# The Fetal Origins Hypothesis in Finance: Prenatal Environment and Investor Behavior*

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**Abstract**

We find that differences in an individual's prenatal environment explain heterogeneity in financial decisions much later in life. An exogenous increase in exposure to prenatal testosterone, the most potent sex hormone in humans, leads to the masculinization of financial behavior, in form of elevated risk taking and trading in adulthood. We also examine birth weight, the most widely used summary measure of the early life environment. Those with higher birth weight are more likely to participate in the stock market, while those with lower birth weight prefer portfolios with higher volatility and skewness, consistent with compensatory behavior. This study is one of the first attempts to incorporate into finance research the notion that prenatal environment programs a fetus in the womb to have persistent behavioral characteristics. Our results contribute to the understanding of how environmental conditions and circumstances shape individuals' behavior in financial markets.

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# I Introduction

A large literature in economics shows the importance of the early life environment for economic outcomes much later in life. In fact, several "fetal origins" studies have shown that conditions and circumstances even before birth are of first-order importance when it comes to explaining the observed heterogeneity in individuals' life trajectories, in particular their long-term human and health capital. In their recent review article, Almond and Currie (2011b) go as far as asking: "[W]hat if the nine months *in utero* are one of the most critical periods in a person's life [...]?"

In financial economics research, specifically related to individual investor behavior, the importance of the early life environment has received relatively limited attention. Some studies, which focus on the *postnatal* environment, have recently attempted to fill this void. For example, the evidence reported by Malmendier and Nagel (2011) suggests that "Depression Babies" develop more aversion to financial risk taking later in life. Cronqvist, Siegel, and Yu (2014) show that individuals who grew up during the Depression era, or in relatively less wealthy families, develop a more value-oriented investment style later in life. Chetty et al. (2011) report that the pre-school (kindergarten) environment explains some asset allocation decisions among adults, such as contributing to a 401(k) retirement savings plan and owning a home.[1]

In this study, we extend these efforts by examining whether differences in the *prenatal*, i.e., pre-birth, environment explain heterogeneity, much later in life, in investor behavior, in particular with respect to financial risk taking. First, we examine the long-term effects of differential prenatal exposures to testosterone. We focus on testosterone as it is the most potent steroid (sex) hormone in humans, and critical for the development of the male fetus, including the masculinization of the brain. Existing research on the effect of prenatal testosterone on risk taking has generally relied on the 2D:4D finger ratio, i.e., the ratio of the index and ring finger lengths, a noisy biomarker of pre-birth testosterone exposure, and has provided inconclusive evidence (e.g., Apicella et al. (2008) and Sapienza, Zingales, and Maestripieri (2009)). Our

[1] Several recent studies have also found that experiences in adulthood are important for an individual's investment behavior later in life (e.g., Malmendier and Nagel (2014) and Knüpfer et al. (2014)).

empirical identification strategy instead relies on a natural experiment that occurs in some twins pregnancies. More specifically, the "Twin Testosterone Transfer" (TTT) hypothesis predicts that, in the case of opposite sex twins, the higher level of prenatal testosterone in the amniotic fluid of a male fetus increases the pre-birth testosterone exposure of the female fetus that shares the womb with the male fetus and leads to a (slight) masculinization of the female fetus, including the brain.

Second, we study the long-term effects of differences in birth weights. While the limitations of birth weight as a summary measure of endowments at birth is increasingly well-recognized (e.g., Almond et al. (2005)), little progress has been made towards identifying a superior measure. We use a sample of identical twins to control for confounding factors, such as unobserved characteristics of the mother as well as the genetic make-up of the twins. It therefore ensures that the birth weight differences are driven by environmental factors (e.g., nutritional intake within the uterus) rather than by genetic factors.

The data we use for this study come from the Swedish Twin Registry (STR), the world's largest twin registry with very detailed information on same- and opposite-sex twin pairs from birth cohorts dating back to the 19th century, and constitute a combination of register and survey data. These data have been matched with detailed financial data from the Swedish Tax Authority and other individual data (e.g., family structure and education data) from Statistics Sweden, and allow us to measure individuals' financial decisions over several years.

Our empirical evidence is consistent with the fetal origins hypothesis and suggests that the prenatal environment is important for an individual's financial decisions several decades later in life. First, we find that a female with a male co-twin, i.e., an individual in the treatment group, takes significantly more risk later in life compared to a female with a female co-twin, i.e., an individual in the control group. A treated female's allocation to risky assets is about 3% higher than the average allocation of a female in the control group. Similarly, in comparison with the control group, her portfolio exhibits a 3% higher volatility and a 14% higher allocation to individual stocks relative to mutual funds. These effects also offer an important insight into the nature of the gender gap in financial risk taking (e.g., Croson and Gneezy (2009) and Sundén and Surette (1998)).[2] Specifically, we find that a significant proportion, between 10 and 39%, of the the gender gap in our data is explained by increased pre-birth exposure to testosterone, suggesting that biological factors explain a sizable proportion of the gender gap. Consistent with the masculinizing effect of prenatal testosterone, we find that females with male co-twins also trade more and invest more in lottery-type assets, as expected given the previously documented gender differences for both outcomes (e.g., Barber and Odean (2001) and Kumar (2009)). Finally, to address concerns about confounding social effects due to the presence of a male co-twin, we verify that intra-twin pair social interactions in adulthood do not explain our results. Importantly, while we cannot rule out social effects completely, we find no evidence that females who grow with a male sibling, but do not share the womb with a male co-twin, display any masculinization of their financial behavior.

Second, controlling for twin pair fixed effects, we find that those with lower birth weight, i.e., with more adverse prenatal conditions in a general sense, are less likely to hold risky assets, but, conditional on holding risky assets, prefer more volatile equity portfolios and hold relatively more individual stocks than those with higher birth weight. A one standard deviation decrease in *Birth Weight (ln)* increases the volatility of the portfolio by about 5% and the proportion of directly held stocks by about 10% relative to respective means for the entire sample. These outcomes are consistent with generally better financial decisions by those with higher birth weight, as expected given the existing evidence on a positive relationship between birth weight and cognitive abilities (Black et al. (2007)). The outcomes are also consistent with compensatory behavior by those with inferior starting conditions, as reflected by low birth weight, and we indeed find that low birth weight investors hold portfolios with significantly higher skewness.

Finally, to distinguish between prenatal conditions affecting financial decisions directly through preferences or indirectly through the ability to make good decisions, we perform a mediation analysis. On the one hand, we find that prenatal testosterone has a direct effect on the share

[2] We recognize that the appropriate label should be "sex gap." We nevertheless follow the convention and describe the differences between behavior of men and women as "gender gap."

of risky asset, while birth weight has a direct effect on portfolio skewness. For volatility, on the other hand, both prenatal treatments operate indirectly. Hence the prenatal environment affects financial decisions by shaping investors' preference as well as by working through indirect cognitive channels that affect investors' ability to make good decisions.

Our paper contributes to several pre-existing literatures in finance and economics research. First, this is one of the first attempt to incorporate the fetal origins hypothesis into financial economics. This hypothesis has been very useful for economists' understanding of long-term effects of the early environment on health and human capital (e.g., Almond and Currie (2011b) and Currie (2011)), and we show that it is useful also for understanding individual investors' financial risk-taking propensities later in life. Differently from existing studies in economics, we explicitly consider the effects of compensatory behavior by those with lower birth weight as discussed by studies in medicine and biology (Hack et al. (2002); Metcalfe and Monaghan (2001)).

Second, with a growing literature in finance having established the importance of genetics in explaining cross-sectional heterogeneity in financial risk taking (e.g., Cesarini et al. (2009), Barnea, Cronqvist, and Siegel (2010), and Cesarini et al. (2010)), the focus is shifting to a search for the environmental circumstances and life experiences that explain outcomes of interest to financial economists. Our research is one of the first attempts in finance to show that the early life environment, even pre-birth experiences in the womb, explains differences in investor behavior.

Finally, our paper contributes to a literature in the intersection of finance and neuroscience which seeks to establish causal effects of prenatal testosterone exposure, but which has provided inconclusive evidence (e.g., Apicella et al. (2008) and Coates et al. (2009), and Sapienza, Zingales, and Maestripieri (2009)). Using a different identification strategy and field data on individuals' financial decisions, our research has the potential to clarify the role prenatal testosterone exposure plays for financial behavior later in life and to shed light on the determinants of gender differences with respect to these behaviors.

# II Related Research

In this section, we review the scientific evidence on which we base our hypothesis that different prenatal environments might explain heterogeneity in investor behavior, in particular with respect to financial risk taking, much later in life. We first introduce the fetal origins hypothesis, which originates from medical research, and review the empirical evidence in applied economics research related to fetal programming and health capital as well as human capital later (sometimes several decades later) in an individual's life. We discuss the reasoning and the evidence related to the "Twin Testosterone Transfer" (TTT) hypothesis, our identification strategy for the effect of prenatal testosterone exposure. Finally, we review the pre-existing empirical evidence related to at-birth endowments, proxied by birth weight, and long-term economic outcomes.

## A Fetal Origins Hypothesis

The fetal origins hypothesis was pioneered in medical research by Barker (1990) and Barker and Robinson (1992) who argued that the intrauterine environment may program a fetus to have particular characteristics which may affect the individual in adulthood. According to this hypothesis, the effects of prenatal conditions and circumstances may be very persistent. More specifically, Barker argued that individuals who are starved or otherwise experience poor nutrition *in utero* are significantly more likely to become overweight as adults, possibly because of compensating programming taking place *in utero*, and that these individuals are actually more likely to suffer from diseases associated with obesity, including diabetes and cardiovascular-related diseases (e.g., Barker (1995)). This mechanism is called "fetal programming" and just started to be researched and understood in depth. One possibility is that the epigenome, which may be thought of as a set of switches that cause parts of the genome to be expressed or not, is affected in a significant way by the pre-birth environment (e.g., Petronis (2010)).[3] Pre-existing scientific evidence related to the fetal origins hypothesis constitutes the basis for the empirical analysis

[3] See, e.g., Lombardo et al. (2012a) and Lombardo et al. (2012b) for recent scientific papers related to fetal programming.

pursued in this paper, i.e., financial decisions later in life may in part be the outcome of fetal programming.

Over the past decade, the fetal origins hypothesis has made its way from medical research into economic research. Currie and Hyson (1999) were first in economics research to conclude that the fetal origin effects were not confined to long-term health capital but also applied to human capital measures, e.g., IQ and educational attainment. Studies in applied economics have used exogenous variation in factors such as nutrition, diseases, and pollution to identify causal treatment effects of the prenatal environment.

To provide only a few examples from applied economics research, the long-term effects of poor nutrition *in utero* have been studied using data from the *Hongerwinter* of 1944-45 towards the end of World War II, when Germany effectively stopped all food supplies to the Netherlands, and adult rations dropped as low as 580 kilocalories per day. Significant effects on disease rates later in life have been reported by, e.g., Stein et al. (1975) and Ravelli et al. (1976). More recent studies of the long-term effects on health as well as human capital of prenatal nutrition include studies of the *Phylloxera* insect which asymmetrically affected available income and food resources at different vineyards in France in the late 19th century (e.g., Banerjee et al. (2010)), and studies of fasting during the Ramadan among pregnant mothers (e.g., Almond and Mazumder (2011)).

Focusing on the health of the mother, Almond et al. (2005) and Almond (2006) study children to mothers who were pregnant during the influenza epidemic of 1918 in the U.S. and find that the children experienced reduced educational attainment, lower income and socioeconomic status, as well as accelerated disability rates as adults. Some of these differences remain observable in the "treated" individuals even when they were in their 80s. Others have studied the long-term treatment effects on cognitive ability of pre-birth exposure to pollution such as exposure to Chernobyl fallout in Sweden (e.g., Almond et al. (2009)) and the effects on educational attainment of particulate matter (PM) in the air, which varies exogenously with the business cycle (e.g., Sanders (2012)).

The overall conclusion from this literature is the importance of the prenatal environment for long-term health and human capital.[4]

## B Twin Testosterone Transfer Hypothesis

Given the importance of risk in financial decisions as well as the well-documented gender difference with respect to risk taking, we examine the long-term effects of heterogeneous *prenatal* exposure to testosterone, the most potent sex hormone in humans and one which has consistently been found to be related to risk taking among adults. During gestation, i.e., while in the mother's womb, a human fetus endogenously generates testosterone, with a male fetus generating much higher levels relative to a female fetus. Indeed, high levels of prenatal testosterone are necessary for the masculinization of the fetus, and in the absence of high levels of testosterone female structures would develop even in a genetically male fetus.[5] Prenatal exposure to testosterone is therefore critical for the development of the male sex organs, but has also been shown to cause permanent changes in the brain's development, the so-called organizational effects of testosterone, which we study here.

In addition to significant differences between male and female fetuses, studies show that there is also substantial within-sex variation in pre-birth testosterone exposure. For example, Baron-Cohen et al. (2005) report significant cross-sectional variation in prenatal testosterone among both male fetuses (N=41; prenatal T range in nmol/l is 0.125-1.800 with a mean of 0.943 and a standard deviation of 0.365) and female fetuses (N=30; prenatal T range in nmol/l is 0.150-0.800 with a mean of 0.358 and a standard deviation of 0.161). As a result, variation in prenatal testosterone exposure is a promising approach to study the effects of different pre-birth environments on financial risk taking as well as other financial behaviors for which men and women have been shown to differ.

Any study of prenatal testosterone is associated with several empirical challenges. First,

[4] We refer to Almond and Currie (2011a) and Almond and Currie (2011b) for additional references and a more complete and in-depth review of the fetal origins hypothesis.

[5] The default sex among mammals is female. For birds, for example, the default sex is male and the development of the female sex depends on the exposure to ovarian hormones, such as estrogen. In mammals feminization through estrogen occurs later than masculinization and largely outside the womb (Baron-Cohen et al. (2004)).

the direct measurement of prenatal testosterone in the amniotic fluid in pregnant mothers (via amniocentesis) is invasive and has therefore been restricted to small and potentially non-representative samples (e.g., van de Beek et al. (2004) and Baron-Cohen et al. (2004)). Second, while exogenous manipulation of testosterone is increasingly used in research in the intersection of economics, finance, and neuroscience to cause treatment effects (e.g., Zak et al. (2009) and Eisenegger et al. (2009)), such manipulation during pregnancy is precluded in research on human fetuses. Finally, exogenous prenatal testosterone manipulation would be impractical for our study as it would take several decades to conduct the treatment and then observe financial decisions later in life.

Existing research on the effect of prenatal testosterone that is relevant for finance has focused on risk-taking behavior and has generally relied on the 2D:4D finger ratio, i.e., the ratio of the index and ring finger lengths, a noisy biomarker of prenatal testosterone exposure, but has provided inconclusive evidence. Apicella et al. (2008) and Sapienza et al. (2009) find no statistically significant relation between 2D:4D ratio and financial risk taking. Coates et al. (2009) find that the 2D:4D ratio is related to the profitability of 44 professional traders at the London Stock Exchange, even though it is possible that this result reflects a cognitive ability effect, as opposed to a risk-taking effect (e.g., Coates and Herbert (2008)).[6]

The identification strategy in this study relies on an experiment that occurs naturally in some twin births, and is referred to as the "Twin Testosterone Transfer" (TTT) hypothesis. Testosterone transfer from male fetuses to neighboring fetuses via diffusion across fetal membranes was first confirmed in animals (e.g., vom Saal et al. (1980) and Hauser and Gandelman (1983)).[7] Several studies of humans have reported evidence consistent with the TTT hypothesis, both with respect to elevated testosterone levels as well as the masculinization of anatomical, physiological, and behavioral traits caused by the presence of a male fetus in the womb (e.g., Slutske et al.

[6]Some studies have indeed reported a relation between prenatal testosterone and cognitive skills (e.g., Finegan et al. (1992)).

