Individuals' Equity Investment and Birth Order

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Abstract

This paper studies the relation between individuals' equity investment and birth order. Earlier-born siblings are more likely to participate in equity markets than later-born siblings are. Participating earlier-born siblings carry less portfolio risk and deliver stronger risk-adjusted portfolio performance than participating later-born siblings do. Baseline and moderation analyses suggest that the main mechanisms behind these patterns are strategic parenting and cultural expectations, and, to a lesser extent, adaptive divergence. By comparison, there is at best limited support for resource-dilution channels and virtually no evidence consistent with sibling confluence.

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I. Introduction

Individuals display substantial heterogeneity in equity-market participation and, conditional on participation, in portfolio risk and risk-adjusted portfolio performance. Standard household-finance variables—wealth, income, education, and age—explain part of this variation (Vissing-Jørgensen (2002), Campbell (2006), and Calvet, Campbell, and Sodini (2007), (2009a), (2009b)), but the role of childhood experiences and childhood family environment remains less understood. In this paper, we study birth order, a key source of within-family heterogeneity among siblings.

Although rarely studied in financial decision-making, birth order has been studied extensively in other domains. On average, earlier-born siblings obtain more education, earn higher income, exhibit slightly better health outcomes, and register slightly stronger cognitive measures than later-born siblings do, even with extensive controls for family size and background characteristics (Black, Devereux, and Salvanes (2005), (2016), Bjerkedal, Kristensen, Skjeret, and Brevik (2007), Kristensen and Bjerkedal (2007), and Barclay (2015)).

Several theories tackle these patterns. Resource dilution emphasizes that finite parental time, attention, and material resources are spread more thinly as sibship size grows, favoring earlier-born children (Behrman and Taubman (1986), Downey (2001), Black et al. (2005), Price (2008), Jayachandran and Pande (2017)). Strategic parenting and cultural expectations highlight that parents may assign roles, expectations, and effort differentially across children, for example by grooming firstborns for responsibility or disciplining older children more strictly to set a precedent for younger ones (Hrdy and Judge (1993), Bennedsen, Nielsen, Pérez-González, and Wolfenzon (2007), Hotz and Pantano (2015), Jayachandran and Pande (2017)). Adaptive divergence maintains that children compete for parental attention and scarce resources by occupying distinct "niches," with firstborns more likely to adopt conscientious, achievement-oriented roles and later-

born siblings more likely to pursue less conventional or riskier activities (Sulloway (1996), (2007), (2010), Sulloway and Zweigenhaft (2010), Black, Grönqvist, and Öckert (2018), Custódio and Siegel (2020)). Confluence models stress the household's evolving intellectual and social climate, including adult interaction, older-sibling mentoring, and sibling rivalry when age gaps are small (Zajonc and Markus (1975), Zajonc (1976)).

Household-finance research documents heritable components of financial behavior (Barnea, Cronqvist, and Siegel (2010), Cesarini, Johannesson, Lichtenstein, Sandewall, and Wallace (2010), Cronqvist and Siegel (2014)), lasting imprints of childhood exposure to adverse outcomes (Malmendier and Nagel (2011), (2016), Knüpfer, Rantapuska, and Sarvimäki (2017)), and word-of-mouth and information diffusion effects in workplaces (Duflo and Saez (2002), (2003)) and communities (Hong, Kubik, and Stein (2004), Ivković and Weisbenner (2007), Brown, Ivković, Smith, and Weisbenner (2008), Kaustia and Knüpfer (2012)). Whether the household's structured, role-differentiated environment—as captured by birth order and related family mechanisms—systematically shapes individual investors' participation, risk-taking, and performance remains largely unexplored.

We address this gap by studying the role of birth order in three aspects of individual investors' equity investment: equity-market participation (extensive margin) and, conditional on participation, portfolio risk and risk-adjusted performance (intensive margin). We use high-quality Swedish administrative data, combining LINDA (Longitudinal INdividual DAtabase), annual information on individuals and their cohabiting family members, with KURU, the financial register used for wealth-tax assessment. We focus on Swedes born between 1970 and 1980 for whom we can reconstruct complete childhood family histories and observe equity holdings from

1999 to 2007. The sample includes 147,829 individuals from sibships of size at least two, of whom 93,257 participated in equity markets in at least two consecutive KURU snapshots.

We capture birth order with indicator variables *Second*, *Third*, and *Fourth+*, with firstborns as the reference category. Central to our design is within-family identification. Portfolio-risk and performance specifications include family fixed effects, birth-year × region fixed effects, and rich childhood family environment controls. Family fixed effects absorb all time-invariant characteristics shared by siblings—genetic background, permanent socio-economic status, stable parental attitudes, and unobserved family culture. Therefore, consistent with the Zajonc and Sulloway (2007) insight that between-family comparisons can conflate genuine birth-order effects, birth-order effects are identified from comparisons of siblings within the same family.

We obtain three baseline results. First, equity-market participation declines monotonically with birth order. Conditional on gender, detailed measures of childhood family resources, birth-year × region fixed effects, and family fixed effects, later-born siblings are less likely to participate in equity markets. Second, conditional on participation, later-born siblings hold riskier portfolios—total and idiosyncratic return volatilities increase with birth order. Third, earlier-born siblings earn higher risk-adjusted returns. Sharpe ratios decline with birth order, and multifactor alphas exhibit a similar negative gradient, albeit with somewhat noisier estimates. In sum, earlier-born siblings participate more, take less risk, and achieve stronger risk-adjusted outcomes.

Next, we examine how gender, parental resources, socio-economic resources, adult human-capital resources, and sibling-relationship structure moderate birth-order gaps in equity-market participation, portfolio risk, and portfolio performance. The evidence points most strongly to strategic parenting and cultural expectations, with limited support for observable resource dilution. Family unemployment, a proxy for adverse income shocks, widens the participation gap,

consistent with resource scarcity and instability amplifying earlier-born siblings' advantage. However, family income and the adults-to-children ratio do not systematically reshape birth-order gradients in participation, risk, or performance. Family education and family participation compress the Sharpe-ratio gap and, to a lesser extent, the alpha gap. In sum, observable resource dilution plays some, but not dominant, role in explaining the relation between equity investment and birth order.

The moderation evidence also supports adaptive divergence on the intensive margin. Family education amplifies the birth-order portfolio-risk gap: in more educated families, later-born siblings take disproportionately more risk, consistent with richer informational environments enabling them to implement their preferred high-risk strategies more fully. Nevertheless, performance gaps narrow in high-education and high-participation families, suggesting that later-born siblings' greater risk appetite translates into more disciplined, rather than reckless, portfolio choices. By contrast, mentor-mentee moderation analyses yield no robust support for confluence.

