Degree					Twins with no University Experience				
Income Definition	**Model**	a^2	c^2	e^2	χ^2	**ρ-value**	a^2	c^2	e^2	χ^2	**ρ-value**
Top 5% Income Status	ACE	0.32	0	0.68			0.00	0.16	0.84		
	CE	-	0.13	0.87	6.56	0.01	-	0.16	0.84	0.00	1.00
	AE	0.32	-	0.68	0.00	1.00	0.07	-	0.93	9.39	0.00
Top 20% Income Status	ACE	0.28	0.49	0.67			0.00	0.22	0.78		
	CE	-	0.25	0.75	2.05	0.15	-	0.22	0.78	0.00	1.00
	AE	0.33	-	0.67	0.10	0.75	0.16	-	0.84	8.12	0.00
Top 1% Income Status	ACE	0.07	0	0.93			0.00	0.03	0.97		
	CE	-	0.05	0.95	0.13	0.72	-	0.03	0.97	0.00	1.00
	AE	0.07	-	0.93	0.00	1.00	0.00	-	1.00	1.10	0.29

Table A3 – Table Adjusting for Age

		Twin Pairs Younger than 36					Twin Pairs Older than 35				
Income Definition	**Model**	a^2	$\boldsymbol{c}^2$	$\boldsymbol{e}^2$	$\boldsymbol{\chi}^2$	$\boldsymbol{\rho}$**-value**	a^2	$\boldsymbol{c}^2$	$\boldsymbol{e}^2$	$\boldsymbol{\chi}^2$	$\boldsymbol{\rho}$**-value**
Top 5% Income Status	ACE	0.00	0.18	0.82			0.25	0	0.75		
	CE	-	0.18	0.82	0.00	1.00	-	0.18	0.83	2.87	0.09
	AE	0.20	-	0.80	7.82	0.01	0.25	-	0.75	0.00	1.00
Top 20% Income Status	ACE	0.04	0.47	0.74			0.00	0.21	0.79		
	CE	-	0.25	0.75	0.09	0.76	-	0.21	0.79	0.00	1.00
	AE	0.29	-	0.71	4.86	0.03	0.25	-	0.76	4.68	0.03
Top 1% Income Status	ACE	0	0.09	0.91			0.00	0.00	1.00		
	CE	-	0.09	0.91	0.00	1.00	-	0.00	1.00	0.00	1.00
	AE	0.09	-	0.91	1.55	0.21	0.00	-	1.00	0.00	1.00