[7]Consistent with the TTT, researchers have documented that the intra-uterine position (IUP) is important (e.g., Ryan and Vandenbergh (2002)). That is, for animals for which multiple births are common (e.g., mice), female fetuses developing in-between two males in the womb show significantly more masculinized traits later in life.

(2011)). While the TTT hypothesis has generally been examined widely (see Tapp et al. (2011) for a review), this paper is first to apply it to financial decisions, in particular financial risk taking, and among the first applications of the TTT hypothesis in economics (see also Gielen et al. (2013)).

## C Birth Weight

A large literature in economics documents that birth weight is predictive of long-term outcomes for adults. More specifically, differences in birth weight are related to differences in health capital as well as human capital much later in life. Birth weight is the most widely available and used proxy summary measure of the prenatal environment. Some researchers have emphasized that birth weight does not fully capture fetal origins effects, particularly because shocks in the first trimester of the pregnancy have been found to be especially critical while the fetus gains most of its weight in the third trimester (e.g., Almond et al. (2005)). As a result, birth weight may not be a sensitive measure of circumstances during the most critical period of the development of a human fetus. Nonetheless, birth weight remains an important measure in economic research on the effects of the prenatal environment because little substantial progress has been made towards identifying an alternative, superior summary measure.

Several studies have used cross-sectional data to show that low birth weight is related to long-term economic outcomes such as educational attainment, employment, and earnings (e.g., Currie and Hyson (1999)). One empirical challenge for these studies is that it is possible that there are no underlying causal relationship, as low birth weight may be correlated with many difficult-to-measure omitted socioeconomic and genetic variables. That is, many variables may be correlated with both negative birth outcomes and lower future performance. As a result, more recent studies have used within-sibling or within-twin variation to identify the effects of birth weight and confirmed the previous results, even though the economic magnitude of some of the documented effects is reduced (e.g., Behrman and Rosenzweig (2004) and Almond et al. (2005)).[8]

[8] We also refer to Currie (2009), Almond and Currie (2011a), and Currie (2011) for a more detailed review of empirical evidence related to birth weight and health and human capital later in life.

Birth weight may be directly or indirectly related to financial decisions later in life. First, fetal programming may directly affect preferences. On the one hand, those with higher birth weight, i.e., better endowments at birth in a general sense, may be expected to take more risk. On the other hand, from an evolutionary perspective where maximizing the propagation of an individual's genes is of importance (e.g., Robson (2001a,b)), individuals with lower birth weight may have been programmed to compensate for lagging behind at birth (e.g., Hack et al. (2002)). Investing in portfolios with high volatility or high skewness may be compensatory behavior through which those with a poor start (in the form of a lower birth weight) attempt to mitigate the effects by taking more risk (e.g., Metcalfe and Monaghan (2001)). Second, there may be an indirect effect on financial decisions because birth weight has been found to be related to socioeconomic outcomes, including education, IQ, and earnings (e.g., Behrman and Rosenzweig (2004) and Black et al. (2007)), which may correlate with individuals' financial behavior, including their willingness to take risk.

# III Data

## A Data Sources and Summary Statistics

Our data come from the Swedish Twin Registry (STR), the world's largest twin registry, and constitute a combination of registry and survey data. Specifically, we obtained data from the "Screening Across Lifespan Twin" (SALT) database and the "Swedish Twin Studies of Adults: Genes and Environment" (STAGE) database. Overall, they provide very detailed information on over 40,000 same- and opposite-sex twin pairs with known zygosity from birth cohorts dating back to the 19th century. For the period 1999-2007, we also obtained for each twin detailed financial data from the Swedish Tax Authority and demographic information from Statistics Sweden (e.g., family structure and education). Last, our data set contains the number of securities owned at the end of the year and security-level data that we have collected from Bloomberg, Datastream, Morningstar, SIX Telekurs, Standard & Poor's, and the Swedish Investment Fund Association.

We select twins that in a given year are at least 18 years old and that have positive disposable income and net-worth.

For our analysis of prenatal testosterone, we further select all fraternal twins. In the main analyses we compare fraternal female twins with male co-twins (i.e., those of opposite sex twin pairs) to fraternal female twins with female co-twins (i.e., those of same sex twin pairs). In some specifications, we also include fraternal male twins to measure gender differences in risk taking. Our final sample consists of 34,460 fraternal twins: 9,410 female twins of opposite sex pairs ($F_M$), 9,093 female twins of same sex pairs ($F_F$), and 15,957 male fraternal twins.[9] In Table 1 Panel A, we report summary statistics of selected sociodemographic characteristics, pooled across all nine years, but separately for women with female co-twins ($F_F$), women with male co-twins ($F_M$), and men. The mean age for women is 57 and for men is 56, suggesting that the twins in our data set were born on average in the 1940s. ($F_F$) twins and ($F_M$) twins differ with respect to the number of siblings they have (excluding their co-twin) and in their birth order. Same-sex female twins are slightly more likely to be first-borns than opposite-sex or same-sex male twins. In our empirical analyses, we therefore control for differences in age and in family structure.

We provide a detailed definition of all variables in Appendix Table A.1. Several economic outcomes, such as business ownership, disposable income, and net worth, exhibit a clear gender difference. While the difference between the treatment ($F_M$) and the control group ($F_F$) of female twins is typically smaller, nonetheless the values for females of opposite-sex pairs are tilted towards the corresponding values for men.

For our analysis of birth weight, we focus on a subset of twins included in the SALT database for whom we have self-reported birth weight information. We consider only identical twins to attribute within-pair differences to environmental as opposed to genetic differences. In addition, we include only those twin-years for which we have non-missing observations for both twins. Our final sample contains 2,466 identical twins with a total of 17,510 twin-year observations

[9] In our sample the ratio of females of same sex twin pairs to females of opposite sex twin pairs is 0.966. According to the 2012 World Development Report, in Sweden the probabilities of male and female birth (respectively, 0.5146 and 0.4854) imply a ratio of 0.943 ($= 0.4854^2 \times 0.4854 \times 0.5146$).

between 1999 and 2007. In Panel B, we report birth weight and sociodemographic characteristics, separately for the lowest and the highest birth weight quartiles, and for the entire sample. For some sociodemographic variables, such age, birth order, number of siblings and years of education there are some clear differences between the lowest and the highest quartiles. It is possible that birth weight affects investor behavior directly as well as indirectly through its effect on such sociodemographic determinants. We address this possibility in our analyses.

The average birth weight of the twins in our sample is 2,414 grams ($g$), slightly below the commonly used low-birth weight cut-off of 2,500 $g$.[10] This average birth weight is below the typical population average, but very similar to what other studies have reported for the birth weight of twins (see, e.g., Behrman and Rosenzweig (2004) and Black et al. (2007)).

Figure 1 reveals that the distribution of birth weight for males and females in our sample of identical twins is indeed centered to the left relative to the population distributions. The population distributions are based on all U.S. live births between January and March of 1950, since historical birth weight data for Sweden is not available before 1973.[11] We address the implications of this difference in distributions for our results in a number of robustness tests.

As we include twin pair fixed effects in our empirical analysis, in the last two columns of Panel B, we report for each variable the mean and standard deviation of the absolute difference between twins in a pair. On average, identical twins in our sample exhibit a difference in Birth Weight of about 356 $g$. This within-pair difference is sizeable and corresponds, for example, to about 60% of the standard deviation of birth weight across all twins in our data set. Importantly, this difference is unrelated to parental influences or an individual's genetic endowment which is the same for identical twins.

[10]Since birth weight is self reported, measurement error is another source of within-pair differences. We explicitly address the consequences of measurement error in Section V.C.2.

[11]The SALT database contains twins born between 1886 and 1958 and the average birth year in our birth weight sample is 1945. Swedish population birth weight data are available from 1973. We use U.S. population data for non-African Americans in 1950 as a reasonable proxy. The data are from Table C of the Vital and Health Statistics published by the National Center for Health Statistics (Series 21, Number 3).

## B Measuring Investor Behavior

We examine several investor behaviors. At the center of our analysis is the effect of prenatal conditions on financial risk taking later in life. We use several standard proxies from the extant literature on financial risk taking. Our first measure is the share of risky (equity) assets (*Risky Share*) out of all financial assets (see, e.g., Merton (1969) and Samuelson (1969)). Our second measure is the volatility of portfolio of risky financial assets. That is, conditional on stock market participation and using twelve monthly return observations, we calculate the annualized, value-weighted portfolio return volatility (*Portfolio Volatility*) for each twin and each year. We also calculate the fraction of risky assets held directly in stocks as opposed to mutual funds (*Proportion Stocks*).

We also consider the decision to participate in the stock market (*Participation*) and the share of risky assets conditional on participation (*Risky Share* $> 0$). While the participation decision could reflect several factors, such as risk preferences, information about the risk-return tradeoff and stock market entry costs, *Risky Share* $> 0$ should largely be determined by risk aversion. We also construct alternative measures of volatility and the proportion invested in stocks. *Total Portfolio Volatility* is the volatility of the entire financial portfolio, consisting of risk-free and risky investments. *Total Proportion Stocks* measures the proportion of all financial assets invested directly in stocks.

Then, we investigate investor behaviors with a documented gender gap: trading and investments in lottery stocks. We analyze trading behavior (*Turnover*) measuring the number of sales transactions in a given year relative to the number of portfolio positions at the beginning of that year (Barber and Odean (2001)).[12] We measure investments in lottery stocks (*Proportion Lottery*) as the end-of-year proportion of risky assets invested in lottery-like assets as defined in Kumar (2009). Last, we study investor's preference for skewness, *Portfolio Skewness*, computed from the value-weighted monthly return of the portfolio of risky assets.

In Table 2 Panel A, we introduce the summary statistics for financial behaviors in our sample

[12] We do not observe the sales prices of mutual funds and therefore cannot calculate a value-based turnover measure.

of fraternal twins used in the prenatal testosterone analysis. Across the three main risk taking proxies, *Risky Share*, *Portfolio Volatility*, and *Proportion Stocks*, men take more risk than women, and females with male co-twins ($F_M$) take more risk than females with female co-twins ($F_F$). With the exception of *Risky Share* $> 0$, we find a similar pattern for the additional financial risk measures and for *Turnover*, *Proportion Lottery*, and *Portfolio Skewness.*

In Table 2 Panel B, we report corresponding summary statistics for the sample of identical twins used in the birth weight analyses. Compared to twins in the lowest birth quartiles, twins in the highest quartile hold more risky assets, but invest (slightly) less in individual stocks, and experience lower volatility in their overall financial portfolio. In particular, higher birth weight twins more often participate in the stock market and, conditional on participation, invest more in risky assets. As a consequence, they also have higher *Total Portfolio Volatility.*

On average, higher birth weight twins invest a smaller fraction of their financial assets in individual stocks, trade more, invest less in lottery type assets, and hold portfolios with lower skewness. However, since birth weight is likely correlated with genetic differences, this simple comparison between low and high birth weight twins does not allow any causal inference on the role of prenatal environment. In our empirical analyses, we therefore examine differences in outcomes between identical twins. The last two columns of Panel B indeed reveal sizeable differences at the twin-pair level.

# IV Effects of Prenatal Testosterone on Financial Risk Taking

## A Identification and Empirical Approach

According to the "Twin Testosterone Transfer" (TTT) hypothesis, a female who shares the womb with a male co-twin ($F_M$) is exposed to a higher level of prenatal testosterone than a female who shares the womb with a female co-twin ($F_F$). This increased testosterone exposure is hypothesized to have a masculinizing effect on the brain of the female twins. Hence, to identify the effects of prenatal testosterone exposure, we compare the financial decisions of ($F_M$) twins, our treatment group, to those of ($F_F$) twins, our control group.

Using panel data on female fraternal twins, we estimate the following equation:

$$y_{ijt} = \beta_0 + \beta_1 I_j^{F_M} + \beta_2 Age_{jt} + \beta_3 Family_j + \epsilon_{ijt}, \tag{1}$$

where $y_{ijt}$ is a measure of financial behavior of twin $i$ of pair $j$ in year $t$. $I^{F_M}$ is our treatment effect, equal to one for a ($F_M$) twin, and zero for a ($F_F$) twin. We control for age ($Age$) by using age indicators for individuals below 35 years, between 35 and 49 years, between 50 and 65, and above 65 years. We also control for the family structure ($Family$) by including both the number of non-twin siblings and the birth order of the twins relative to other siblings.

We emphasize several aspects of this empirical approach. First, while the gender of fraternal twins is determined exogenously relative to parental and twin's (genetic) characteristics, it is still possible that $F_F$ and $F_M$ twins differ in systematic ways. As mentioned above, the ratio of $F_F$ to $F_M$ twins in our data is 0.966, while probabilities of male and female births in Sweden would imply a ratio of 0.943. The difference could arise due to non-random sampling from the population of female twins or due to lower life expectancy of $F_M$ twins relative to $F_F$ twins.[13] We address these points in a number of robustness checks.

Second, while this study identifies treatment effects for female twins, it provides broader insights into the importance of naturally occurring variation in prenatal testosterone that is endogenously generated by human fetuses when in utero.[14] By design, we focus entirely on organizational, i.e., *prenatal*, effects of testosterone as opposed to the effects of circulating testosterone the level of which responds endogenously to environmental conditions.[15]

[13]We thank an anonymous referee for this observation.

[14]While there is substantial within-gender variation in testosterone, male fetuses on average produce higher levels of testosterone than female fetuses. In addition to different levels of prenatal testosterone, male and female fetuses also differ with respect to the presence of testosterone receptors.

[15]Men generally have higher levels of circulating testosterone than women during puberty and in adulthood. Circulating testosterone can be measured in saliva or blood and exogenously manipulated in experiments. Some studies have examined the effects of circulating testosterone on financial risk preferences, but the empirical evidence is so far inconclusive. More specifically, higher circulating testosterone has been found to increase risk taking in investment games in the lab in men (e.g., Apicella et al. (2008)) or only in women and not in men (e.g., Sapienza, Zingales, and Maestripieri (2009)).

Last, because a female fetus on average generates significantly less prenatal testosterone compared to males, we expect the strongest treatment effect for females who share the womb with a male co-twin and therefore focus on comparing "treated" and "untreated" female twins. For a male who shared the womb with another male the average effect is more ambiguous as the male co-twin may generate either more or less testosterone.[16]

## B Prenatal Testosterone, Financial Risk Taking, and the Gender Gap

### B.1 Prenatal Testosterone and Financial Risk Taking

In Table 3 Panel A, we present our estimates of the effect of prenatal testosterone on financial risk much later in life. For*Risky Share*, *Portfolio Volatility*, and *Proportion Stocks*, we report the differential effect of having a male co-twin versus a female co-twins, first without additional controls and then after controlling for age and family characteristics.[17]

In all cases, we find that females who shared the womb with a male co-twin ($F_M$) take significantly more financial risk than females who shared the womb with a female co-twin ($F_F$). Consistent with life cycle portfolio choice models, we find that age differences are important for risk taking,[18] while additional family characteristics are not significantly related to any of the measures of financial risk taking.

Focusing on specifications with controls, i.e., columns (2), (4), and (6), we find that a $F_M$ twin allocates about 1.24 percentage points more of her financial assets to equities compared to a $F_F$ twin. This treatment effect corresponds to an increase of about 3% compared to the mean equity allocation (41.6%) of the control group of $F_F$ twins. Similarly, a treated female's portfolio

[16] We also note that we do not expect a feminization of the brain of male twins with female co-twins as "ovarian-estrogen-mediated feminization [largely] takes place after the individual is free from the maternal-hormonal environment of the womb" (Baron-Cohen et al. (2004)). Importantly, exposure to testosterone which occurs before the female fetal ovaries are functional (in the 3rd trimester) makes males unresponsive to subsequent exposure to estrogens. That is, masculinization must *not* have occurred for feminization to occur (see, Fitch and Denenberg (1998) as well as the discussion following the article).