Our paper contributes to the birth-order literature by documenting robust within-family birth-order gradients in equity-market participation, portfolio risk, and portfolio performance. To our knowledge, we are the first to do so using linked population-level administrative and portfolio data for individual investors. We also contribute to household finance by showing that a structured, role-differentiated family environment helps explain who invests in equities, how much risk they take, and how well they perform. We complement the studies quantifying heritable components of financial behavior (Barnea et al. (2010), Cesarini et al. (2010), Cronqvist and Siegel (2014)) and lasting effects of adverse early-life experiences on financial risk-taking and portfolio choice (Malmendier and Nagel (2011), (2016), Knüpfer et al. (2017)). Third, we complement recent work on birth order and professional money managers (e.g., Agarwal, Cochardt, and Orlov (2025)) by

using within-family identification and examining both the extensive and intensive margins. Finally, we contribute to the peer-effects literature by treating the nuclear family as a salient peer group whose hierarchy and learning structure leave lasting imprints on financial behavior, akin to workplace and community interactions (Duflo and Saez (2002), (2003), Hong et al. (2004), Ivković and Weisbenner (2007), Brown et al. (2008), Kaustia and Knüpfer (2012)).

II. Birth Order Overview

A. Birth Order and Various Outcomes: A Brief Review

Large administrative and conscription-based studies document modest cognitive advantages for earlier-born siblings. Using Norwegian draft-board data with family fixed effects, Bjerkedal et al. (2007) show that intelligence test scores decline slightly with birth order. Kristensen and Bjerkedal (2007) analyze the same data and conclude that social rank, rather than biological birth order, is central to this pattern. Barclay (2015) reports similar within-family evidence using Swedish conscription data. Together with earlier confluence model work (e.g., Zajonc and Markus (1975)), these studies suggest that within-family variation—not only between-family differences—generates small but measurable cognitive advantages for earlier-born siblings.

These findings matter for financial decision-making; Grinblatt, Keloharju, and Linnainmaa (2011), (2012) show that higher-IQ individuals are more likely to participate in equity markets and, conditional on participation, display stronger trading and investment performance. This suggests a negative relation between participating investors' portfolio performance and birth order. Educational and economic outcomes show closely related patterns. Using Norwegian population registers, Black et al. (2005) document that schooling declines monotonically with birth order; the gradients persist with family fixed effects and twin-birth instruments, indicating genuine within-

family birth-order effects. Black et al. (2016) link birth order to adult health and economic outcomes, although health effects are modest relative to education and income differences.

IQ, educational attainment, income, and wealth may themselves reflect birth order and childhood family environment. Therefore, conditioning on them does not provide a causal decomposition of birth-order gradients and may introduce post-treatment bias. Whereas we exclude them from baseline specifications, in Section VIII.A we report auxiliary specifications conditioning on these adult outcomes and discuss the limited descriptive inference available from the resulting coefficient comparisons.

B. Birth-Order Theories and Family Mechanisms

The literature offers several explanations for why siblings differ by birth order. Four mechanisms guide our empirical analysis of financial decision-making: resource dilution, strategic parenting and cultural expectations, adaptive divergence, and confluence.

Resource dilution emphasizes that parental resources—time, attention, energy, and material resources—are finite and are spread across the children present in the household (Downey (2001)). Earlier-born children initially share parents with fewer siblings, often none, whereas later-born children spend more of their childhood in larger sibling groups. Under realistic constraints, this gives earlier-born children periods of relatively undivided parental attention and leaves thinner parental resources for later-born children.

Resource dilution has been linked to poorer cognitive, health, and educational outcomes for later-born children relative to their older siblings, especially in low-resource settings (Behrman and Taubman (1986), Black et al. (2005), Price (2008), Jayachandran and Pande (2017)). It predicts that, on average, earlier-born siblings should accumulate more human capital and financial capability through greater parental time and capacity to transfer skills, norms, and information.

Therefore, they should be more likely to participate in equity markets and, conditional on participation, better equipped to calibrate risk and achieve stronger risk-adjusted performance. Birth-order gaps should also be larger within families with scarce or volatile resources.

Strategic parenting and cultural expectations emphasize that parents shape children's roles, expectations, and responsibilities differently across children. Primogeniture and related norms often assign the firstborn—especially the firstborn son—special privileges and responsibilities such as inheriting the family business or land and caring for aging parents (Hrdy and Judge (1993)). These patterns persist in developing countries such as India (Jayachandran and Pande (2017)) and developed countries such as Denmark, where family firms often favor firstborn sons in succession decisions (Bennedsen et al. (2007)). Therefore, parents may invest disproportionately in firstborns' education and socialization and impose stricter discipline and higher expectations on earlier-born children, both to prepare them for these roles and to establish a reputation of strictness that influences later-born children (Hotz and Pantano (2015)).

Strategic parenting predicts that earlier-born children may be socialized into more "responsible" financial roles. Even with similar total parenting time across siblings, parents may discuss finances, asset ownership, career choices, and risk management more extensively with earlier-born children. This steers earlier-born children toward more "responsible" financial behavior: consistent participation in formal financial markets, cautious risk management, and disciplined, rule-following investment strategies. Later-born siblings may receive less targeted parental attention and more latitude to experiment or deviate from conservative financial norms.

Adaptive divergence focuses on children's strategic responses. Siblings compete for parental attention and differentiated family roles, choosing niches to reduce direct competition (Sulloway (1996), (2001)). Firstborns are more likely to align with parental expectations, adopt conventional

and achievement-oriented roles, and excel in conscientiousness and academic achievement, whereas later-born siblings are more likely to differentiate themselves through less conventional or riskier pursuits (Sulloway (2007)). Black et al. (2018) show that earlier-born men are more emotionally stable, persistent, socially outgoing, willing to assume responsibility, and able to take initiative. Custódio and Siegel (2020) report that firstborns are considerably more likely to become CEOs than expected if birth order were unrelated to career outcomes. By contrast, later-born children may become more easygoing (Sulloway (2010)), emphasize openness (Healey and Ellis (2007)), and engage in high-risk activities in adolescence (Argys, Rees, Averett, and Witoonchart (2006)) and beyond (Sulloway and Zweigenhaft (2010)).

Adaptive divergence predicts that, on average, later-born siblings should tolerate more risk and favor novel nontraditional pursuits. However, adaptive divergence does not uniquely pin down whether these preferences manifest through equity-market participation or other risky domains (e.g., entrepreneurship, self-employment, highly concentrated holdings). Its intensive-margin prediction is clearer: conditional on participation, on average, later-born siblings should be more willing than earlier-born siblings to hold riskier portfolios and pursue more aggressive strategies.

Confluence theory highlights the household's intellectual and social climate, linking children's development to the average maturity and experience of household members with whom they interact (Zajonc and Markus (1975), Zajonc (1976)). Earlier-born children initially interact primarily with adults and may later mentor younger siblings, who, in turn, learn from both adults and older siblings. Sibling teaching depends on spacing: sufficiently large age gaps can support mentor-mentee relationships, whereas closely spaced siblings are more likely to be rivals than teachers and pupils (Cicirelli (1972), (1973)). Confluence suggests that sibling relationships provide channels for financial socialization and learning. Effective mentor-mentee constellations

should compress birth-order gaps in financial outcomes. Conversely, tight spacing, more likely to result in intense sibling rivalry, may leave birth-order gaps unchanged or even widen them.

C. Conceptual Roadmap

Guided by these four theories, we document baseline birth-order gaps in equity-market participation, portfolio risk, and portfolio performance (Tables 3 and 4), and examine gap variation with gender, parental resources, socio-economic resources, adult human-capital resources, and sibling confluence (Tables 5-7).