[17] Since all measures of financial risk taking have non-negative values, we employ a standard Tobit model with zero as the lower bound. All standard errors are double-clustered at the individual and year levels.

[18] *Risky Share* decreases monotonically with age (see, e.g, Barsky et al. (1997)), while *Proportion Stocks* increases until age 65, possibly reflecting increasing familiarity with individual stocks over the course of the working life. While *Portfolio Volatility* is lower for those in retirement age (i.e., 66 years or older), no monotonic association with age exists until age 65.

exhibits a 3% higher volatility (*Portfolio Volatility*) and a 14% higher allocation to individual stocks relative to mutual funds (*Proportion Stocks*) in comparison with the control group.

In Panel B of Table 3, we consider alternative measure of financial risk taking. In columns (1) and (2), we report estimation results from a linear probability model of *Participation*. Controlling for age and family characteristics reduces the size of the treatment effect, making it statistically insignificant. On the other hand, examining the effect on the share of risky assets conditional on participation (*Risky Share* $> 0$) in columns (3) and (4), we find that the controls for age and and family characteristics lead to an increase in the size of the treatment effect, which, in column (4), corresponds to a 1.3% increase in *Risky Share* $> 0$ relative to the control group, with a *p*-value of 10.7%.

Last, in columns (5) through (7), we consider the effect of having a male co-twin on portfolio volatility (*Total Portfolio Volatility*) and the proportion of stocks (*Total Proportion Stocks*) when both are measured relative to the entire financial portfolio, including risk-free investments. The relative size of the treatment effect, which is statistically significant in both cases, is similar to the results in Panel A. Compared to the mean value of the control group ($F_F$), we find an increase of 4% in the case of *Total Portfolio Volatility* and 16% in the case of *Total Proportion Stocks*.

Our empirical evidence is consistent with the TTT hypothesis. A female twin with a male co-twin takes more financial risk, potentially reflecting the partial masculinization of the brain due to increased exposure to prenatal testosterone. While this result draws attention to the importance of the fetal environment, it also offers insights into a possible biological perspective on the gender gap in financial risk taking.

### B.2 The Gender Gap in Financial Risk Taking

Differential exposure to prenatal testosterone is considered a primary determinant of the development of a male versus female phenotype. Therefore, we compare the economic magnitude of the estimated treatment effect to the overall difference in risk taking between men and women, i.e., the "gender gap." In practice, we add fraternal male twins to our sample and re-estimate Equation (1), including a *Male* indicator variable.

In Table 4 we find an economically and statistically significant gender gap in the three major risk-taking measures. For example, the estimated coefficient on the *Male* indicator is 3.30 percentage points, that is, men's *Risky Share* is about 8% higher than that of women. This result is consistent with previous studies that have documented a significant gender gap in financial risk taking (e.g., Croson and Gneezy (2009) and Sundén and Surette (1998)).

At the bottom of Table 4, we report the ratio of the effect of prenatal testosterone to the gender gap. For *Risky Share*, we find that the treatment effect is about 38.6% (= 1.273/3.299) of the gender gap, i.e., a female who shared the womb with a male on average has a 38.6% smaller gender gap in financial risk taking compared to a female in the control group. For the other two measures, we find smaller but comparable effects: 10% for *Portfolio Volatility*, 11% for *Proportion Stocks*.

To the best of our knowledge, no human data exist on the magnitude of the increase in prenatal testosterone due to a male co-twin. Nonetheless, animal studies on mice suggest that testosterone transfer from male fetuses increases the blood testosterone levels in female fetuses by about 10% of the difference in testosterone levels between male and female fetuses (vom Saal et al. (1980)). Assuming that these studies have some relevance for humans and that the relationship between testosterone levels and risk taking is approximately linear, our estimates of the treatment effect relative to the overall gender gap would appear plausible.[19]

The effect of prenatal testosterone on the brain is of primary interest for understanding the gender gap in financial decisions. Nevertheless, a male co-twin could lead to the masculinization of the female fetus along other dimensions.[20] In untabulated results, we apply our empirical

[19]Gender differences in general reflect not only biological but also social factors. Given the strong emphasis on gender equality in Sweden (e.g., Guiso, Monte, Sapienza, and Zingales (2008)), our data on Swedish twins might be relatively less influenced by gender identity effects.

[20]Since the effect of testosterone also depends on the presence of testosterone receptors that can vary across different tissues, this does not have to be the case. Animal studies document indeed that the masculinization due to a male fetus next to a female fetus causes anatomic and physiological consequences in addition to behavioral effects (see, e.g., vom Saal et al. (1980)).

model to a subset of slightly older female twins included in the SALT database for whom we have data on birth weight, adult height and weight. Consistent with Glinianaia et al. (1998), who documents larger birth weight for females with male co-twins, we find that having a male co-twin has significantly positive (at the 10% level) effects on birth weight, adult weight, and the Body Mass Index (*BMI*). The treatment effects for birth weight, adult weight, and *BMI* account for 13, 2, and 10% of the respective gender gaps.[21]

Our results are consistent with a masculinizing effect of prenatal testosterone for female twins with male co-twins. Our evidence suggests that differences in prenatal testosterone between men and women could explain a significant proportion of the observed gender gap in financial risk taking, complimenting social explanations as for example explored by D'Acunto (2014).

## C Robustness

Our tests of the TTT hypothesis rely on the assumption that female twins with male co-twins ($F_M$) differ from female twins with female co-twins ($F_F$) only in their conditions in the womb. This might not be the only difference. For example, male twins could shape their female co-twins' preferences trough social interaction from early years to adulthood. Moreover, the gender of the co-twin might not be randomly assigned in our sample and $F_M$ twins could differ from $F_F$ twins along some relevant parental or family characteristics. If confirmed, this sample selection could affect our results. We address these concerns in this section.

### C.1 Social Interaction Effects

We test if social interactions between twins explain our results. A co-twin may be a particularly low-cost source of casual financial advice. Because men on average take more financial risk than women, male co-twins may advice for riskier investments than female co-twins.

The ideal test to rule out social interactions would be to analyze twins that are separated at birth and have not been in contact since. While a few cases of twins that grew up separately

[21]For adult height, the treatment effect is positive, but small in magnitude and statistically insignificant.

exist, this sample is too small and we cannot rule out any communication during our sample period. As a viable alternative, we control for communication, travel distance, and portfolio overlap between the two twins. If contemporaneous social interactions drive our results, the effect of a male co-twin should be stronger among those twins that are more likely to have frequent social interactions.

We proxy for high social interaction in three ways: (i) above median communication and contact frequency, as measured in the Swedish Twin Registry surveys; (ii) below median travel time;[22] and (iii) more than 50% of the portfolio invested in the same securities. We add to our base line model in Equation (1) indicators for twins that are more likely to interact during our sample period as well as interaction terms between these indicators and our treatment indicator, $I^{F_M}$. If social interactions determine our results, the direct effect of a male co-twin in these specifications should decrease, potentially to zero.

As the results in Table 5 reveal, the direct effect of a male co-twin is statistically significant in six out of nine cases and the point estimates are similar (or slightly larger) in seven out of nine cases, compared to previous estimates. The interaction term is significantly positive only in one of the nine specifications: the treatment effect on the *Proportion Stocks* increases from 2.88% to 10.00% in the case of higher portfolio overlap.

The evidence in Table 5 shows that social interactions between twins cannot easily explain our results. That is, we observe elevated financial risk taking propensities even among females who are less likely to frequently interact with their male co-twins. We reach a similar conclusion when we perform the same analysis on the alternative risk taking measures (see Appendix Table A2).

### C.2 Effects of Male Siblings

We also investigate if a more general male sibling effect drive our results. For example, a female with a male co-twin may be exposed to relatively more aggressive or risk taking male behaviors

[22] We acknowledge that nowadays geographic distance may be an imperfect measure of communication. The results are similar if we use living in different regions or cities to proxy for geographic distance (untabulated).

when growing up. By way of imitation she could adopt such behaviors and later in life decide to take more financial risk. Differently from an effect due to prenatal testosterone, such an effect would not be limited to male co-twins, but should occur with any male sibling.

We therefore analyze if masculinization effects in financial risk taking occur for females with male siblings. Ideally, we would draw a random sample of Swedish families and test if females with male siblings close in age exhibit increased risk taking, in the same way that female twins with male co-twins do. In practice, we have access only to information on the family structure of the twins in our sample. Hence, we analyze the portfolio choices of the female siblings of the twins in our sample. We conduct this analysis in two ways.

First, we look at families with a total of three siblings, including the twin pair. Since it is difficult to fully account for family structure effects, we design a test that is less likely to be affected by endogenous choices in term of family structure. Specifically, we compare first-born non-twin females that are followed by either two male fraternal twins or two female fraternal twins. In both cases, parents decided to have additional children after the first-born daughter. We therefore do not expect any potential selection issues between these two types of families. In the former case, the female first-born is treated by two male siblings; in the latter case, she is treated by two female siblings.

We report the results in Table 6 Panel A. In the case of *Risky Share* in column (1), having a male sibling (*Male Sibling*) has a very small positive, but statistically insignificant effect (0.173 versus 1.242 in Table 3). For *Portfolio Volatility* and *Proportion Stocks*, the point estimates in columns (3) and (5) are negative, but again statistically insignificant.

We also control for the age gap between the first born female and the twin siblings. *Male Sibling Age Gap* is the age difference (in years) between the first born female and the younger male twins, it is zero if the twins are female. *Female Sibling Age Gap* is the age difference (in years) between the first born female and the younger male twins, it is zero if the twins are male. The coefficient estimates for *Male Sibling* are negative and not statistically significant in all three cases. Similarly, neither *Male Sibling Age Gap* nor *Female Sibling Age Gap* are ever significantly different from zero. Hence, even after controlling for age differences, we do not find that having a male sibling increases financial risk taking.

In Panel B of Table 6, we consider non-twin females being "treated" by any male sibling, including non-twins, independent of birth order or family size. Not controlling for age differences, we find a positive, but small and statistically insignificant effect of having a male sibling in columns (1), (3), and (5). When controlling for the (absolute) age difference between the female sibling and the male sibling closest in age, the Male Sibling effect turns negative in two out of the three cases. Only for *Proportion of Stocks* in column (6), the effect is positive, but small in magnitude (0.441 versus 2.984 in Table 3) and statistically insignificant.

While our data set is not perfect to estimate the general effect of having male sibling, the overall evidence does not seem to provide strong support for social interactions driving our results.[23]

### C.3 Sample Selection

To investigate potential sample selection, we first test if parental characteristics at the birth of the female twin could predict the gender of the co-twin. We regress the treatment indicator $I^{F_M}$, which is one for $F_M$ twins and zero for $F_F$ twins, on the age of the parents and the maximum number of years of education across both parents.[24] In untabulated results, we find no effect of these parental characteristics on $I^{F_M}$, suggesting that $F_M$ twins are not born in different families than $F_F$ twins.

As an additional robustness check, we estimate the effect of a male co-twin for those female that in our records appear as not having non-twin siblings. This test will account for any possible effect of family composition and birth order. Untabulated results reveal stronger treatment effects for this sub set of female twins.

[23] We again repeat the analysis performed in Table 6 for the alternative risk taking measures, reaching very similar conclusions. See Appendix Table A3 for details.

[24] We perform this analysis on a subset of female twins with non-missing parental data. While parental education is recorded during our sample period, we assume that it is a reasonable proxy for the education level at the twin birth. Finally, we include the same controls as in Equation (1).

Finally, we also estimate our treatment effect including a large set of sociodemographic controls such as years of education, net worth, disposable income, income volatility, business ownership, marital status, number of children, and health status. In this specification, we absorb any effect of a male co-twin that operates through these controls, and our treatment indicator $I^{F_M}$ will only reflect the direct effect on financial risk taking. In Appendix Table A4, we report these results for all our measures of financial risk taking. While the treatment effect decreases and is statistically insignificant for *Risky Share* and *Participation*, our results are largely unchanged for all other risk taking measures.

Overall, we conclude that sample selection or sociodemographic characteristics associated with $F_F$ and $F_M$ twins do not seem to drive our results.

# V Effects of Birth Weight on Financial Risk Taking

## A Identification and Empirical Approach

In economic research, birth weight is the most widely available and used summary measure of the prenatal environment. In this section, we analyze the effect of birth weight on financial risk taking later in life. Using data on identical twins, we use the following model specification:

$$y_{ijt} = \delta_0 + \delta_1 BW_{ij} + a_j + c_j + \omega_{ijt}, \tag{2}$$

where $y_{ijt}$ is a measure of financial risk taking of twin $i$ of pair $j$ in year $t$. $BW_{ij}$ is a twin birth weight. $a_j$ and $c_j$ are, respectively, unobservable genetic endowments and environmental effects common to each twin pair, such as, e.g., the mother's health during the pregnancy or the parents' socioeconomic status.

Birth weight may be correlated with these genetic endowments and common environmental effects. Therefore, we include twin pair fixed effects to isolate the individual-specific effects of the prenatal environment, such as better or worse nutritional intake of one twin relative to the other twin. That is, by simultaneously accounting for $a_j$ and $c_j$, twin pair fixed effects result in an unbiased estimate of $\delta_1$ (e.g., Behrman and Rosenzweig (2004) and Black et al. (2007)). To understand any bias attributable to unobservable genetic and common environmental variation, we also report estimates without twin pair fixed effects.

We estimate Equation (2) using standard ordinary least squares. All reported standard errors are double-clustered at the individual and year levels.

## B Main Results

The effect of birth weight on risk taking is unclear *ex ante*. On the one hand, the existing literature shows that higher birth weight leads to higher education, higher earnings, and better health (e.g., Behrman and Rosenzweig (2004) and Black et al. (2007)). Higher economic resources and human capital could allow those with higher birth weight to take more risk in financial markets. On the other hand, Hack et al. (2002) hypothesize that lower birth weight might lead to more risk taking later in life. Individuals might engage in compensatory behaviors and take more risk to mitigate the effects of a poor start (in term of lower birth weight).[25]

In Table 7 Panel A, we report the effect of birth weight, measured using the natural logarithm (*Birth Weight (ln)*), on financial risk taking. In columns (1), (3), and (5), we report results without twin pair fixed effect; in columns (2), (4), and (6), we include them.[26] The inclusion of twin pair fixed effects significantly increases the *R-squared*. This result is not surprising and reflects the significant commonality between identical twins. The importance of genetic and common environmental effects for risk taking is consistent with recent studies by, e.g., Barnea et al. (2010) and Cesarini et al. (2010).

We find that birth weight has a positive effect on *Risky Share*. The estimated effect is larger, but the statistical significance is somewhat weaker, in the second column where we also include twin pair fixed effects. In the fixed effects model, a one standard deviation increase in *Birth Weight (ln)* increases the *Risky Share* by about 1.46 percentage points, or about 3.3% of the

[25] Metcalfe and Monaghan (2001) provides an overview on compensatory behaviors in response to low birth weight.

[26] In the specification without twin pair fixed effects, we also control for gender as we use both male and female identical twins.

mean allocation in the entire sample (45.0%).

We also find that birth weight has a negative effect on *Portfolio Volatility* and *Proportion Stocks*. Both effects are highly statistically significant after we account for twin pair fixed effects ($p$-value = 0.000 and $p$-value = 0.011). The estimates in column (4) imply that a one standard deviation increase in *Birth Weight (ln)* decreases the *Portfolio Volatility* by about 4.6% relative to the sample mean of 15.3%. Estimates in Column (6) imply that an analogous change in birth weight generates an even larger effect and reduces the *Proportion Stocks* by about 10.4% of the sample mean (28.6%).