Resource dilution and strategic parenting both predict greater equity-market participation among earlier-born siblings. Resource dilution attributes this pattern to greater parental resources and capability transfer; strategic parenting emphasizes role assignment, expectations, and financial socialization. Adaptive divergence offers no unequivocal participation prediction because later-born siblings' taste for risk may be expressed outside equity markets. Confluence predicts that mentor-mentee structures and rich within-family learning environments, including high family equity-market participation, should narrow sibling participation gaps.

Conditional on participation, adaptive divergence predicts that later-born siblings should hold riskier portfolios than earlier-born siblings. Resource dilution and strategic parenting make less direct predictions about raw portfolio risk, but they suggest that earlier-born siblings should receive more instruction, oversight, or discipline and, therefore, be less prone to avoidable portfolio mistakes. Confluence predicts that sibling mentoring and shared family investment experience should reduce differences in risk-taking across siblings.

Resource dilution and strategic parenting imply that, on average, earlier-born siblings should achieve stronger risk-adjusted performance, particularly in families with scarce resources, adverse shocks, or stronger role differentiation. Adaptive divergence is compatible with a wider dispersion

of outcomes for later-born siblings; whether their more aggressive strategies generate higher or lower Sharpe ratios and alphas is an empirical question. Confluence predicts that mentoring constellations and shared investment practice should compress performance gaps across siblings.

III. Related Literature

A. Household Finance, Early-Life Experiences, and Peer Effects

Household-finance research emphasizes wealth, income, education, age, and other contemporaneous characteristics as determinants of participation and portfolio choice (Vissing-Jørgensen (2002), Campbell (2006), Calvet et al. (2007), (2009a), (2009b)). Related work shows that investor behavior partly reflects persistent family or early-life influences, including heritable components (Barnea et al. (2010), Cronqvist and Siegel (2014)) and formative exposure to adverse macroeconomic experiences (Malmendier and Nagel (2011), (2016), Knüpfer et al. (2017)). We contribute by studying birth order as a within-family source of heterogeneity in financial behavior.

The peer-effects literature shows that social interactions influence retirement-plan participation and portfolio choices in the workplace (Duflo and Saez (2002), (2003)), community equity-market participation (Hong et al. (2004), Brown et al. (2008)), local stock choices (Ivković and Weisbenner (2007)), and equity-market entry following peers' realized returns (Kaustia and Knüpfer (2012)). Our setting has a peer-like structure: parents (senior peers) and siblings (closest peers) form individuals' first, most intense, and most important peer groups. Household education, household equity-market participation during childhood, and older-sibling mentoring provide plausible channels for long-term intra-family social interaction and word-of-mouth learning.

B. Related Literature Concerning Financial Decision-Making

To our knowledge, only a small literature directly links birth order or sibling structure to financial behavior. Gilliam and Chatterjee (2011) find that, among married individuals, later-born

individuals, particularly men, report greater financial risk tolerance. Bonaparte, Fabozzi, and Koslowsky (2020) compare the portfolio choices of only children to those of individuals with siblings. Although their setting does not identify within-family birth-order gradients, it is closely related in emphasizing the relevance of childhood family structure for portfolio choice.

Agarwal, Cochardt, and Orlov (2025) find that later-born U.S. equity mutual-fund managers take more portfolio risk, perform worse, make more extreme style bets, hold more lottery stocks, and have more civil and regulatory violations than earlier-born managers do. Our paper differs in three ways. First, we study individual investors, allowing us to examine both the extensive margin of equity-market participation and the intensive margins of portfolio risk and performance. Second, observing multiple siblings from the same family allows us to use family fixed effects and identify within-family birth-order gaps. Third, we use the mechanisms described in Section II to interpret not only baseline gaps but also their variation with gender, childhood resources, family human capital, family equity-market participation, and sibling mentor–mentee structure.

IV. Data, Sample, and Variables

A. LINDA and KURU

Swedish administrative data have been used to study individuals' financial decision-making (e.g., Calvet et al. (2007), (2009a), (2009b), Bodnaruk and Simonov (2015), Black, Devereux, Lundborg, and Majlesi (2017)). We combine two Swedish micro-level data sets, LINDA and KURU. LINDA (Longitudinal INdividual DAtabase), a representative panel of the Swedish population covering approximately 300,000 households, provides annual snapshots from the Income Registry (e.g., taxable income, unemployment support) and Statistics Sweden (e.g., educational attainment, occupation, wages) for the sampled individuals and cohabiting family members. It also records demographic information such as age, gender, residence, and civic status.

KURU contains individuals' annual participation information since inception and detailed portfolio snapshots recording financial assets held outside defined-contribution pension accounts from 1999 to 2007. We define equity holdings as directly held common stocks and equity mutual funds, excluding bank deposits, bonds, money-market funds, insurance products, defined-benefit pension claims, defined-contribution pension holdings, and other retirement-account assets.

B. Sample

Our sample comprises LINDA individuals born between 1970 and 1980 with complete childhood family histories for their first 17-18 years. These annual snapshots of all individuals sharing the family ID allow us to ascertain birth order, gender, and childhood family environment.

C. Dependent Variables

For each sample individual i, the indicator variable $Participate_i$ is set to 1 if the individual holds at least 5,000 SEK in equities or shares of equity mutual funds at any annual KURU snapshot during the period from 1999 to 2007, and is set to 0 otherwise.[1]

For participating individuals, we use KURU holdings to calculate implied monthly portfolio returns from 1999 to 2007. Calculating risk and performance requires equity holdings across at least two consecutive annual snapshots, yielding at least 24 consecutive monthly portfolio returns. Idiosyncratic risk and alpha rely on a six-factor model comprising three standard Fama-French (1992), (1993) factors for Sweden and three standard Fama-French (1992), (1993) factors for the world portfolio. This approach reflects that Swedish investors commonly hold both domestic and global equities (Calvet et al. (2007)). In the regression analyses, return-based outcome variables are winsorized at the 1st and 99th percentiles.

[1] The 5,000 SEK cutoff follows the equity-market participation literature. For example, Heaton and Lucas (2000) exclude stockholdings below $500 (akin to 5,000 SEK during our sample period), thereby focusing on non-negligible equity holdings.

We summarize portfolio performance using Sharpe ratios and multifactor alphas. The Sharpe ratio captures the portfolio total risk-return tradeoff, including factor exposures and idiosyncratic bets. Alpha isolates expected excess return not explained by factor exposures. Its simple and natural interpretation is that of a pure equity-selection measure, though it is model-dependent and more sensitive to benchmark choice and small-sample noise. Interpretation is straightforward when the measures align. When they differ, alpha-only effects suggest selection differences without material changes in overall risk-adjusted performance, whereas Sharpe-only effects suggest broader differences in total portfolio positioning, including factor tilts and selection. Dahlquist, Martinez, and Söderlind (2017) show that active investors earn higher risk-adjusted returns than inactive investors do, primarily by successfully timing mutual funds and asset classes, rather than by superior stock selection. In our setting, Sharpe-ratio differences without alpha differences similarly reflect overall portfolio positioning rather than pure selection skill.