In Panel B of Table 7, we report results for alternative measures of financial risk taking. As in Panel A, controlling for unobserved, time-invariant twin pair heterogeneity is important. Based on columns (2) and (4) we find a statistically significant and positive effect of birth weight on stock market participation. We do not find a significant effect on risky assets conditional on participation.

Based on the results in Panel A, higher birth weight individuals are more likely to hold risky assets, but conditional on holding risky assets, they choose less volatile portfolios with a smaller fraction of individual stocks to mutual funds. We therefore examine the net-effect relative to an investor's entire financial portfolio. For *Total Portfolio Volatility* the effect of birth weight is negative but not statistically significant in the fixed effect estimation (column (6)). For *Total Proportion Stocks* the effect is negative and statistically significant at the 10% level in the relevant fixed effect specification of column (8).

The evidence in Table 7 reveals that lower birth weight individuals are less likely to invest in risky assets. This finding is consistent with adverse prenatal conditions, experienced in the womb and orthogonal to genetic endowments, increasing stock market participation costs. Conditional on holding any risky asset, lower birth weight twins hold more volatile portfolios with a higher fraction of individual stocks. This evidence is consistent with compensatory behaviors in response to unfavorable starting conditions.

Biologists have pointed out that selection will favor compensatory strategies if they increase the chances of reproductive success, even if they have some negative aspects such as, for example, shortening life (Metcalfe and Monaghan (2001)). In the financial domain, Robson (1992) and more recently by Roussanov (2010) have examined the implications of status concerns and the desire to get ahead of others. Consistent with our findings that low birthweight investors take more risk and prefer individual stocks over well-diversified mutual funds, Roussanov (2010) finds that status-concerned investors prefer idiosyncratic risks over aggregate risk.

Finally, this evidence questions if the previous prenatal testosterone results are explained by differences in birth weight. As stated, in our sample the difference in birth weight between females with a male co-twin and those with a female co-twin is indeed positive. To formally test for this possibility, we have re-estimated Equation (1), adding *Birth Weight (ln)* to the model. In untabulated results, we find that our estimates of the effect of a *Male Co-Twin* do not change after we control for birth weight. That is, the effect of prenatal testosterone is orthogonal to general prenatal conditions as captured by birth weight.

## C Robustness

We first investigate the external validity of our findings, given that on average twins have lower birth weight than singletons. Then, we discuss the robustness of our results to measurement error in the birth weight data and to controlling for a host of known factors that affect financial risk taking.

### C.1 External Validity

The fact that twins have on average lower birth weight than singletons is explained entirely by twinning rather than parental characteristics of the twin parents (Behrman and Rosenzweig (2004)). Given the lower birth weight of twins, we examine the external validity of our results. If the effect of birth weight on risk taking varies as a function of the level of birth weight, our results would be different if estimated on a random sample of the population with a higher average birth weight. A particular concern is that our results apply largely to those with very low birth weights and that we might not find any effect above the low-birth weight cut-off of 2,500 $g$.

We address this concern in two ways. First, we perform a weighted regression, using weights such that we replicate the birth weight distributions for the U.S. population (as shown in Figure 1). Second, we split our sample into two groups, using the low birth weights cut-off of 2,500 $g$. We analyze our three measures of financial risk taking, including twin pair fixed effects in all cases.

Table 8 Panel A reports the weighted regression results. The effect of birth weight on *Risky Share* is substantially smaller and no longer statistically significant when estimated with appropriate population weights. At the same time, the effects for *Portfolio Volatility* and *Proportion Stocks* are statistically significant and at least twice as large (in absolute size) as our previous estimates.

In Panel B of Table 8, we report results from unweighted regressions for twins with birth weights below or above 2,500 $g$. For *Risky Share*, we find relatively large positive, but statistically insignificant point estimates for both sub-samples. Interestingly, for *Portfolio Volatility* the negative effect of birth weight is only present in the sub-sample of twins with higher birth weight. For *Proportion Stocks*, birth weight has a negative effect in both sub-samples, but the effect is larger and statistically significant in the sub-sample with higher birth weight.

Taken together, the results in Table 8 suggest that the effect of birth weight on *Risky Share* might be limited to samples that include a large number of low birth weight individuals, while the effects on *Portfolio Volatility* and *Proportion Stocks* seem to be present and possibly stronger in the general population.

Finally, we investigate if the effect of birth weight has changed over time, due for example to medical advances or to higher resources devoted to those with a less favourable prenatal environment. We are limited in our ability to address this question because we only have birth weight data for twins born before 1958 and we observe their financial decisions only for few years such that we cannot distinguish between life cycle and cohort effects. Nevertheless, in Figure 2 we document that the within-pair differences in twin birth weight and in our three risk taking measures are substantially constant across different cohorts. In untabulated analyses, we have also included an interaction term between birth weight and birth year in our baseline specifications. For *Risky Share* and *Proportion Stocks* this interaction term is insignificant; for *Portfolio Volatility* is significant and negative. With the caveat that we cannot fully distinguish between life cycle and cohort effects, our results would suggest that the effect of birth weight does not appear to decline over time.

### C.2 Measurement Error

Our measure of birth weight likely suffers from measurement error, as it is self-reported and not from archival data. As pointed out in Taubman (1976), estimation with twin-pair fixed effects can lead to an increased attenuation bias relative to OLS estimation if the correlation between the true birth weight of both twins is larger than the correlation of the measurement errors. Since we do not have access to archival birth weight data, we cannot directly test for the effect of measurement error. Instead, we have explored an instrumental variable (IV) approach. We instrument $BirthWeight(ln)$ with an indicator variable that for a given twin pair is one for the twin with the higher birth weight and zero for the other twin (Black et al. (2006)). This IV estimation depends on the assumptions that although twins might not recall their exact birth weight, they still remember which of the two twins had the higher birth weight and that these recollections are not affected by outcomes later in life.

For *Risky Share*, *Portfolio Volatility*, and *Proportion Stocks*, the IV regressions (untabulated) yield point estimates that are on average about 66% larger than the fixed effect estimates in Table 7 Panel A. At the same time, the standard errors of the IV estimates are larger as well, such that in all cases the 95% confidence interval around the IV point estimate includes the point estimates from the fixed effect estimation. We therefore conclude that our fixed effect estimates offer a lower bound of the true effect of $BirthWeight(ln)$ on our key outcomes.

### C.3 Is There a Direct Effect of Birth Weight?

Birth weight can directly influence financial risk taking, as fetal programming may affect risk preferences. In addition, birth weight might affect other economic outcomes, such as education, income, or health that can influence in turn investment decisions (e.g., Behrman and Rosenzweig (2004), Grjibovski et al. (2005), and Black et al. (2007)).

To test if birth weight has a direct effect above and beyond known channels, we estimate our baseline model including a large set of control variables suggested by the existing portfolio choice literature: *Net Worth* (e.g., Brunnermier and Nagel (2008)), *Labor Income Volatility* and *Business Owner* (e.g. Heaton and Lucas (2000)), cognitive abilities proxied by *Years of Education* (e.g., Grinblatt et al. (2011)), and *Poor Health* (e.g., Rosen and Wu (2004)), *Single*, *Divorced*, *Number of Children*, *Retired*, and *Disposable Income (ln)*.

In Appendix Table A5 we document that the effects of birth weight on our measures of financial risk-taking remain largely unchanged, even after controlling for all the above variables and twin fixed effects. In some cases, the absolute size of the birth weight effect actually increases.

This evidence suggests that the effects of birth weight on financial risk taking are not easily explained by known factors that affect financial risk taking. The prenatal environment as "summarized" by birth weight seems to have persistent and direct effects on financial decisions much later in life.

## VI Interpretation of Results

Our results so far suggest that prenatal conditions significantly affect financial risk taking later in life. In this section, we analyze additional financial decisions that could be affected by variation in prenatal testosterone or birth weight. We also shed light on the interpretation and implications of our findings by examining whether prenatal conditions affect financial decisions through cognitive abilities or preferences.

## A Prenatal Conditions and Additional Financial Decisions

According to the TTT hypothesis, a male co-twin increases the level of prenatal testosterone for the female twin and leads to a (slight) masculinization of the brain and hence of her behavior. In addition to a gender gap in risk taking, research in finance has documented gender differences in trading (Barber and Odean (2001)) and lottery-type investments (Kumar (2009)).[27] We therefore examine if female twins with a male co-twin ($F_M$) are more likely to trade and hold more lottery-type investments than female twins with a female co-twin ($F_F$).

In Table 9 Panel A, we find evidence that supports these predictions. Female twins with a male co-twin ($F_M$) have a higher turnover (*Turnover*) by 1.99 percentage points (statistically significant at the 10% level). This corresponds to an increase of about 11% compared to the mean turnover (18.1%) of the control group of $F_F$ twins. The effect on *Proportion Lottery* is even more sizable and statistically significant at the 1% level. $F_M$ twins hold 2.93 percentage points more of lottery-type investments or about 72.5% more compared to the average allocation (4.04%) of the control group of $F_F$ twins. Finally, for *Portfolio Skewness* the estimated treatment effect is also positive, but relatively smaller in magnitude and not statistically significant at conventional levels.

In untabulated results, we compare the treatment effect of having a male co-twin to the gender gap for trading and lottery-type investments in our data set. The ratio of the treatment effect and the gender gap is equal to 9.3% for *Turnover* and 19.3% for *Proportion Lottery* (statistically significant at the 10% and 1% level). The magnitude of these ratios is highly comparable with the evidence presented in Table 4 about financial risk-taking. We do not find a statistically significant gender gap in *Portfolio Skewness*.

We also investigate the relation between birth weight and these additional outcome variables. On the one hand, if lower-birth-weight twins engage in compensatory risk-taking behaviors (e.g.,

[27] Using data from a large discount brokerage firm, Barber and Odean (2001) document that men trade 45 percent more than women. Kumar (2009) finds that men are more likely than women to invest in lottery type stocks, i.e., stocks with low price and high idiosyncratic skewness and volatility, consistent with evidence outside the financial domain that men exhibit higher rates of pathological gambling than women (e.g., Stoletenberg et al. (2007); Slutske et al. (2003)).

Hack et al. (2002); Metcalfe and Monaghan (2001)), then we expect that their portfolios exhibit higher skewness and, possibly, a larger fraction of lottery-type assets, as these investments have higher idiosyncratic volatility and skewness.[28] On the other hand, there is no clear prediction in terms of birth weight affecting trading activity.

In Table 9 Panel B, we report the corresponding results for the twin pair fixed effect specification of Equation (2). Consistent with an unclear prediction, we find a negative, but statistically insignificant effect of birth weight on trading activity. Birth weight has instead a statistically significant (at the 10% level) negative effect on the share of lottery-type stocks. Our estimates imply that a one standard deviation decrease in *Birth Weight (ln)* increases the *Proportion Lottery* by about 13% relative to the sample mean (5.6%). The effect of birth weight on skewness is statistically significant at the 1% level and also economically meaningful. A one standard deviation decrease in *Birth Weight (ln)* increases the *Portfolio Skewness* by about 47.8% of the average portfolio skewness in the entire sample (2.9%).

The evidence in Table 9 nicely dovetails with our previous results. First, we find that having a male co-twin increases trading and investments in lottery-type stocks. These results are consistent with important gender differences reported by previous studies with respect to trading and gambling. They also offer further support for masculinization effects in financial behaviors due to prenatal testosterone.

Second, we find that lower birth weight considerably increases portfolio skewness and, to a lower extent, holdings of lottery-type investments. This latter result is consistent with our previous findings that lower-birth-weight twins hold more volatile equity portfolios and more individual stocks. Overall, this evidence suggests that lower-birth-weight individuals are more likely to engage in compensatory behaviors.

[28]Robson (1992) and, more recently, Roussanov (2010) have examined the financial risk implications of social status concerns (i.e., the desire to get ahead of others). In Roussanovs model, for example, status-concerned investors prefer idiosyncratic risks to aggregate risk.

## B Preferences vs. Cognitive Abilities and Biases

The additional results in Table 9 raise the question if prenatal conditions affect investor behavior through cognitive abilities and ultimately investment mistakes or if they directly influence investors' preferences. On the one hand, frequent trading, more lottery-type investments, and poor diversification (i.e., more individual stocks) are directly related to behavioral biases (Cronqvist and Siegel (2014)) and low financial sophistication (Calvet et al. (2009)). On the other hand, the share of risky assets, portfolio volatility, and portfolio skewness could reflect underlying preferences.

We use mediation analysis to systematically account for the possibility that prenatal conditions can have a direct effect on portfolio choice and also an indirect effect, trough cognitive abilities.[29] We control for cognitive skills by using education, income, and net worth as proxies (Grinblatt et al. (2011)).[30] We also employ the bias index of Cronqvist and Siegel (2014) as a proxy of financial sophistication. This index reflects the extent to which investors commit a number of investment mistakes.[31]

We conduct the mediation analysis for the three outcome variables that most likely reflect investors' preferences: share of risky assets (conditional on participation), portfolio volatility, and portfolio skewness. For computational ease, we use pure cross-sectional data, by converting time-varying variables into time-series averages. We employ the seemingly unrelated regression model by Zellner (1962, 1963) and estimate the following set of equations separately for the three

[29]Our analysis is similar in spirit to Brañas-Garza and Rustichini (2011) who investigate the effect of prenatal testosterone exposure as measured by the 2D:4D ratio on risk aversion, with reasoning ability as the mediating factor. The possibility of an indirect effect of prenatal conditions on investor behaviors is suggested by the existing literature. For example, higher birth weight is associated with higher IQ (e.g., Black et al. (2007)) and IQ positively influences investment decisions (Grinblatt et al. (2011)).

[30]Grinblatt et al. (2011) document that roughly two-thirds of the effect of IQ on stock market participation is indeed explained (or mediated) by education, income, and wealth.

[31]We compute the bias index for each individual and for each year in our sample. The index takes the value between zero (high financial sophistication) and ten (low sophistication), aggregating in a linear way the tendency to engage in five different behavioral biases: i) under-diversification; ii) home bias; iii) trend-chasing; iv) trading; v) holding lottery stocks. For more details on the construction of this index, see Appendix Table A1.

outcomes ($y_{ij}$) and the two prenatal treatments:

$$\begin{aligned} y_{ij} = \eta_1 + \lambda_1 Prenatal\,Treatment_{ij} + \alpha Education_{ij} + \beta Income_{ij} \\ + \gamma Net\,Worth_{ij} + \delta Bias\,Index_{ij} + \Omega_1 Baseline\,Controls_{ij} + \epsilon_{1ij} \end{aligned} \tag{3}$$

$$Education_{ij} = \eta_2 + \lambda_2 Prenatal\,Treatment_{ij} + \Omega_2 Baseline\,Controls_{ij} + \epsilon_{2ij} \tag{4}$$

$$Income_{ij} = \eta_3 + \lambda_3 Prenatal\,Treatment_{ij} + \Omega_3 Baseline\,Controls_{ij} + \epsilon_{3ij} \tag{5}$$

$$Net\,Worth_{ij} = \eta_4 + \lambda_4 Prenatal\,Treatment_{ij} + \Omega_4 Baseline\,Controls_{ij} + \epsilon_{4ij} \tag{6}$$

$$Bias\,Index_{ij} = \eta_5 + \lambda_5 Prenatal\,Treatment_{ij} + \Omega_5 Baseline\,Controls_{ij} + \epsilon_{5ij} \tag{7}$$

As before, we include age and family structure controls for the prenatal testosterone analyses and twin fixed effects in all the birth weight analyses as *Baseline Controls*.

The coefficient of the direct effect, $\lambda_1$, is estimated in Equation (3). The indirect effects are estimated by multiplying the coefficients of each of the mediating factors in Equation (3) with the estimates of the *Prenatal Treatment* effects on each of these factors in the following equations (4 - 7). For example in the case of education as a mediator, the indirect effect of our prenatal treatment is given by the product $\lambda_2\alpha$. Therefore, the total indirect effect is given by: $\lambda_2\alpha + \lambda_3\beta + \lambda_4\gamma + \lambda_5\delta$.