D. Independent Variables

We consider individuals from sibships of at least two. Firstborns are the reference category, and indicators *Second*, *Third*, and *Fourth*$^{+}$ identify second-born, third-born, and fourth- or later-born siblings, respectively.[2]

Men are more likely than women to participate in equity markets and, conditional on participating, hold riskier portfolios (Jianakoplos and Bernasek (1998), Sundén and Surette (1998), Barber and Odean (2001), Campbell (2006)). These gender gaps may reflect several factors, including strategic parenting and societal expectations encouraging men to take risks and women to be more conservative. Barber and Odean (2001) further show that men earn lower portfolio net

[2] These birth-order characterizations are precise but not perfect. Because the data do not identify biological parentage, adoption, or deceased older siblings, our birth-order indicator variables primarily capture social rank within the family.

returns than women do. We define an indicator *Male*, set to 1 for male sample individuals and set to 0 otherwise.

Absent precise measures of parental investment, we calculate for each sample individual *Adults/Children*, the childhood average of the annual number of household adults per child. It proxies for adult caretaker availability and the household's capacity to allocate attention to children. Downey (2001) emphasizes that parental investment encompasses time, money, and cognitive stimulation, and Price (2008) shows that parental time is allocated unevenly across siblings as family size grows.

Parental Age is the average age of the household adults at the individual's birth. Older parents may differ from younger parents in education, income, stability, experience, and parenting environment (Goisis (2015), Barclay and Myrskylä (2016)). Because they may also have lower physical energy or face different household constraints, the net relation between parental age and later financial decision-making is an empirical question.

Two variables capture childhood socio-economic resources. *Family Income* averages annual household income per capita percentile over childhood, adjusting for household size and broad income trends over time. *Family Unemployment* captures the fraction of childhood years in which at least one household adult experienced unemployment, comprising both income shocks and adverse labor-market exposure. Malmendier and Nagel (2011) show that exposure to the Great Depression reduces later equity-market participation and, conditional on participation, lowers portfolio risk. Similarly, childhood exposure to adult employment loss may affect risk aversion, propensity to participate in capital markets, and portfolio risk conditional on participation.

Family Education captures general family human capital as the childhood average of annual household adult educational levels.[3] *Family Participation* captures investment-related family human capital as the fraction of childhood years in which household adults invested in equity markets. It ranges between 0 (no adult participation at any point) and 1 (adult participation in all childhood years). It captures the family's financial sophistication, a trait that may be transmitted to their children through teaching, advising, and other forms of word-of-mouth communication.

Confluence theory emphasizes that siblings may benefit from mentoring younger siblings and from being mentored by older siblings (Cicirelli (1972), (1973), Zajonc and Markus (1975), Zajonc (1976)). To capture the mentoring role, we define the indicator *Mentor*, set to 1 if any sibling is at least three years younger than individual *i* and set to 0 otherwise. Similarly, we define the indicator *Mentee*, set to 1 if any sibling is at least three years older than individual *i* and set to 0 otherwise. These variables distinguish sibling constellations more likely to support mentor-mentee interactions from more closely spaced, rivalry-dominated sibships.

We define birth-year × region fixed effects, $\theta_{y(i),r(i)}$, where $y(i)$ denotes individual i's year of birth (between 1970 and 1980) and $r(i)$ stands for the region of Sweden in which individual i grew up. They absorb cohort-region differences in local economic conditions, region-specific institutional features, and persistent financial infrastructure differences. We also include family fixed effects, $\phi_{f(i)}$, in the main linear probability and portfolio outcome specifications. They absorb all time-invariant characteristics shared by the family's siblings. As a result, coefficients associated with the birth-order indicators are identified from within-family contrasts among siblings of different birth order, rather than from cross-sectional differences across families. This distinction

[3] LINDA variables UTBILDN (before 1993) and BSUN (1993 and later) report educational levels on a 1-6 scale: 1 = fewer than nine years of elementary education; 2 = nine to ten years of elementary education; 3 = completed high school; 4 = up to two years of undergraduate education; 5 = three or more years of undergraduate education; and 6 = an advanced degree.

is central in the birth-order literature because between-family comparisons may confound birth-order effects with family-size or socio-economic differences (Zajonc and Sulloway (2007)).

Local Area Participation$_i$ is the 1999-2007 average of annual equity-market participation rate among all other LINDA individuals in *i*'s postal-code area. Annual participation requires at least SEK 5,000 in directly held common stocks or equity mutual funds at the corresponding annual KURU snapshot. Following the community-participation logic from Brown et al. (2008), *Local Area Participation*$_i$ captures geographic variation in local financial culture, information flows, and peer effects in equity-market participation.[4] Whereas *Participate*$_i$ identifies whether the focal sample individual meets the participation threshold in at least one annual snapshot during the 1999-2007 period, *Local Area Participation*$_i$ measures typical annual community participation and the local investment climate relevant for information flows and peer effects surrounding individual *i*.[5] It enters only equity-market participation regressions and serves as the excluded variable in portfolio outcome equations, providing variation for the Heckman-style selection correction without directly affecting portfolio risk or portfolio performance.

[4] In the spirit of Brown et al. (2008), we average the annual fractions of participating LINDA individuals in the postal-code area over the period from 1999 to 2007 (rather than calculating the fraction of neighbors who ever participate during the period):

$$Local\ Area\ Participation_i = \frac{1}{9}\sum_{t=199}^{2007}\left[\frac{1}{N_{p(i,t)}-1}\sum_{j\neq i,\ j\in p(i,t)} Annual\ P\ articipate_{j,t}\right],$$

where $p(i,t)$ is individual *i*'s local area in year *t*; $N_{p(i,t)}$ is the number of LINDA individuals living there in year *t*; and *Annual Participate*$_{j,t}$ is set to 1 if LINDA individual *j* holds at least 5,000 SEK in equities or equity mutual funds in year *t*, and is set to 0 otherwise.

[5] A cumulative local measure based on whether each LINDA resident ever met the participation threshold during the 1999-2007 period would treat one-year and full-period participants alike. It would also combine the contemporaneous local investment environment with participation persistence and lifecycle composition in the broader LINDA population. Annual rates instead capture current participation; averaging the nine rates reduces year-specific noise while preserving the intended interpretation.

E. Summary Statistics

Table 1 reports full-sample statistics for the 147,829 sample individuals. About 63% meet the 5,000 SEK equity-market participation criterion at some point during the sample period, and the gender split is balanced. Childhood family environment varies substantially. *Family Education* spans the full 1-6 scale, with a 2.24-3.95 interquartile range. *Family Participation* ranges from 0 to 1, with a 0.125-0.529 interquartile range. *Family Unemployment* is concentrated near zero but has a long upper tail: its 75th percentile is 0.111, and some individuals spent their entire childhood with at least one unemployed household adult. These patterns indicate variation in childhood human-capital and socio-economic family resources. Mean *Local Area Participation* is 43.5%.[6]

<TABLE 1 ABOUT HERE>

Table 2 summarizes 93,257 individuals holding equity in at least two consecutive annual KURU snapshots. Gender is nearly balanced (52.8% of the participating sample individuals are male). Relative to the full sample, participants come from somewhat more advantaged childhood environments, with slightly higher family income, education, and equity-market participation. Portfolio outcomes vary widely. Total risk averages 6.4% per month (interquartile range 4.6%-7.7%); idiosyncratic risk averages 4.3% per month (interquartile range 2.6-5.4%). Sharpe ratios (×100) have a mean close to zero (-3.2) and a cross-sectional standard deviation of 16. Alphas average 0.1 basis points per month, with a cross-sectional standard deviation of 69.5 basis points per month, reflecting both genuine performance heterogeneity and substantial return noise.[7]

[6] This mean differs from individual-level equity market participation (63.1%) because the measures aggregate participation over time differently. *Participate* equals 1 if the sample individual meets the 5,000 SEK threshold at any point during the 1999-2007 period; *Local Area Participation* averages nine annual neighborhood participation rates among all other LINDA individuals in the sample individual's local area. Thus, participants in only part of the sample period count in the individual-level participation rate, but LINDA individuals contribute to local-area rates only in the years in which they participate. Therefore, the cumulative individual-level participation rate (the average of *Participate* over sample individuals) can exceed the LINDA individuals' average annual local participation rate *Local Area Participation*.