If the direct effect, $\lambda_1$, is significant and dominates the total indirect effect, we would interpret this case as prenatal conditions affecting a given outcome by shaping preferences. If instead the indirect effect prevails, we would conclude that prenatal testosterone and birth weight influence our outcomes largely through the cognition channel.

In Table 10 Panel A, we present the results relative to prenatal testosterone. For each variable, we first report the coefficient estimates and then the size of the effect relative to the total (direct plus indirect) effect. For ease of comparison, we also report the combined indirect effect. We assess the statistical significance of the direct and indirect effects using bootstrapping methods

(Preacher and Hayes (2004); Zhao et al. (2010)).[32]

Having a *Male Co-Twin* has a positive direct effect on *Risky Share* > 0, which is statistically significant at the 10% level. This effect is even larger than the *Total Effect* by 15.7%, implying a negative total indirect effect. While education, income and the bias index all have a statistically significant effects (at the 5% level), they have competing effects (i.e., of opposite signs). As a result the *Total Indirect Effect* is indeed negative and not statistically significant at conventional levels. Taken together, this evidence favors an interpretation of the effect of prenatal testosterone on the share of risky assets as largely due to preferences, rather than cognitive abilities.

For both *Portfolio Volatility* and *Portfolio Skewness*, the total indirect effect is statistically significant at the 5% level. The direct effect is not only smaller in magnitude, but also statistically insignificant. The *Bias Index* largely contributes to this result. Females with a male co-twin choose equity investments with higher volatility and skewness, but this is largely explained by their propensity to make investment mistakes more in general.[33] In other words, prenatal testosterone increases the likelihood of making investment mistakes and this tendency largely explains the higher portfolio volatility and skewness. In Table 10 Panel B, we report the results of the mediation analysis for birth weight. We account for twin fixed effects in all cases. Hence, we identify the indirect effect of birth weight controlling also for the fact that the channels, such as biases, might have strong genetic determinants (e.g., Cesarini et al. (2012); Cronqvist and Siegel (2014)).

In the case of *Risky Share* > 0, neither the direct nor the total indirect effect is statistically significant. The lack of a significant direct effect is consistent with the evidence in Table 7 Panel B, documenting how birth weight influences the share of risky assets largely through participation in the stock market.

[32]We perform 10,000 repetitions with case resampling. Following the convention in this methodology, we account for the fact that the indirect effects are generally non-normally distributed (i.e., usually positively skewed and kurtotic) by estimating asymmetric confidence intervals for the indirect effects.

[33]The bias index includes also the fraction of lottery stocks, investments that have by definition higher skewness. We are not worried that this index is mechanically related to our outcome variable, Portfolio Skewness. In Table 10 Panel B, we indeed present evidence that in the case of birth weight the bias index does not explain the portfolio skewness.

For *Portfolio Volatility* we find a prevalent total indirect effect of birth weight. While the direct effect now turns insignificant, the total indirect effect is statistically significant at the 10 percent level and represents 84.3% of the *Total Effect* of birth weight. This indirect effect is largely driven by the *Bias Index* and suggests that the effect of birth weight on portfolio volatility acts largely trough the propensity of committing investment mistakes. That is, birth weight decreases the likelihood of investment biases and this effect largely accounts for the lower portfolio volatility.

In the case of *Portfolio Skewness*, we find a statistically significant direct effect at the 1% level. This effect also represents 91.0% of the *Total Effect*. We also find evidence of a significant (at 10% level) indirect effect through the *Bias Index*, but this effect account only for 10.1% of the total effect. These results lend support to the notion that birth weight affect preferences for skewness consistent with the type of compensatory risk-taking hypothesized in the literature (e.g., Hack et al. (2002); Metcalfe and Monaghan (2001)).

Overall, our mediation analysis results in Table 10 highlight that prenatal conditions have the potential to shape cognitive abilities and investment biases as well as lifetime investment preferences. Prenatal testosterone increases the likelihood of investment mistakes and this propensity largely accounts for the higher portfolio volatility and skewness of female twins with a male co-twin. At the same time, prenatal testosterone directly influences the preference for risky assets (conditional on participation) above and beyond cognitive abilities and biases.

Analogously, lower birth weight increases the likelihood of investment biases. This higher propensity of investment mistakes largely explains the higher portfolio volatility of lower birth weight twins. Nonetheless, this same propensity plays a very limited role in determining the higher portfolio skewness, which is largely due to birth weight directly affecting investors' preference for skewness.

## VII Conclusion

A large and growing literature in economics has recently documented the importance of the prenatal, i.e., pre-birth, environment for economic outcomes much later in life (e.g., Almond and Currie (2011b) and Currie (2011)). This scientific evidence has even made its way into mainstream media, for example Paul's (2011) book "Origins: How the Nine Months Before Birth Shape the Rest of Our Lives" and an article in Time magazine summarizing the evidence: The "quality of nutrition [we] received in the womb; the pollutants, drugs and infections [we] were exposed to during gestation [...] shape our susceptibility to disease, our appetite and metabolism, our intelligence and temperament." In this paper we have asked whether the prenatal environment also affects outcomes in the domain of financial decisions.

We find that differences in an individual's prenatal environment explain heterogeneity in investor behavior, in particular with respect to financial risk taking, much later in life. An exogenous increase in exposure to prenatal testosterone "masculinizes" financial decisions and leads to elevated risk taking, more trading, and larger investments in lottery-type assets. We also examine birth weight, the most widely used summary measure of the prenatal environment. Controlling for identical twin pair fixed effects, we find that those with lower birth weight, i.e., those that experience more adverse prenatal conditions in a general sense, make worse financial decisions, by, for example, not investing in the stock market. At the same time, low birth weight investors hold portfolios with higher volatility and skewness, consistent with compensatory behavior. Finally, we show that on the one hand the prenatal environment can affect financial decisions directly by shaping investors' preference. For example, prenatal testosterone has a direct effect on risk preferences, while birth weight directly affects skewness-related preferences. On the other hand, prenatal testosterone as well as birth weight seem to affect the chosen level of portfolio volatility indirectly through their general effect on decision making.

This study is one of the first attempts to incorporate into finance research the fetal origins hypothesis, a growing literature in economic research which has documented that the prenatal environment programs a fetus in the womb to have persistent behavioral characteristics. Our results contributes to our understanding of how (prenatal) environmental conditions can shape individuals' behavior in financial markets. Furthermore, our evidence with respect to prenatal testosterone exposure also suggests that biological factors could explain a sizable proportion of the gender gap in financial decisions, while our birth weight results provide novel empirical evidence of the compensatory behavior by those with low birth weight.

Future research may focus on how different prenatal environmental factors, other than testosterone exposure or birth weight, affect financial decisions. Several economists have also emphasized the importance of the *postnatal* early life environment for outcomes much later in life (e.g., Garces, Thomas, and Currie (2002) and Cunha and Heckman (2010)), which provides another direction for related research.

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**Table 1**
Summary Statistics: Socioeconomic Characteristics

Panel A: Twin Testosterone Transfer Sample (Fraternal Twins)

| | Female with Female Co-Twin ($F_F$) (*N* = 61,099) | | Female with Male Co-Twin ($F_M$) (*N* = 63,042) | | Male (*N* = 106,975) | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| Age | 57.399 | 15.770 | 56.724 | 13.862 | 55.941 | 14.129 |
| Birth Order | 1.599 | 1.275 | 1.679 | 1.430 | 1.688 | 1.422 |
| Number of Siblings | 1.150 | 1.385 | 1.274 | 1.518 | 1.309 | 1.500 |
| Net Worth (ln) | 12.619 | 1.520 | 12.664 | 1.518 | 13.001 | 1.459 |
| Volatility of Labor Income | 14.089 | 13.646 | 13.603 | 13.075 | 13.473 | 13.596 |
| Business Owner | 0.014 | 0.119 | 0.016 | 0.126 | 0.034 | 0.181 |
| Years of Education | 9.368 | 4.957 | 10.070 | 4.451 | 9.741 | 4.392 |
| Missing Education Data | 0.162 | 0.369 | 0.103 | 0.304 | 0.109 | 0.311 |
| Poor Health | 0.174 | 0.379 | 0.204 | 0.403 | 0.126 | 0.332 |
| Single | 0.210 | 0.407 | 0.207 | 0.405 | 0.267 | 0.442 |
| Divorced | 0.120 | 0.324 | 0.124 | 0.330 | 0.103 | 0.304 |
| Number of Children | 0.586 | 1.034 | 0.592 | 1.030 | 0.662 | 1.076 |
| Retired | 0.408 | 0.491 | 0.370 | 0.483 | 0.354 | 0.478 |
| Disposable Income (ln) | 12.268 | 0.596 | 12.277 | 0.586 | 12.475 | 0.692 |

Panel B: Birth Weight Sample (Identical Twins)

| | Lowest Birth Weight Quartile *(N = 5,140)* | | Highest Birth Weight Quartile *(N = 2,581)* | | Entire Sample Twin (*N* = 17,510) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Observations by Twin | | Within-Twin-Pair Differences | |
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| Birth Weight (g) | 1,759.7 | 239.7 | 3,308.6 | 210.7 | 2,413.9 | 567.0 | 356.0 | 320.2 |
| Birth Weight (ln) | 7.462 | 0.151 | 8.102 | 0.062 | 7.760 | 0.246 | 0.154 | 0.145 |
| Age | 59.354 | 9.692 | 56.727 | 8.800 | 57.854 | 9.274 | 0.000 | 0.000 |
| Birth Order | 1.462 | 0.772 | 2.071 | 1.133 | 1.688 | 0.964 | 0.000 | 0.000 |
| Number of Siblings | 1.109 | 1.345 | 1.506 | 1.379 | 1.252 | 1.340 | 0.000 | 0.000 |
| Net worth (ln) | 13.019 | 1.405 | 13.209 | 1.416 | 13.122 | 1.390 | 1.143 | 1.174 |
| Volatility of Labor Income | 0.121 | 0.111 | 0.132 | 0.114 | 0.119 | 0.109 | 0.089 | 0.112 |
| Business Owner | 0.024 | 0.152 | 0.038 | 0.190 | 0.024 | 0.154 | 0.037 | 0.190 |
| Years of Education | 10.311 | 4.427 | 11.070 | 4.203 | 10.844 | 4.279 | 1.871 | 2.931 |
| Missing Education Data | 0.094 | 0.292 | 0.067 | 0.251 | 0.076 | 0.265 | 0.045 | 0.207 |
| Poor Health | 0.175 | 0.380 | 0.199 | 0.399 | 0.175 | 0.380 | 0.222 | 0.416 |
| Single | 0.117 | 0.322 | 0.106 | 0.308 | 0.119 | 0.323 | 0.132 | 0.339 |
| Divorced | 0.160 | 0.366 | 0.149 | 0.356 | 0.155 | 0.362 | 0.243 | 0.429 |
| Number of Children | 0.495 | 0.895 | 0.621 | 0.947 | 0.579 | 0.957 | 0.437 | 0.769 |
| Retired | 0.357 | 0.479 | 0.272 | 0.445 | 0.312 | 0.463 | 0.132 | 0.339 |
| Disposable Income (ln) | 12.367 | 0.633 | 12.339 | 0.712 | 12.357 | 0.629 | 0.406 | 0.572 |

Table 1 Panel A provides summary statistics for several socioeconomic characteristics for the fraternal twins used in the Twin Testosterone Transfer analyses, separately for women with a female co-twin ($F_F$), women with a male co-twin ($F_M$), and for men. Table 1 Panel B provides summary statistics for the identical twins used in the Birth Weight analyses, separately for the lowest birth weight quartile, the highest quartile, and the entire sample. The last two columns of Panel B report summary statistics for within-twin-pair differences. All variables are defined in detail in Appendix Table A1*N* provides the total number of twin-year observations.

**Table 2**
Summary Statistics: Financial Decisions

Panel A: Twin Testosterone Transfer Sample (Fraternal Twins)

| | Female with Female Co-Twin ($F_F$) | | | Female with Male Co-Twin ($F_M$) | | | Male | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | *N* | Mean | Std. Dev. | *N* | Mean | Std. Dev. | *N* |
| Risky Share | 41.555 | 38.340 | 61,099 | 42.686 | 38.537 | 63,042 | 43.901 | 38.298 | 106,975 |
| Portfolio Volatility | 14.251 | 11.471 | 26,690 | 14.706 | 11.911 | 28,203 | 18.296 | 14.179 | 49,748 |
| Proportion Stocks | 21.969 | 35.598 | 44,658 | 23.579 | 36.491 | 46,864 | 35.784 | 41.183 | 83,231 |
| Participation | 73.104 | 44.342 | 61,099 | 74.338 | 43.677 | 63,042 | 77.804 | 41.557 | 106,975 |
| Risky Share (>0) | 56.845 | 33.789 | 44,658 | 57.422 | 33.935 | 46,864 | 56.425 | 34.330 | 83,231 |
| Total Portfolio Volatility | 7.805 | 8.816 | 26,690 | 8.108 | 9.033 | 28,203 | 9.952 | 11.166 | 49,748 |
| Total Proportion Stocks | 11.160 | 23.286 | 44,658 | 11.985 | 23.967 | 46,864 | 18.783 | 28.945 | 83,231 |
| Turnover | 0.181 | 0.393 | 31,882 | 0.187 | 0.410 | 33,576 | 0.267 | 0.551 | 61,456 |
| Proportion Lottery | 0.040 | 0.149 | 41,334 | 0.045 | 0.156 | 43,706 | 0.067 | 0.189 | 79,646 |
| Portfolio Skewness | 2.289 | 22.124 | 29,659 | 2.469 | 22.145 | 31,162 | 4.526 | 22.900 | 54,971 |
| Bias Index | 1.894 | 1.699 | 42,010 | 1.961 | 1.747 | 44,302 | 2.510 | 1.971 | 80,913 |

Panel B: Birth Weight Sample (Identical Twins)

| | Lowest Birth Weight Quartile | | | Highest Birth Weight Quartile | | | Entire Sample Observations by Twin | | | Entire Sample Within-Twin-Pair Differences | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | *N* | Mean | Std. Dev. | *N* | Mean | Std. Dev. | *N* | Mean | Std. Dev. |
| Risky Share | 43.269 | 37.478 | 5,140 | 47.510 | 38.773 | 2,581 | 44.959 | 37.494 | 17,510 | 28.959 | 29.043 |
| Portfolio Volatility | 14.925 | 12.356 | 1,329 | 14.703 | 11.434 | 763 | 15.263 | 12.323 | 4,926 | 11.605 | 11.642 |
| Proportion Stocks | 29.965 | 39.115 | 3,368 | 29.331 | 39.787 | 1,774 | 28.636 | 38.408 | 11,744 | 29.458 | 37.475 |
| Participation | 77.646 | 41.666 | 5,140 | 81.945 | 38.472 | 2,581 | 79.931 | 40.052 | 17,510 | 35.604 | 47.902 |
| Risky Share (>0) | 56.389 | 33.141 | 3,368 | 58.560 | 34.265 | 1,774 | 57.019 | 33.115 | 11,744 | 32.369 | 27.048 |
| Total Portfolio Volatility | 7.827 | 8.691 | 1,318 | 8.177 | 8.264 | 758 | 8.387 | 9.232 | 4,876 | 7.572 | 8.630 |
| Total Proportion Stocks | 14.715 | 25.739 | 3,368 | 16.779 | 28.383 | 1,774 | 14.983 | 26.100 | 11,744 | 13.657 | 22.805 |
| Turnover | 0.228 | 0.456 | 2,036 | 0.279 | 0.531 | 1,065 | 0.242 | 0.483 | 7,094 | 0.436 | 0.559 |
| Proportion Lottery | 0.059 | 0.180 | 3,088 | 0.054 | 0.159 | 1,600 | 0.056 | 0.168 | 10,736 | 0.109 | 0.233 |
| Portfolio Skewness | 0.030 | 0.222 | 1,890 | 0.024 | 0.224 | 883 | 0.029 | 0.226 | 6,448 | 0.198 | 0.181 |
| Bias Index | 2.288 | 1.853 | 3,220 | 2.302 | 1.974 | 1,668 | 2.251 | 1.913 | 11,142 | 1.695 | 1.477 |

Table 2 Panel A reports summary statistics for measures of financial risk taking for the fraternal twins used in the Twin Testosterone Transfer analyses, separately for women with a female co-twin ($F_F$), women with a male co-twin ($F_M$), and for men. Table 2 Panel B provides similar measures for the identical twins used in the Birth Weight analyses, separately for the lowest birth weight quartile, the highest quartile, and the entire sample. The last two columns of Panel B report summary statistics for within twin pair differences. All variables are defined in detail in Appendix Table A1. *N* provides the total number of twin-year observations.

**Table 3**
The Effect of Having a Male Co-Twin

Panel A: Financial Risk Taking

| | Risky Share | | Portfolio Volatility | | Proportion Stocks | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Male Co-Twin ($F_M$) | 1.591** | 1.242** | 0.456*** | 0.386*** | 3.512*** | 2.984** |
| | (0.013) | (0.046) | (0.003) | (0.010) | (0.005) | (0.016) |
| Age less than 35 | | 21.004*** | | 2.790*** | | -13.702*** |
| | | (0.000) | | (0.001) | | (0.000) |
| Age less than 50 | | 16.332*** | | 3.563*** | | -2.715 |
| | | (0.000) | | (0.000) | | (0.350) |
| Age less than 66 | | 12.483*** | | 2.284*** | | 3.732* |
| | | (0.000) | | (0.000) | | (0.087) |
| Number of Sibling | | -0.743 | | 0.061 | | -0.432 |
| | | (0.188) | | (0.651) | | (0.526) |
| Birth Order | | 0.400 | | -0.150 | | -0.740 |
| | | (0.330) | | (0.156) | | (0.294) |
| Intercept | 33.645*** | 23.761*** | 14.251*** | 12.496*** | -9.068*** | -7.053*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.004) |
| *N* | 124,141 | 124,141 | 54,893 | 54,893 | 91,522 | 91,522 |
| *R-squared* | 0.000 | 0.002 | 0.000 | 0.002 | 0.000 | 0.001 |

Panel B: Alternative Measures of Financial Risk Taking

| | Participation | | Risky Share > 0 | | Total Portfolio Volatility | | Total Proportion Stocks | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Male Co-Twin ($F_M$) | 1.233** | 0.747 | 0.578 | 0.731 | 0.314** | 0.303** | 2.037*** | 1.752** |
| | (0.025) | (0.176) | (0.223) | (0.108) | (0.011) | (0.012) | (0.010) | (0.024) |
| Age less than 35 | | 13.000*** | | 11.400*** | | 3.560*** | | -3.282** |
| | | (0.000) | | (0.000) | | (0.000) | | (0.049) |
| Age less than 50 | | 10.959*** | | 8.009*** | | 3.398*** | | 2.678* |
| | | (0.000) | | (0.000) | | (0.000) | | (0.088) |
| Age less than 66 | | 12.082*** | | 1.981** | | 1.614*** | | 3.787*** |
| | | (0.000) | | (0.035) | | (0.000) | | (0.009) |
| Number of Sibling | | -1.111*** | | 0.366 | | 0.090 | | -0.203 |
| | | (0.007) | | (0.315) | | (0.244) | | (0.634) |
| Birth Order | | 0.471 | | -0.050 | | -0.084 | | -0.626 |
| | | (0.166) | | (0.856) | | (0.248) | | (0.166) |
| Intercept | 73.104*** | 65.538*** | 56.845*** | 52.866*** | 7.630*** | 5.963*** | -9.148*** | -9.717*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *N* | 124,141 | 124,141 | 91,522 | 91,522 | 54,893 | 54,893 | 91,522 | 91,522 |
| *R-squared* | 0.000 | 0.001 | 0.000 | 0.001 | 0.000 | 0.003 | 0.000 | 0.001 |

Table 3 Panel A reports results from Tobit regressions of annual measures of financial risk taking of female fraternal twins between 1999 and 2007 onto an indicator variable for women with a male co-twin (“Male Co-Twin”) without and with additional controls. Table 3 Panel B reports corresponding results for alternative annual measures of risk taking. For each model, we report the coefficient estimates as well as the corresponding *p*-values. *p*-values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the *pseudo R-squared*. Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Table 4**
The Effect of Having a Male Co-Twin and the Gender Gap

| | Risky Share | Portfolio Volatility | Proportion Stocks |
|---|---|---|---|
| | (1) | (2) | (3) |
| Male Co-Twin ($F_M$) | 1.273** | 0.380** | 2.931** |
| | (0.034) | (0.012) | (0.013) |
| Male | 3.299*** | 3.923*** | 26.190*** |
| | (0.000) | (0.000) | (0.000) |
| Age less than 35 | 19.378*** | 3.005*** | -12.190*** |
| | (0.000) | (0.001) | (0.000) |
| Age less than 50 | 15.654*** | 4.151*** | 0.336 |
| | (0.000) | (0.000) | (0.885) |
| Age less than 66 | 11.477*** | 2.604*** | 3.451** |
| | (0.000) | (0.000) | (0.039) |
| Number of Sibling | -0.775 | -0.057 | -0.345 |
| | (0.123) | (0.655) | (0.445) |
| Birth Order | 0.327 | -0.012 | -0.443 |
| | (0.330) | (0.832) | (0.332) |
| Intercept | 24.828*** | 12.139*** | -6.574*** |
| | (0.000) | (0.000) | (0.000) |
| Ratio of $F_M$ to Male | 0.386** | 0.097*** | 0.112*** |
| | (0.020) | (0.009) | (0.009) |
| *N* | 231,116 | 104,641 | 174,753 |
| *R-squared* | 0.002 | 0.004 | 0.005 |

Table 4 reports results from Tobit regressions of annual measures of financial risk taking of female and male fraternal twins between 1999 and 2007 onto an indicator variable for women with a male co-twin ("Male Co-Twin"), an indicator variable for men ("Male"), and additional controls. For each model, we report the coefficient estimates and the ratio of the male co-twin effect to the male effect as well as the corresponding *p*-values. *p*-values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the pseudo *R-squared*. Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Table 5**
Social Interactions

| | Risky Share | | | Portfolio Volatility | | | Proportion Stocks | | |
|---|---|---|---|---|---|---|---|---|---|
| | Contact Frequency | Travel Distance | Porfolio Overlap | Contact Frequency | Travel Distance | Porfolio Overlap | Contact Frequency | Travel Distance | Porfolio Overlap |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Male Co-Twin ($F_M$) | 2.549** | 1.585* | 1.820*** | 0.339 | 0.521*** | 0.419** | 0.797 | 2.682 | 2.876** |
| | (0.016) | (0.061) | (0.003) | (0.234) | (0.007) | (0.050) | (0.710) | (0.105) | (0.021) |
| More Contacts | -0.669 | | | -0.244 | | | -3.599* | | |
| | (0.559) | | | (0.305) | | | (0.079) | | |
| More Contacts x $F_M$ | -2.921* | | | -0.035 | | | 2.514 | | |
| | (0.056) | | | (0.917) | | | (0.360) | | |
| Shorter Travel Distance | | -2.421*** | | | -0.322 | | | -3.553** | |
| | | (0.007) | | | (0.125) | | | (0.039) | |
| Shorter Travel Distance x $F_M$ | | -0.852 | | | -0.298 | | | 0.450 | |
| | | (0.497) | | | (0.316) | | | (0.847) | |
| High Portfolio Overlap | | | 26.598*** | | | 1.469** | | | 18.980*** |
| | | | (0.000) | | | (0.016) | | | (0.000) |
| High Portfolio Overlap x $F_M$ | | | -3.965** | | | -0.078 | | | 7.128* |
| | | | (0.010) | | | (0.868) | | | (0.075) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 124,141 | 124,141 | 124,141 | 54,893 | 54,893 | 54,893 | 91,522 | 91,522 | 91,522 |
| *R-squared* | 0.002 | 0.002 | 0.004 | 0.002 | 0.002 | 0.002 | 0.001 | 0.001 | 0.002 |

Table 5 reports results from Tobit regressions of annual measures of financial risk taking of female fraternal twins between 1999 and 2007 onto an indicator variable for women with a male co-twin ("Male Co-Twin"), proxies for high social interactions, as well as interactions between the indicator variable for women with a male co-twin and proxies for high social interactions. Additional controls are the same control variables used in Table 3. Proxies for high social interactions are: an indicator for twin pairs with above median contact frequency, an indicator for twin pairs with below median travel distance between twins' primary residences, and an indicator for twin pairs with more than 50 percent portfolio overlap. For each model, we report the coefficient estimates as well as the corresponding *p* -values. *p* -values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the *pseudo R-squared.* Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Table 6**
The Effect of Having Male Siblings

Panel A: Familes of First-Born Female Singletons and Same-Sex Fraternal Twins

| | Risky Share | | Portfolio Volatility | | Proportion Stocks | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Male Sibling | 0.173 | -2.608 | -0.945 | -0.534 | -8.043 | -2.891 |
| | (0.951) | (0.655) | (0.221) | (0.746) | (0.174) | (0.819) |
| Male Sibling Age Gap | | 1.085 | | -0.076 | | -2.105 |
| | | (0.243) | | (0.712) | | (0.314) |
| Female Sibling Age Gap | | 0.426 | | 0.021 | | -0.888 |
| | | (0.597) | | (0.925) | | (0.603) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 5,624 | 5,624 | 2,610 | 2,610 | 4,449 | 4,449 |
| *R-squared* | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.002 |

Panel B: All Families

| | Risky Share | | Portfolio Volatility | | Proportion Stocks | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Male Sibling | 0.785 | -0.102 | 0.076 | -0.180 | 1.020 | 0.441 |
| | (0.369) | (0.922) | (0.717) | (0.464) | (0.567) | (0.840) |
| Male Sibling Age Gap | | 0.183 | | 0.051* | | 0.095 |
| | | (0.180) | | (0.079) | | (0.713) |
| Female Sibling Age Gap | | -0.074 | | -0.034 | | -0.218 |
| | | (0.476) | | (0.203) | | (0.337) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 133,560 | 133,560 | 60,276 | 60,276 | 99,477 | 99,477 |
| *R-squared* | 0.001 | 0.001 | 0.001 | 0.001 | 0.003 | 0.003 |

Table 6 Panel A reports results from Tobit regressions of annual measurs of financial risk taking of a first-born female singleton between 1999 and 2007 onto an indicator variable for same-sex male twins (“Male Sibling”) as well as the age gap separately for same-sex male twins (Male Sibling Age Gap) and same-sex female twins (Female Sibling Age Gap). Additional controls are the same control variables used in Table 3. Table 6 Panel B reports corresponding results for any female singleton. For each model, we report the coefficient estimates as well as the corresponding *p*-values. *p*-values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the *pseudo R-squared*. Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Table 7**
The Effect of Birth Weight

Panel A: Financial Risk Taking

| | Risky Share | | Portfolio Volatility | | Proportion Stocks | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Birth Weight (ln) | 4.950** | 5.958* | -0.224 | -2.703*** | -5.752* | -12.061** |
| | (0.042) | (0.095) | (0.798) | (0.001) | (0.098) | (0.011) |
| Female | 1.875 | | -4.413*** | | -15.782*** | |
| | (0.207) | | (0.000) | | (0.000) | |
| Twin Pair Fixed Effects | No | Yes | No | Yes | No | Yes |
| *N* | 17,510 | 17,510 | 4,876 | 4,876 | 11,744 | 11,744 |
| *R-squared* | 0.001 | 0.417 | 0.025 | 0.460 | 0.033 | 0.581 |

Panel B: Alternative Measures of Financial Risk Taking

| | Participation | | Risky Share >0 | | Total Portfolio Volatility | | Total Proportion Stocks | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Birth Weight (ln) | 6.260** | 10.800*** | 1.489 | 2.603 | 0.828 | -1.361 | -0.314 | -5.318* |
| | (0.023) | (0.006) | (0.558) | (0.451) | (0.330) | (0.325) | (0.891) | (0.077) |
| Female | 0.200 | | 1.763 | | -2.594*** | | -9.259*** | |
| | (0.889) | | (0.277) | | (0.000) | | (0.000) | |
| Twin Pair Fixed Effects | No | Yes | No | Yes | No | Yes | No | Yes |
| *N* | 17,510 | 17,510 | 11,744 | 11,744 | 4,876 | 4,876 | 11,744 | 11,744 |
| *R-squared* | 0.001 | 0.459 | 0.001 | 0.398 | 0.015 | 0.457 | 0.030 | 0.441 |

Table 7 Panel A reports results from linear regressions of annual measures of financial risk-taking of identical twins between 1999 and 2007 onto birth weight ("Birth Weight (ln)") without and with twin pair fixed effects. In the models without twin fixed effects, we add an indicator variable for women ("Female"). Table 7 Panel B reports corresponding results for alternative measures of financial risk taking. For each model, we report the coefficient estimates as well as the corresponding *p* -values. *p* -values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the coefficient of determination. Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Table 8**
The Effect of Birth Weight: Twins vs. the Population

Panel A: Weighted Regression Results

| | Risky Share | Portfolio Volatility | Proportion Stocks |
|---|---|---|---|
| | (1) | (2) | (3) |
| Birth Weight (ln) | 1.787 | -7.173** | -27.430** |
| | (0.860) | (0.045) | (0.049) |
| Twin Pair Fixed Effects | Yes | Yes | Yes |
| *N* | 17,510 | 4,876 | 11,744 |
| *R-squared* | 0.503 | 0.491 | 0.653 |

Panel B: Sub-Sample Regressions

| | Risky Share | Portfolio Volatility | Proportion Stocks |
|---|---|---|---|
| | (1) | (2) | (3) |
| **Birth Weight < 2,500 *g*** | | | |
| Birth Weight (ln) | 8.862 | 1.659 | -14.006 |
| | (0.147) | (0.405) | (0.113) |
| Twin Pair Fixed Effects | Yes | Yes | Yes |
| *N* | 9,320 | 2,576 | 6,275 |
| *R-squared* | 0.486 | 0.510 | 0.674 |
| **Birth Weight >= 2,500 *g*** | | | |
| Birth Weight (ln) | 5.669 | -8.200** | -39.504*** |
| | (0.554) | (0.015) | (0.006) |
| Twin Pair Fixed Effects | Yes | Yes | Yes |
| *N* | 8190 | 2300 | 5469 |
| *R-squared* | 0.465 | 0.506 | 0.628 |

Table 8 Panel A reports results from linear regressions of annual measures of financial risk-taking of identical twins between 1999 and 2007 onto birth weight ("Birth Weight (ln)") and twin pair fixed effects. Each observation is weighted depending such that the distributing of the weighted birth weight represents the population distribution of birth weigh as shown in Figure 1. Table 8 Panel B reports results for unweighted linear regressions perfomed separately for twins with birth weight below 2,500 g and twins with birth weight above 2,500 g. All regressions include twin pair fixed effects. For all models, we report the coefficient estimates as well as the corresponding *p* -values. *p* -values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the coefficient of determination. Levels of significance are denoted as follows: * if $p$ <0.10; ** if $p$ <0.05; *** if $p$ <0.01.