[7] Internet Appendix Table IA2.3 shows that using return-based variables without winsorization leaves the main results unchanged.

<TABLE 2 ABOUT HERE>

Because most specifications include family fixed effects, continuous covariate coefficients are identified from deviations from family means rather than from raw levels.[8]

V. Estimation

A. Baseline Analyses

To study the participation decision, we estimate a probit model for all the sample individuals:

$$Prob\left(Participate_i = 1 \mid \boldsymbol{Z_i}\right) = \Phi(\boldsymbol{Z_i}\gamma), \tag{1}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function. Variables $\boldsymbol{Z_i}$ include birth-order indicators, gender, parental resources, socio-economic resources, adult human-capital resources, birth-year × region fixed effects $\theta_{y(i),r(i)}$, and *Local Area Participation*$_i$. We omit family fixed effects, a deliberate choice that circumvents the challenges of including many fixed effects (more than 50,000) in probit estimations. Standard errors are clustered by family. We also estimate linear probability models both without and with family fixed effects $\phi_{f(i)}$. In the latter specification, identification comes entirely from within-family variation.

Birth-order studies often examine, for example, educational attainment and earnings (e.g., Behrman and Taubman (1986), Black et al. (2005)). In those settings, information regarding educational attainment and earnings is usually available for all sample individuals. By contrast, in our context portfolio characteristics are available only for the participating sample individuals, requiring us to account for selection. We use a Heckman (1979)-style selection model, with the equity-market participation probit estimation from Table 3, column 1 as the selection equation.

[8] Internet Appendix Table IA1.1 reports family-mean-adjusted summary statistics for all continuous variables. Its Panel A covers the full sample (Table 1), and its Panel B covers the participant sample (Table 2).

Portfolio risk and portfolio performance regressions retain the selection covariates except *Local Area Participation* and add family fixed effects. *Local Area Participation* may affect market entry but, conditional on birth order, family fixed effects and other covariates, it is assumed not to have additional effects on portfolio risk or portfolio performance.

In sum, to study the role of birth order in portfolio risk and portfolio performance for the participating individuals in our sample, we estimate a cross-sectional regression specification:

$$(2) \qquad Y_i = \beta_1 Second_i + \beta_2 Third_i + \beta_3 Fourth^+_i + \boldsymbol{\gamma' X}_i + \theta_{y(i),r(i)} + \phi_{f(i)} + \delta \lambda_i + \varepsilon_i,$$

where Y_i measures participating individual i's portfolio risk (*Total Risk* or *Idiosyncratic Risk*) or performance (*Sharpe Ratio* or *Alpha*). $\boldsymbol{X}_i$ includes gender, parental resources, socio-economic resources, and adult human-capital resources. Finally, the specification includes birth-year × region fixed effects $\theta_{y(i),r(i)}$, and family fixed effects $\phi_{f(i)}$. Standard errors are clustered by family.

Equation (2) also includes the Mills ratio $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$, estimated from the participation probit (Table 3, column 1), in the spirit of the generalized residual approach of Gourieroux, Monfort, Renault, and Trognon (1987) and Vella (1998). As in the standard Heckman (1979) two-step procedure, this regressor corrects for selection into equity-market participation under the usual assumptions regarding the joint distribution of selection and outcome errors.[9]

B. Moderation Analyses

We next examine whether birth-order differences in equity-investment decisions vary with a range of moderators M: gender, parental resources, socio-economic resources, adult human-capital resources, and sibling confluence. For moderator M, we augment equation (2) with interactions between M and birth-order indicators.

[9] Internet Appendix Table IA2.2 shows that the results are similar with and without the Inverse Mills Ratio.

VI. Baseline Results

A. Extensive Margin: Equity-Market Participation

Table 3 reports baseline equity-market participation results. Columns 1 to 3 omit family fixed effects, so identification stems from total regressor cross-sectional variation. Column 4 estimates a linear probability model with family fixed effects, so coefficients associated with childhood family environment variables are identified from within-family deviations from family means, with family fixed effects absorbing family-level time-invariant averages.

Column 4 shows a monotonic decline in equity-market participation with birth order. Relative to firstborns, participation probabilities are 2.1, 4.2, and 4.9 percentage points lower for second-, third-, and fourth- or later-born siblings, respectively; all three differences are highly statistically significant. Men are 2.9 percentage points more likely to participate than women are.

Turning to childhood family environment, column 4 captures the effect of within-family differences. For *Parental Age*, the 0.007 coefficient implies that a three-year, interdecile shift in the within-family parental age distribution (1.588 - (-1.565) = 3.15 years; Internet Appendix Table IA1.1) is associated with a 2.2 percentage points higher participation probability (0.007×3.15 = 0.022).

Family Education can vary across siblings. A parent might have completed a degree while children were growing up, with the degree completion timing affecting some siblings more than others; a new, highly educated adult might have entered the household, with the timing affecting some siblings more than others. An interdecile shift in the within-family *Family Education* distribution (0.035 - (-0.035) = 0.070; Internet Appendix Table IA1.1), coupled with the -0.029 coefficient, is associated with a modest, 0.20 percentage-point decline in participation probability (-0.029×0.070 = -0.0020). This gentle decline reflects that, consistent with adaptive divergence,

individuals exposed to a more educated family environment than their siblings explore broader ways to gain risk exposure, including ways that bypass direct equity-market participation.

Family Participation can differ across siblings, with parental investment activity overlapping more with some siblings than with others. An interdecile shift in the within-family *Family Participation* distribution (0.068 - (-0.068) = 0.136; Internet Appendix Table IA1.1), coupled with the 0.118 coefficient, is associated with a sizeable, 1.6 percentage-point increase in participation probability (0.118×0.136 = 0.016). Finally, equity-market participation is associated with neither *Mentor* nor *Mentee*, offering no clear empirical support for confluence on the extensive margin.

Variation in no fewer than eight childhood family environment variables does not attenuate the birth-order coefficients, making simple, observable resource dilution an unlikely explanation for extensive-margin birth-order effects. In principle, it is possible that some materially important family resource variables have been omitted, or that more complex nonlinearities or interactions among the observed resource variables—absent any theoretical foundation—could absorb birth-order effects. The Table 3 estimates cannot fully rule out these possibilities, but they strongly suggest that within-family birth-order and gender participation gaps most likely reflect strategic parenting and conformance to prevailing cultural norms, with at best a remote residual role for unobserved or highly nonlinear resource dilution. We return to this point in Section VIII.B.

<TABLE 3 ABOUT HERE>

B. Intensive Margin

Table 4 reports the intensive-margin results. Birth-order gaps in portfolio risk and portfolio performance appear in all four columns, with the total-risk gap for fourth- or later-born individuals falling short of traditional statistical significance levels.

Relative to firstborns, second-born siblings' portfolios have 0.220 percentage points per month higher total risk and 0.215 percentage points per month higher idiosyncratic risk. Both gaps for third-born siblings are 0.357 percentage points per month. For fourth- or later-born siblings, they are 0.298 and 0.360 percentage points per month, respectively, with the former not statistically significant. With participating investors' total and idiosyncratic risk cross-sectional interquartile ranges of 3.05 and 2.78 percentage points per month, respectively (Table 2), these gaps constitute about 7% to 8% of the respective interquartile ranges for second-born siblings, 12% to 13% for third-born siblings, and 10% to 13% for fourth- or later-born siblings.

Relative to firstborns, second-born siblings' portfolios have Sharpe ratios lower by 0.951 and alphas lower by 3.2 basis points per month. The corresponding gaps are 1.515 and 5.6 basis points per month for third-born siblings, and 3.216 and 6.5 basis points per month for fourth- or later-born siblings. Participating investors' Sharpe ratio and alpha cross-sectional interquartile ranges of 11.66 points and 50.8 basis points per month (Table 2) suggest that the corresponding gaps constitute about 8% and 6% of the corresponding interquartile ranges for second-born siblings, 13% and 11% for third-born siblings, and 28% and 13% for fourth- or later-born siblings.

As in the participation analyses, childhood family environment variables do not absorb birth-order or gender gaps, indicating that simple, observable resource dilution is unlikely to be the prevailing explanation (*Adults/Children* and *Family Participation* have their own direct associations with the intensive-margin outcomes). Neither portfolio risk nor portfolio performance is consistently related to *Mentor* or *Mentee*, offering no clear empirical support for confluence on the intensive margin.

Birth-order gaps in portfolio risk are consistent with adaptive divergence, and gender risk gaps with male overconfidence (Barber and Odean (2001)). On the other hand, birth-order and gender

gaps in both performance measures strongly support strategic parenting and adherence to prevailing cultural norms. Firstborns (especially firstborn males) earn higher risk-adjusted returns than later-born siblings do, consistent with parents and cultural norms encouraging firstborns to be more disciplined, rule-following, and responsible in their financial behavior. For example, third-born individuals underperform firstborns by about 1.5 points in terms of monthly Sharpe ratio and 6 basis points per month in terms of alpha, while men outperform women by roughly 1.5 points in terms of monthly Sharpe ratio and 2 basis points per month in terms of alpha.

<TABLE 4 ABOUT HERE>

VII. Moderation Analyses

Tables 3 and 4 establish three core facts. First, earlier-born siblings are more likely to participate in equity markets than later-born siblings are. Second, conditional on participation, earlier-born siblings take less risk and earn higher risk-adjusted returns than their later-born siblings do. Third, these within-family gradients survive rich linear controls for childhood family environment—parental resources, socio-economic resources, adult human capital resources, and proxies for sibling confluence.

These baseline results sharply limit the explanatory power of simple resource dilution. They also offer little support for confluence as captured by *Mentor* and *Mentee* indicators. By contrast, they are naturally consistent with a combination of strategic parenting and prevailing cultural norms that favor earlier-born (especially firstborn) children through attention and socialization into responsible, disciplined financial roles, alongside adaptive divergence in risk-taking. However, baseline specifications treat birth-order effects as homogeneous, estimating average within-family effects without informing us for whom and under what childhood conditions the birth-order gaps are larger or smaller. Moderation analyses examine this variation across environments. For

continuous moderators, we multiply each birth-order interaction coefficient by the moderator's cross-sectional interquartile range (using total values, not within-family deviations).

A. Moderation by Gender

Table 5, column 1 shows that, among firstborns, men are 3.6 percentage points more likely to participate than women are, a highly statistically significant difference. Birth-order interactions are small and statistically indistinguishable from zero. Columns 2 and 3 show that, among firstborn investors, men hold riskier portfolios than women do: monthly total and idiosyncratic portfolio return volatilities are higher by approximately 1.5 and 1.3 percentage points, respectively. Birth-order interaction coefficients are statistically indistinguishable from zero, providing no evidence that gender moderates the birth-order gradient in portfolio risk.

Birth-order coefficients from Table 5, column 4 show that later-born female investors have lower Sharpe ratios than firstborn female investors do. The main *Male* coefficient of 1.399 (×100) indicates that, among firstborn investors, men's Sharpe ratios exceed women's Sharpe ratios. However, the interaction coefficients do not reveal a consistent pattern of gender moderation of the birth-order Sharpe-ratio gaps.

By contrast, although not all three interaction coefficients are statistically significant, column 5 largely suggests that male birth-order alpha gaps are approximately twice as steep as female birth-order alpha gaps. For example, the third-born female alpha gap is -3.7 basis points per month (not statistically significant), whereas the third-born male alpha gap is -7.5 basis points per month. This corresponds to men, especially later-born men, trading more aggressively and incurring higher transaction costs (Barber and Odean (2001)). The absence of a consistent gender birth-order Sharpe ratio gap narrowing suggests that later-born men's tendency to catch up in factor exposures

(plausibly through asset allocation) is offset by alpha erosion through churning. These tendencies would leave Sharpe ratios unaltered while widening birth-order alpha gaps.

Pure resource dilution, adaptive divergence, and confluence make no sharp gender-moderation predictions. Beyond the pronounced gender-based differences reported in Tables 3 and 4, strategic parenting and differential cultural expectations could have extended to a more pronounced birth-order mitigation for males (based on parental preference for involving male children in financial matters). However, Table 5 does not offer much support for that interpretation. If anything, the results suggest that male alpha birth-order gaps steepen more than female alpha birth-order gaps do, suggesting patterns of more aggressive trading consistent with adaptive divergence.

<TABLE 5 ABOUT HERE>

B. Moderation by Parental Childhood Resources: Participation

Table 6, Panel A documents the moderating effects of childhood parental, socio-economic, and adult human capital resources on the birth-order participation gap. *Adults/Children*, *Family Income*, and *Family Education* interactions are small and statistically insignificant. By contrast, most interactions associated with *Parental Age* indicate that it moderates the birth-order gap. For example, the third-born participation gap reduction as *Parental Age* shifts from the 25th to the 75th percentile of the parental age distribution (30.92 - 24.44 = 6.48 years; Table 1) is 2.6 percentage points (0.004 × 6.48 = 0.026), partially offsetting the baseline participation gap.

Family Unemployment widens participation gaps. For example, for third-born siblings, its interquartile increase from the 25th to the 75th percentile of the family unemployment distribution (0.111 - 0.000 = 0.111) widens the gap by 1.5 percentage points (-0.139 × 0.111 = -0.015). Finally, *Family Participation* narrows birth-order participation gaps. For example, an interquartile shift from the 25th to the 75th percentile of the family participation distribution (0.529 - 0.125 = 0.404)

reduces the third-born participation gap by 4.16 percentage points (0.103 × 0.404 = 0.0416), making childhood parental equity-market participation the most influential participation moderator in Table 6, Panel A.