**Table 9**

Additional Financial Decisions

Panel A: The Effect of Having a Male Co-Twin

| | Turnover | Proportion Lottery | Portfolio Skewness |
|---|---|---|---|
| | (1) | (2) | (3) |
| Male Co-Twin ($F_M$) | 1.987* | 2.933*** | 0.163 |
| | (0.085) | (0.001) | (0.131) |
| Additional Controls | Yes | Yes | Yes |
| *N* | 65,458 | 85,040 | 60,821 |
| *R-squared* | 0.000 | 0.003 | 0.000 |

Panel B: The Effect of Birth Weight

| | Turnover | Proportion Lottery | Portfolio Skewness |
|---|---|---|---|
| | (1) | (2) | (3) |
| Birth Weight (ln) | -2.484 | -2.960* | -5.635*** |
| | (0.565) | (0.086) | (0.001) |
| Twin Pair Fixed Effects | Yes | Yes | Yes |
| *N* | 7,094 | 10,736 | 6,448 |
| *R-squared* | 0.294 | 0.193 | 0.138 |

Table 9 Panel A reports results from Tobit regressions of annual measures of financial decisions of female fraternal twins between 1999 and 2007 onto an indicator variable for women with a male co-twin (“Male Co-Twin”) and additional controls. Table 9 Panel B reports results from linear regressions of annual measures of financial decisions of identical twins between 1999 and 2007 onto birth weight ("Birth Weight (ln)") and twin pair fixed effects. For each model, we report the coefficient estimates as well as the corresponding *p*-values. *p*-values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the pseudo *R-squared* (Panel A) or the coefficient of determination (Panel B). Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Table 10**
Mediation Analaysis

Panel A: The Effect of Having a Male Co-Twin

| | Risky Share >0) | | Portfolio Volatility | | Portfolio Skewness | |
|---|---|---|---|---|---|---|
| | Coeff. | % of Total | Coeff. | % of Total | Coeff. | % of Total |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Direct Effect:** | | | | | | |
| Male Co-Twin ($F_M$) | 0.899* | 115.7% | 0.189 | 46.4% | 0.066 | 33.3% |
| **Indirect Effects:** | | | | | | |
| Years of Education | 0.038** | 4.9% | 0.013*** | 3.2% | -0.002 | -1.0% |
| Disposable Income (ln) | -0.055** | -7.1% | -0.005 | -1.2% | -0.002 | -1.0% |
| Net worth (ln) | -0.054 | -6.9% | 0.000 | 0.0% | 0.000 | 0.0% |
| Bias Index | -0.051** | -6.6% | 0.210** | 51.6% | 0.136** | 68.7% |
| *Total Indirect* | *-0.122* | *-15.7%* | *0.218*** | *53.6%* | *0.132*** | *66.7%* |
| **Total (Direct + Indirect)** | 0.777 | | 0.407 | | 0.198 | |
| *N* | 11,950 | | 10,415 | | 10,377 | |

**Table 10**
(continued)

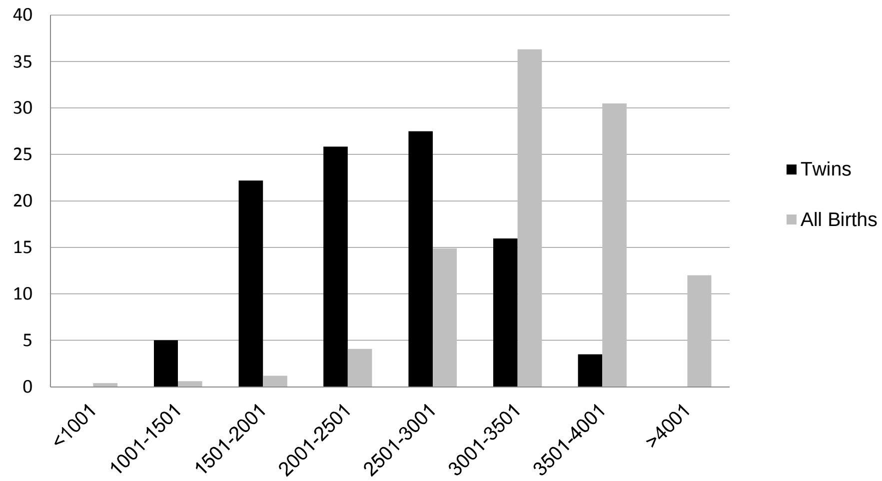
Panel B: The Effect of Birth Weight

| | Risky Share >0 | | Portfolio Volatility | | Portfolio Skewness | |
|---|---|---|---|---|---|---|
| | Coeff. | % of Total | Coeff. | % of Total | Coeff. | % of Total |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Direct Effect:** | | | | | | |
| Male Co-Twin ($F_M$) | 2.295 | 89.4% | -0.205 | 15.7% | -4.273*** | 91.0% |
| **Indirect Effects:** | | | | | | |
| Years of Education | 0.358** | 13.9% | 0.056 | -4.3% | 0.049 | -1.0% |
| Disposable Income (ln) | -0.250 | -9.7% | -0.061 | 4.7% | -0.084 | 1.8% |
| Net worth (ln) | -0.334 | -13.0% | 0.082 | -6.3% | 0.087 | -1.9% |
| Bias Index | 0.498** | 19.4% | -1.175** | 90.2% | -0.474* | 10.1% |
| *Total Indirect* | *0.272* | *10.6%* | *-1.098** | *84.3%* | *-0.422* | *9.0%* |
| **Total (Direct + Indirect)** | 2.567 | | -1.303 | | -4.695 | |
| *N* | 2,833 | | 2,570 | | 2,604 | |

Table 10 Panel A reports results from a mediation analaysis of the direct and indirect effects of having a male co-twin ("Male Co-Twin") on financial decisions. Table 10 Panel B report corresponding resuults for the direct and indirect effects of birth weight in the presence of twin fixed effects. Mediating variables are education, income, net worth, and a proxy for financial sophistication. Where appropriate, variables represent time-series averages. Statistical signficance is established by bootstrapping with 10,000 repititions. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. Levels of significance are denoted as follows: * if p<0.10; ** if p<0.05; *** if p<0.01.

**Figure 1**
Birth Weight Distributions: Twins vs. all Births

Panel A: Birth Weight Distribution: Males




Panel B: Birth Weight Distribution: Females

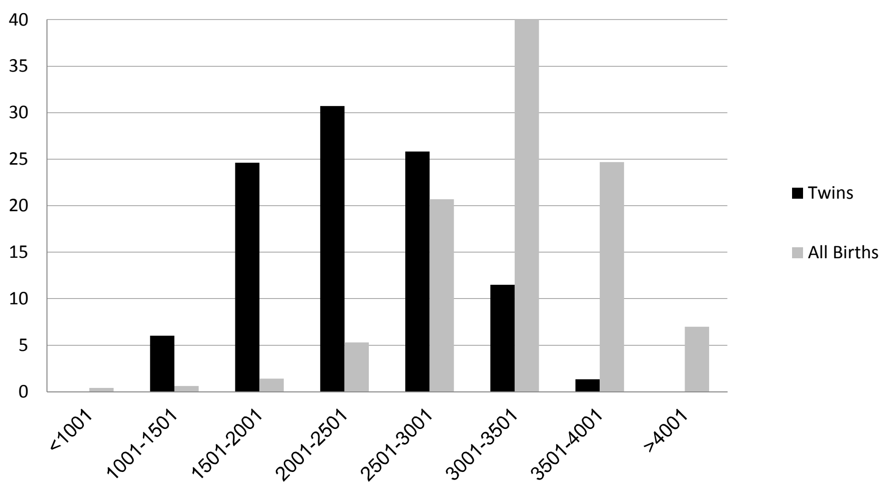
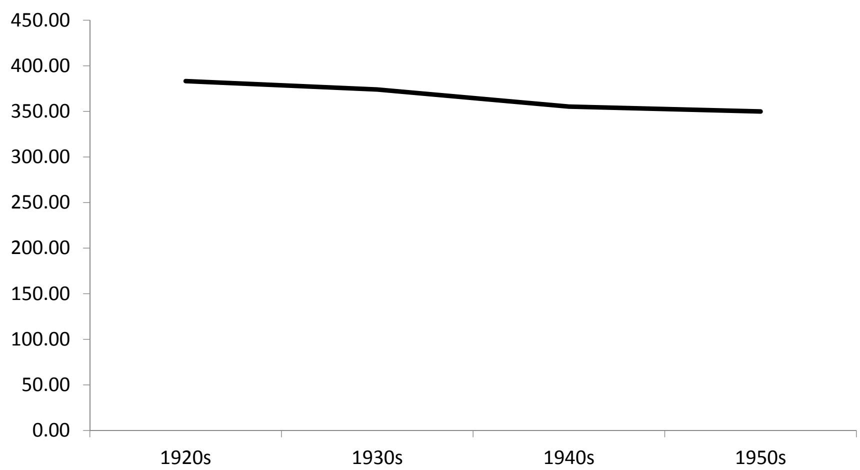



Figure 1 shows the birth weight distribution for identical twins in our sample as well as for all live births in the U.S.A. between January and March 1950. U.S. data are from Table C of the Vital and Health Statistics published by the National Center for Health Statistics (Series 21, Number 3).

**Figure 2**
Within-Pair Differences over by Birth Decade

Panel A: Birth Weight




Panel B: Financial Risk Taking

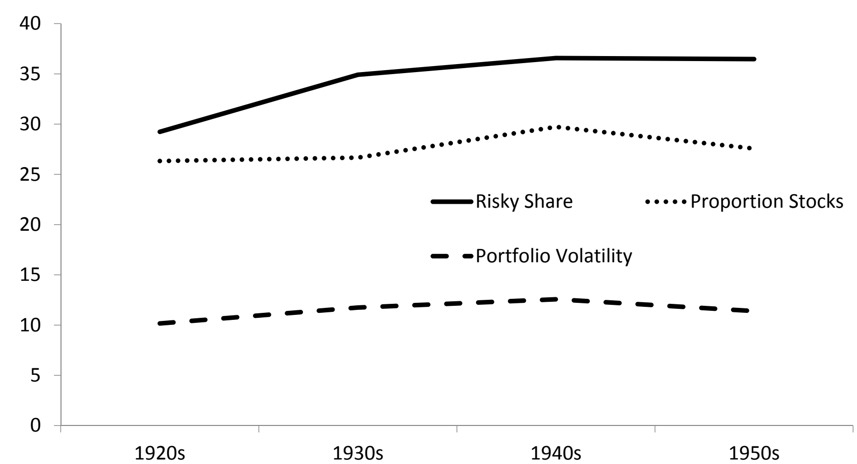



Figure 2 shows the average within twin pair difference for Birth Weight (Panel A) and for *Risky Share* , *Portfolio Volatility* , and *Proportion Stocks(* Panel B) by decade of birth year.

**Appendix Table A1**
Definition of all Variables

| Variable | Definition |
|---|---|
| **Types of Twins** | |
| Fraternal Twins | Twins that on average have a genetic correlation of 50%, also called dizygotic or non-identical twins. Fraternal twins can be of the same sex or of opposite sex. Zygosity is determined by the Swedish Twin Registry based on questions about intrapair similarities in childhood. |
| Identical Twins | Twins that are genetically identical, also called monozygotic twins. Zygosity is determined by the Swedish Twin Registry based on questions about intrapair similarities in childhood. |
| **Measures of Investor Behavior** | |
| Risky Share | The fraction of financial assets invested in equity either directly (individual stocks) or indirectly (equity mutual funds). The ratio is computed annually using end-of-year market values as reported by Statistics Sweden. Financial assets include checking, savings, and money market accounts, (direct and indirect) bond holdings, (direct and indirect) equity holdings, investments in options and other financial assets such as rights, convertibles, and warrants. |
| Portfolio Volatility | Using twelve monthly return observations, we calculate the annualized, value-weighted portfolio return volatility for each twin and year. The portfolio consists of the holdings of risky (i.e., equity) assets and missing if for individuals that do not hold risky assets. |
| Proportion Stocks | The fraction of risky (i.e., equity) holdings invested in individual stocks as opposed to mutual funds, as reported by Statistics Sweden. This measure is computed annually and is missing for for individuals that do not hold risky assets. |
| Participation | An annual indicator variable that equals one if Risky Share is strictly positive and zero if Risky Share is zero. |
| Risky Share > 0 | The variable equals Risky Share if Risky Share is strictly positive and is missing otherwise. |
| Total Portfolio Volatility | The return volatility of the entire financial portfolio, consisting of risk-free investments as well as risky (equity) investments. The volatility of risk-free investments is assumed to be zero. It is calculated annually using monthly return observations. It is missing for those that do not hold risky financial assets. The portfolio consists of the holdings of risky (i.e., equity) assets and missing if for individuals that do not hold risky assets. |
| Total Proportion Stocks | The fraction of all financial assets invested in individual stocks as opposed to mutual funds, as reported by Statistics Sweden. This measure is computed annually and is missing for for individuals that do not hold risky assets. |
| Turnover | The number of sales transactions over the course a year relative to the number of portfolio positions at the beginning of the year. |
| Proportion Lottery | The end-of-year proportion of risky assets invested in lottery-like assets. We define an aseet as a lottery asset if it has a below median price as well as above median idiosyncratic volatility and skewness. See Cronqvist and Siegel (2014) for details. |
| Portfolio Skewness | The return skewness of the portfolio of risky financia assets. It is calculated annually using monthly return observations. |
| Bias Index | The Bias Index summarizes the magnitude of the five investment behaviors. It takes on values between zero and ten. For each behavior, we assign a value of zero (no bias), one, or two (most biased), depending on the observed level. The index is the sum across all six investment behaviors. If for a given investor, a behavior is missing, we use the median behavior to assign the bias index component (zero, one, or two). In particular, for Diversification, we assign two to investors who hold 70% or more of their risky financial assets in individual stocks, one to investors who hold between 30 and 70% of their risky financial assets in individual stocks, and zero to all other investors. For Home Bias, we assign two to investors who invest at least 80% of their risky financial portfolio in Sweden, one to investors with less than 80%, but more than 20% in Sweden, and zero to all other investors. For Turnover, we assign two to investors with a value above 55%, one to investors with a value between 20% and 55%, and zero otherwise. For Performance Chasing, we assign two to investors with a value above 40%, one to investors with a value between 20 and 40%, and zero otherwise. For Skewness preference, we assign two to investors with a value above 15%, one to investors with a value between 5 and 15%, and zero otherwise. |
| **Socioeconomic Characteristics** | |
| Male Co-Twin ($F_M$) | An indicator variable that is one if a female twin has a male co-twin and zero otherwise. |
| Non-twin Male (Female) Sibling | An indicator that is one if a female fraternal twin has a Male (Female) non-twin sibling and zero otherwise. |
| Any Male (Female) Sibling | An indicator that is one if a female non-twin has any male (female) siblings and zero otherwise. |
| Birth Weight (ln) | The natural logarithm of the birth weight (measured in grams (g)) as reported by the Swedish Twin Registry. |
| Net Worth (ln) | The difference between the end-of-year market value of an individual's assets and her liabilities (for each year an individual is included in our sample), as reported by Statistics Sweden. We compute the natural logarithm of net worth, originally expressed in nominal Swedish Krona (SEK). |
| Volatility of Labor Income | The time-series standard deviation of the log growth rate of an individual's income (including income of employees and of those that are self-employed, but excluding income from capital) between 2000 and 2007 (as reported by Statistics Sweden). The variable is missing if four or more of the log growth rates are missing. The top and bottom one percentile of the log growth rate distribution is set to missing. |
| Business Owner | An indicator that is one if in a given year an individual has income from active business activity that exceeds 50% of the labor income. The indicator is zero otherwise. Income data are from Statistics Sweden. |
| Years of Education | Years of Education is based on the highest completed degree. For a subset of the sample, the variable is obtained from the Swedish Twin Registry. We use a linear regression model to extend the variable to the rest of our sample. Specifically, we regress the years of education onto variables indicating the higest degree obtained (e.g., high school, college) (avaialable for most individuals in our data set from Statistics Sweden) and then predict years of education out of sample. |
| Poor Health | An indicator variable that equals one if in a given year an individual an individual receives payments due to illness, injury, or disability and zero otherwise. Data on payments are obtained from Statistics Sweden. |