Resource dilution predicts larger birth-order participation gaps in lower-resource families. Consistent with a resource-dilution channel through income shocks (as captured by *Family Unemployment*), rather than through permanent income levels (as captured by *Family Income*), *Family Income* does not shrink the participation birth-order gap and *Family Unemployment* widens it consistently. Strategic parenting and cultural norms predict that parents place greater responsibility and expectations on earlier-born children, especially in stressful environments. Accordingly, the participation birth-order gap narrows among individuals with lower family unemployment, older parents, and higher levels of family equity-market participation.

Adaptive divergence offers no sharp participation predictions because later-born siblings may express risk preferences outside equity markets. Similarly, Table 6, Panel A does not provide a direct test of confluence (Table 7 examines moderation by its direct proxies, *Mentor* and *Mentee*).

C. Moderation by Parental Childhood Resources: Portfolio Risk

Table 6, Panel B examines how childhood parental, socio-economic, and adult human capital resources moderate birth-order portfolio risk gaps. *Family Education* is the only systematic moderator of both total and idiosyncratic portfolio risk. These findings support neither resource dilution nor strategic parenting with adherence to cultural norms. In both frameworks, richer and more skilled parental environments would more naturally compress, rather than amplify, within-family risk gaps. By contrast, adaptive divergence is central. *Family Education* strengthens the portfolio risk birth-order gap; later-born individuals who grew up in highly educated families

appear to have gathered more knowledge and tools than the individuals who grew up in less educated families did, allowing the former to better implement their preferred high-risk strategies.

D. Moderation by Parental Childhood Resources: Portfolio Performance

Table 6, Panel C examines how parental, socio-economic, and adult human-capital resources moderate birth-order portfolio performance gaps. Across all Sharpe ratio specifications, all birth-order interactions with resource moderators are positive and many are statistically significant, indicating that richer childhood environments narrow birth-order Sharpe ratio gaps. These patterns are the strongest and most robust for *Family Education* and, particularly, *Family Participation*.

For *Family Education*, an interquartile increase of 1.5 (4.00 - 2.50 = 1.50; Table 2) reduces the Sharpe-ratio birth-order gaps by 0.315 (0.210 × 1.5) for second-born siblings, 0.963 (0.642 × 1.5) for third-born siblings, and 1.298 (0.865 × 1.5) for fourth- or later-born siblings. Relative to the Table 4 baseline Sharpe ratio birth-order gaps, these increases close approximately one-third of the gap for second-born (0.315/0.951 = 0.331), two-thirds of the gap for third-born (0.963/1.515 = 0.636), and two-fifths of the gap for fourth- or later-born siblings (1.298/3.216 = 0.404). Therefore, higher family education substantially attenuates the Sharpe-ratio birth-order gap.

For *Family Participation*, an interquartile increase of 0.428 (0.619 - 0.191 = 0.428; Table 2) reduces the Sharpe-ratio birth-order gap by 0.706 (1.650 × 0.428) for second-born, 0.832 (1.943 × 0.428) for third-born, and 2.033 (4.750 × 0.428) for fourth- or later-born siblings. Relative to the Table 4 baseline Sharpe ratio birth-order gaps, these increases close approximately three-quarters of the gap for second-born (0.706/0.951 = 0.742), one-half of the gap for third-born (0.832/1.515 = 0.549), and three-fifths of the gap for fourth- or later-born siblings (2.033/3.216 = 0.632), making persistent parental equity-market participation the strongest performance moderator.

Other Sharpe ratio birth-order moderators are less pronounced. *Parental Age* and, to a lesser extent, *Family Income* have positive interactions consistent with some Sharpe-ratio gap narrowing, but their magnitudes and statistical significance are modest relative to interactions involving *Family Education* and *Family Participation*. The least pronounced is *Family Unemployment*, with all interaction coefficients statistically indistinguishable from zero.

Alpha moderation is weaker, with most interactions statistically indistinguishable from zero. *Family Unemployment* exhibits the clearest pattern; its interquartile increase of 0.077 (0.077 - 0.000 = 0.077; Table 2) reduces birth-order alpha gaps by 1.4 basis points per month (17.9 × 0.077) for second-born siblings, 1.8 basis points per month (23.8 × 0.077) for third-born siblings, and 1.7 basis points per month (22.2 × 0.077) for fourth- or later-born siblings. Relative to Table 4 baseline gaps, these reductions close just under one-half of the second-born gap (1.4/3.2 = 0.438), just under one-third of the third-born gap (1.8/5.6 = 0.321), and just over one-quarter of the fourth- or later-born gap (1.7/6.5 = 0.262). The stronger *Family Unemployment* moderation pattern for alpha than for Sharpe ratio suggests that family unemployment-related performance moderation may operate more strongly through security selection (as reflected in the positive alpha interactions), whereas broader allocation might largely be unaffected (or, arguably, might be getting somewhat worse).

Overall, Table 6, Panel C stresses that human capital and specific investment experience, rather than simple financial resources, are central to mitigating performance birth-order gaps. Strong Sharpe-ratio moderation by *Family Education* and *Family Participation* is consistent with strategic parenting and cultural norms that, in more educated and investment-active families, extend discipline, information, and good practices to all children rather than concentrating them on firstborns. It is also compatible with adaptive divergence: richer informational and experiential

environments enable later-born siblings, who may be more willing to take risk, to express those preferences more efficiently and convert risk-taking into better risk-adjusted performance.

<TABLE 6 ABOUT HERE>

E. Moderation by Parental Childhood Resources: Across or Within Families?

The moderation results in Table 6 use individual-level childhood family resource variables M_i, reflecting total moderator variation (encompassing both their across-family and within-family cross-sectional variation). In Internet Appendix Table IA2.4, we replace individual-level moderators M_i with their family-level averages M^f_i, calculated across all siblings in individual i's family f. The principal moderation patterns, particularly those associated with *Family Education* and *Family Participation*, remain similar when the moderators are averaged within families.

F. Moderation by Sibling Childhood Resources

Table 7 does not reveal any evidence that confluence, proxied by *Mentor* and *Mentee* indicators, moderates birth-order gaps. For equity-market participation, total and idiosyncratic risk, and Sharpe ratio, with but one exception, neither *Mentor* nor *Mentee* main effects nor their interaction terms are statistically significant or economically meaningful. All corresponding alpha interactions are statistically indistinguishable from zero. Whereas it remains possible that confluence operates through channels not captured by *Mentor* and *Mentee* indicators (e.g., content, quality, and timing of sibling conversations), or that *Family Education* and *Family Participation* partly absorb confluence-like learning, including these confluence proxies provides no support for confluence as a birth-order gap reduction mechanism in the domain of financial decision-making.

<TABLE 7 ABOUT HERE>

VIII. Auxiliary Specification Analyses

A. Specifications Conditioning on Post-Treatment Adult Outcomes

Section II.A reviews the role birth order plays in IQ, educational attainment, and adult economic outcomes. The challenge in considering their role in the relation between equity investment decision-making and birth order is that IQ, educational attainment, economic outcomes, and financial behavior are all outcomes of the family environment while growing up. Therefore, in the present context of studying the relation between equity investments and birth order, educational attainment, economic outcomes, and IQ are endogenous because they too are post-treatment variables. As such, they raise the specter of "bad controls" in the Angrist and Pischke (2009) sense, and we deliberately have not included them in our primary specifications.