**Appendix Table A1**

(continued)

| Variable | Definition |
|---|---|
| Age | The age for every year an individual is included in our sample. Age is obtained from the Statistics Sweden. In our analyses, we use indicator variables for those younger than 35 (*Age less than 35* ), between 35 and 49 (*Age less than 50* ), and between 50 and 65 (*Age less than 66* ). |
| Male / Female Sibling Age Gap | The age difference between a female singleton and the closest (in age) male/female sibling. |
| Birth Order | The order of birth within the family. First-born siblings are assigned value equal to one. Twins are assigned the same birth order number. |
| Number of Siblings | The number of siblings (brothers and sisters) of the twin in the family of origin. The count includes the co-twin. |
| Male | An indicator variable that equals one if an individual is male and zero otherwise. Gender is obtained from Statistics Sweden. |
| Female | An indicator variable that equals one if an individual is female and zero otherwise. Gender is obtained from Statistics Sweden. |
| Missing Education Data | An indicator variable that equals one if no educational data are available for an individual, zero otherwise. Educational information is obtained from Statistics Sweden. |
| Single | An indicator variable that equals one if an individual is single in a given year and zero otherwise. Marital status information are obtained from the Statistics Sweden. |
| Divorced | An indicator variable that equals one if an individual has divorced in the past (and has not re-married since) and zero otherwise. Marital status information is obtained from the Statistics Sweden. |
| Number of Children | The number of children living in the same household in a given year. Family data are from Statistics Sweden. |
| Retired | An indicator variable that equals one if an individual is retired and zero otherwise. Occupational data are obtained from Statistics Sweden. |
| Disposable Income (ln) | The natural logarithm of individual disposable income for every year an individual is included in our sample, as defined by Statistics Sweden, that is, the sum of income from labor, business, and investment, plus received transfers, less taxes and alimony payments, originally expressed in nominal Swedish Krona (SEK). The data are obtained from Statistics Sweden. |
| **Measures of Social Interaction** | |
| More Contacts | An indicator variable that is one for those twin pairs with above median contact frequency and zero for those with below median contact frequency. Contact frequency is the number of contacts per year between twins. The number is calculated as the average of the numbers reported by both twins. If only one twin provides a number, this number is used. The data are obtained from the Swedish Twin Registry. |
| Shorter Travel Distance | An indicator variable that is one for those twins with below medain driving distance between them. Driving distance is the distance in kilometers between the municipalities of the twins' primary residence. The distance is obtained from Google Maps. |
| High Portfolio Overlap | An indicator variable that is one for those twin pairs whose portfolio overlap is 50 percent or larger. Portfolio overlap is the sum of the absolute value of portfolio weight differences across the two twins. This measure ranges between zero (identical portfolios) and two (non-overlapping portfolios). A value equal to one corresponds to a 50 percent portfolio overlap. |

**Appendix Table A2**
Social Interactions

| | Participation | | | Risky Share > 0 | | | Total Portfolio Volatility | | | Total Proportion Stocks | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Contact Frequency | Travel Distance | Porfolio Overlap | Contact Frequency | Travel Distance | Porfolio Overlap | Contact Frequency | Travel Distance | Porfolio Overlap | Contact Frequency | Travel Distance | Porfolio Overlap |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) |
| Male Co-Twin ($F_M$) | 2.206** | 0.682 | 1.152** | 0.733 | 1.258** | 0.993** | 0.149 | 0.300** | 0.407*** | -0.301 | 1.623 | 1.989*** |
| | (0.030) | (0.368) | (0.048) | (0.322) | (0.034) | (0.030) | (0.497) | (0.048) | (0.002) | (0.827) | (0.119) | (0.009) |
| More Contacts | -0.718 | | | -0.020 | | | -0.359* | | | -3.106** | | |
| | (0.473) | | | (0.979) | | | (0.055) | | | (0.013) | | |
| More Contacts x $F_M$ | -3.221** | | | -0.014 | | | 0.121 | | | 2.510 | | |
| | (0.014) | | | (0.988) | | | (0.653) | | | (0.148) | | |
| Shorter Travel Distance | | -2.596*** | | | -0.051 | | | -0.427*** | | | -2.508** | |
| | | (0.001) | | | (0.940) | | | (0.005) | | | (0.026) | |
| Shorter Travel Distance x $F_M$ | | -0.010 | | | -1.114 | | | -0.014 | | | 0.138 | |
| | | (0.993) | | | (0.242) | | | (0.958) | | | (0.926) | |
| High Portfolio Overlap | | | 26.083*** | | | 3.677** | | | 2.161*** | | | 15.802*** |
| | | | (0.000) | | | (0.038) | | | (0.000) | | | (0.000) |
| High Portfolio Overlap x $F_M$ | | | -0.790 | | | -3.455** | | | -1.010** | | | 0.588 |
| | | | (0.227) | | | (0.029) | | | (0.033) | | | (0.819) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 124,141 | 124,141 | 124,141 | 91,522 | 91,522 | 91,522 | 54,893 | 54,893 | 54,893 | 91,522 | 91,522 | 91,522 |
| *R-squared* | 0.014 | 0.014 | 0.028 | 0.001 | 0.001 | 0.001 | 0.003 | 0.003 | 0.003 | 0.001 | 0.001 | 0.002 |

Appendix Table 2 extends the analysis performed in Table 5 to additional outcomes. For each model, we report the coefficient estimates as well as the corresponding *p* -values. *p* -values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the *pseudo R-squared*. Levels of significance are denoted as follows: * if $p$ <0.10; ** if $p$ <0.05; *** if $p$ <0.01.

**Appendix Table A3**
The Effect of Having a Male Sibling

Panel A: Familes of First-Born Female Singletons and Same-Sex Fraternal Twins

| | Participation | | Risky Share > 0 | | Total Portfolio Volatility | | Total Proportion Stocks | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Male Sibling | -2.039 | -4.285 | 2.337 | 0.934 | -0.004 | 0.066 | -3.858 | 1.746 |
| | (0.399) | (0.413) | (0.276) | (0.825) | (0.995) | (0.957) | (0.348) | (0.840) |
| Male Sibling Age Gap | | 0.052 | | 1.366** | | 0.179 | | -1.318 |
| | | (0.949) | | (0.032) | | (0.323) | | (0.346) |
| Female Sibling Age Gap | | -0.475 | | 1.035* | | 0.195 | | 0.011 |
| | | (0.487) | | (0.079) | | (0.289) | | (0.993) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 5,624 | 5,624 | 4,449 | 4,449 | 2,608 | 2,608 | 4,449 | 4,449 |
| *R-squared* | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.000 | 0.000 |

Panel B: All Families

| | Participation | | Risky Share (>0) | | Total Portfolio Volatility | | Total Proportion Stocks | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Male Sibling | -0.099 | -0.823 | 1.064* | 0.750 | 0.221 | 0.056 | 0.921 | 0.937 |
| | (0.893) | (0.354) | (0.079) | (0.315) | (0.203) | (0.789) | (0.430) | (0.513) |
| Male Sibling Age Gap | | 0.141 | | 0.076 | | 0.031 | | -0.026 |
| | | (0.256) | | (0.404) | | (0.192) | | (0.881) |
| Female Sibling Age Gap | | -0.127 | | 0.062 | | -0.035 | | -0.159 |
| | | (0.160) | | (0.420) | | (0.169) | | (0.293) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 133,560 | 133,560 | 99,477 | 99,477 | 60,139 | 60,139 | 99,477 | 99,477 |
| *R-squared* | 0.005 | 0.005 | 0.003 | 0.003 | 0.003 | 0.003 | 0.001 | 0.001 |

Appendix Table 3 extends the analysis performed in Table 6 to additional outcomes. For each model, we report the coefficient estimates as well as the corresponding *p* -values. *p* -values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the *pseudo R-squared* . Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.

**Appendix Table A4**
Controlling for Socioeconomic Characsteristics

| | Risky Share | Participation | Risky Share > 0 | Portfolio Volatility | Total Portfolio Volatility | Proportion Stocks | Total Proportion Stocks |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Male Co-Twin ($F_M$) | 0.811 | 0.195 | 0.803* | 0.357** | 0.282** | 2.778** | 1.616** |
| | (0.177) | (0.723) | (0.058) | (0.011) | (0.010) | (0.018) | (0.027) |
| Net Worth (ln) | 1.347*** | 4.682*** | -4.082*** | 0.028 | -0.505*** | 7.879*** | 4.087*** |
| | (0.000) | (0.000) | (0.000) | (0.855) | (0.000) | (0.000) | (0.000) |
| Volatility of Labor Income | -0.083*** | -0.004 | -0.096*** | 0.019*** | 0.001 | 0.545*** | 0.318*** |
| | (0.001) | (0.880) | (0.000) | (0.001) | (0.755) | (0.000) | (0.000) |
| Business Owner | -2.900 | 2.565 | -6.396*** | 0.745 | -0.151 | 19.973*** | 10.187*** |
| | (0.285) | (0.198) | (0.001) | (0.573) | (0.828) | (0.000) | (0.000) |
| Years of Education | 0.940*** | 0.747*** | 0.350*** | 0.180*** | 0.156*** | 1.318*** | 1.094*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Missing Education Data | -0.913 | -3.314** | 3.738** | 0.570 | 0.832 | 13.199*** | 10.853*** |
| | (0.596) | (0.021) | (0.014) | (0.104) | (0.267) | (0.000) | (0.000) |
| Poor Health | -3.911*** | -4.089*** | -0.292 | -0.214 | -0.092 | -3.352*** | -2.388*** |
| | (0.005) | (0.000) | (0.664) | (0.126) | (0.605) | (0.003) | (0.003) |
| Single | -0.270 | 0.799 | -1.375** | -1.169*** | -0.778*** | -3.994** | -2.596** |
| | (0.739) | (0.314) | (0.017) | (0.000) | (0.000) | (0.014) | (0.011) |
| Divorced | -2.394** | -1.955** | -0.709 | -0.636*** | -0.227 | -2.964* | -1.412 |
| | (0.044) | (0.028) | (0.409) | (0.002) | (0.309) | (0.097) | (0.212) |
| Number of Children | 1.630*** | -0.418 | 2.359*** | 0.124* | 0.481*** | -0.066 | 0.576 |
| | (0.000) | (0.156) | (0.000) | (0.061) | (0.000) | (0.912) | (0.141) |
| Retired | -1.625 | -0.849 | -0.705 | 0.082 | -0.084 | -0.239 | -0.284 |
| | (0.384) | (0.421) | (0.512) | (0.836) | (0.828) | (0.895) | (0.793) |
| Disposable Income (ln) | -2.109*** | 1.698 | -4.284*** | -0.296 | -0.690*** | 9.689*** | 4.755*** |
| | (0.000) | (0.159) | (0.000) | (0.723) | (0.000) | (0.000) | (0.000) |
| Additional Controls | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 124,141 | 124,141 | 91,522 | 54,893 | 54,893 | 91,522 | 91,522 |
| *R-squared* | 0.003 | 0.052 | 0.006 | 0.002 | 0.005 | 0.009 | 0.002 |

Appendix Table A4 reports results from Tobit regressions of annual measures of financial risk taking of female fraternal twins between 1999 and 2007 onto an indicator variable for women with a male co-twin ("Male Co-Twin") as well as a large set of socioecnomic characteristics. Additional controls are the same control variables used in Table 3. For each model, we report the coefficient estimates as well as the corresponding *p*-values. *p*-values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the *pseudo R-squared*. Levels of significance are denoted as follows: * if *p*<0.10; ** if *p*<0.05; *** if *p*<0.01.

**Appendix Table A5**
Direct Effect of Birth Weigth

| | Risky Share | Participation | Risky Share > 0 | Portfolio Volatility | Total Portfolio Volatility | Proportion Stocks | Total Proportion Stocks |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Birth Weight (ln) | 5.920* | 8.208* | 5.183 | -3.272*** | -1.924* | -13.267*** | -5.605* |
| | (0.078) | (0.051) | (0.132) | (0.002) | (0.091) | (0.005) | (0.051) |
| Net worth (ln) | -1.201*** | 2.650*** | -2.818*** | -0.064 | -0.368* | 1.724*** | 0.782* |
| | (0.038) | (0.000) | (0.000) | (0.885) | (0.352) | (0.001) | (0.092) |
| Volatility of Labor Income | 0.901 | -1.313 | -0.872 | 4.935* | -0.548 | 26.554*** | 12.019** |
| | (0.903) | (0.876) | (0.914) | (0.112) | (0.847) | (0.002) | (0.041) |
| Business Owner | -3.295 | 1.262 | -4.571 | -1.541 | -2.809*** | 7.880 | 4.369 |
| | (0.398) | (0.437) | (0.326) | (0.232) | (0.002) | (0.099) | (0.145) |
| Years of Education | 0.186 | 0.013 | 0.394 | -0.032 | -0.022 | -0.214 | -0.117 |
| | (0.535) | (0.965) | (0.234) | (0.810) | (0.845) | (0.586) | (0.665) |
| Missing Education Data | -6.709* | -8.526** | -0.629 | 0.513 | -1.082 | -4.393 | -3.425 |
| | (0.104) | (0.088) | (0.873) | (0.846) | (0.576) | (0.360) | (0.293) |
| Poor Health | 0.510 | -0.013 | 1.179 | -0.711 | 0.016 | 0.712 | 0.717 |
| | (0.494) | (0.989) | (0.302) | (0.444) | (0.970) | (0.533) | (0.380) |
| Single | 1.168 | 3.273 | -1.098 | -2.787*** | -2.861*** | -3.432 | -2.608 |
| | (0.567) | (0.147) | (0.567) | (0.000) | (0.005) | (0.214) | (0.212) |
| Divorced | -0.305 | -6.890*** | 3.195* | -1.138 | 0.101 | -4.486* | -0.905 |
| | (0.857) | (0.000) | (0.084) | (0.239) | (0.826) | (0.062) | (0.535) |
| Number of Children | -0.105 | -0.851 | -0.615 | 0.235 | -0.188 | 0.672 | 0.168 |
| | (0.916) | (0.355) | (0.477) | (0.601) | (0.537) | (0.377) | (0.791) |
| Retired | -4.877*** | -3.939*** | -3.155** | 0.618 | 0.064 | 2.905* | 0.589 |
| | (0.004) | (0.008) | (0.085) | (0.441) | (0.922) | (0.058) | (0.611) |
| Disposable Income (ln) | -5.127*** | -0.544 | -6.195*** | -2.339*** | -2.377*** | 0.578 | -1.584 |
| | (0.004) | (0.761) | (0.000) | (0.038) | (0.002) | (0.659) | (0.159) |
| Twin Pair Fixed Effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| *N* | 15,767 | 15,767 | 10,754 | 4,497 | 4,497 | 10,754 | 10,754 |
| *R-squared* | 0.452 | 0.475 | 0.433 | 0.489 | 0.489 | 0.605 | 0.555 |

Appendix Table A5 reports results from linear regressions of annual measures of financial risk-taking of identical twins between 1999 and 2007 onto birth weight ("Birth Weight (ln)"), a large set of socioeconomic controls, and twin pair fixed effects. For each model, we report the coefficient estimates as well as the corresponding *p* -values. *p* -values are based on double-clustered standard errors, robust for correlation across years within same individuals and across individuals within the same year. All variables are defined in detail in Appendix Table A1. *N* provides the number of observations used in each estimation. *R-squared* denotes the coefficient of determination. Levels of significance are denoted as follows: * if $p<0.10$; ** if $p<0.05$; *** if $p<0.01$.