Internet Appendix Table IA2.5, Panel A reports auxiliary specifications that add current education, income, employment status, wealth, and, for men, IQ. Adding these controls in the full sample reduces the participation birth-order coefficients by approximately one-fifth to one-third, while portfolio risk and portfolio performance birth-order coefficients remain essentially unchanged. However, because the added variables are themselves post-treatment outcomes, these are descriptive conditional specifications involving "bad controls," not causal mediation analyses. They show only that the observed adult outcomes and IQ do not statistically subsume birth-order associations. They do not establish that these variables are unimportant channels or identify the mechanisms underlying the remaining coefficients. Therefore, we place greater weight on moderation analyses involving childhood family environment, especially *Family Education* and *Family Participation*.

B. Nonlinearity in Continuous Controls

Tables 3 and 4 show that observable childhood family environment controls do not absorb equity-market participation, portfolio risk, or portfolio performance birth-order gradients. These controls may enter the outcome equations nonlinearly, so linear specifications might understate observable resource-dilution channels. To address this concern, we replace each continuous control with a flexible piecewise-linear specification. In the spirit of Knüpfer et al. (2017), we assign continuous controls to quintiles and interact quintile indicators with the underlying continuous variable, allowing the slope to vary across quintiles. We re-estimate the baseline Table 3 and 4 specifications and report the results in Internet Appendix Table IA2.5, Panel B.

Those birth-order coefficient estimates are virtually unchanged from the baselines in Tables 3 and 4; even a very flexible approach to shaping observable childhood family environment variables does not attenuate the birth-order gradients. Therefore, a detailed approach to nonlinearity does not position resource dilution as a plausible explanation. Instead, it further highlights a combination of strategic parenting and conformance to prevailing cultural norms.

C. Firstborn Advantage

The granular, second-, third-, and fourth- or later-born specification is our baseline because it permits a flexible birth-order gradient. Given firstborns' prominent role in theoretical and empirical birth-order research (e.g., Custódio and Siegel (2020)), we also estimate a parsimonious firstborn-premium specification, replacing *Second*, *Third*, and *Fourth+* with *Firstborn*. Defined as $Firstborn = 1 - Second - Third - Fourth^{+}$, it is set to 1 for firstborns and to 0 for others. Appendix Table A2 reports analogs to the baseline and moderation analyses reported in Tables 3 through 6.

As Table A2 shows, the key insights from the granular birth-order specifications carry over; the more focused estimation of the firstborn effect generally yields no additional insights.[10]

IX. Conclusion

Using Swedish administrative and portfolio data, we document robust within-family birth-order gradients in equity-market behavior. Later-born siblings are less likely to participate and, conditional on participation, hold portfolios with greater risk and lower risk-adjusted performance. These patterns survive rich family environment controls and flexible nonlinear specifications.

Observable resource dilution and confluence proxies do little to explain or moderate birth-order gradients. The results align closely with strategic parenting and cultural expectations (parents allocating responsibility, information, and monitoring differentially across siblings), and with adaptive divergence (later-born siblings' greater willingness to take risk). Human-capital and experience variables, especially *Family Education* and *Family Participation*, are the dominant moderators. Higher family education amplifies the portfolio risk gap, consistent with later-born siblings in more informed families having the tools to implement their higher risk appetite. Sustained parental equity-market participation substantially narrows performance gaps and, at high levels, almost eliminates Sharpe-ratio differences, suggesting that intensive within-family financial practice can level the playing field.

Our evidence rests on a sample of Swedes born between 1970 and 1980. Sweden's deep capital markets, high income levels, relatively widespread financial literacy, and rich administrative data

[10] Pooling later-born categories changes the regression projection rather than merely averaging the original coefficients. Once family fixed effects and the remaining covariates are taken out, the *Firstborn* coefficient is not the negative of a raw-frequency-weighted average of the three flexible specification coefficients. Rather, pooling the later-born categories changes the within-family comparisons that identify the birth-order coefficient and changes the effective regression weights. We elaborate on these issues in Internet Appendix IA3.

make it a natural setting for identifying within-family birth-order effects. Countries differ in social insurance, taxation, pension arrangements, parenting practices, inheritance norms, and gender roles. The four mechanisms we study are likely relevant in other developed economies, but their relative strength and the magnitudes of the birth-order gradients may vary with local institutions and cultural expectations.

Portfolio data are only available for the 1999-2007 period because a subsequent legal change altered the Swedish Tax Authority's reporting requirements. Therefore, we observe sample individuals' investment decisions from the late teens through the late thirties, allowing detailed study of the formative stages of equity-market participation, risk-taking, and performance. However, we cannot examine how birth-order effects evolve over longer horizons, whether learning and experience attenuate or amplify the gaps, whether cumulative wealth outcomes differ by birth order later in life, or the consequences for retirement or bequests.

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Table 1

Summary Statistics for the Full Sample

Table 1 presents the summary statistics for the sample of all 147,829 LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980.

	Mean	S.D.	Min	10th	25th	Median	75th	90th	Max
Dependent Variable									
Participate	0.631								
Independent Variables									
Birth Order									
Second	0.416								
Third	0.171								
Fourth^{+}	0.077								
Gender									
Male	0.510								
Childhood Family Environment									
Parental Resources									
Adults/Children	1.009	0.286	0.125	0.639	0.806	1.000	1.222	1.333	2.917
Parental Age	27.83	5.07	5.00	21.86	24.44	27.47	30.92	34.50	56.04
Socio-Economic Resources									
Family Income	44.98	15.80	4.00	25.33	33.00	43.76	55.33	66.53	99.00
Family Unemployment	0.073	0.129	0.000	0.000	0.000	0.000	0.111	0.235	1.000
Adult Human Capital Resources									
Family Education	3.07	1.12	1.00	1.54	2.24	3.00	3.95	4.93	6.00
Family Participation	0.358	0.274	0.000	0.000	0.125	0.333	0.529	0.769	1.000
Sibling Resources									
Mentor	0.345								
Mentee	0.439								
Local Area Participation	0.435	0.055	0.000	0.389	0.434	0.434	0.434	0.494	0.630

Table 2

Summary Statistics for the Sample of Equity Market Participants

Table 2 presents the summary statistics for the sample of 93,257 LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980, who featured equity holdings in at least two consecutive annual KURU snapshots.

	Mean	S.D.	Min	10th	25th	Median	75th	90th	Max
Dependent Variables									
Total Risk (%/month)	6.43	3.45	0.04	2.70	4.63	5.85	7.68	11.31	80.74
Idiosyncratic Risk (%/month)	4.33	2.95	0.02	1.67	2.58	3.36	5.36	8.66	72.43
Sharpe Ratio (× 100)	-3.21	16.14	-420.68	-15.84	-7.73	-1.18	3.93	10.40	139.44
Alpha (bp/month)	0.1	69.5	-917.6	-62.1	-23.9	-1.6	26.9	66.0	1,245.3
Independent Variables									
Birth Order									
Second	0.426								
Third	0.159								
Fourth^{+}	0.058								
Gender									
Male	0.528								
Childhood Family Environment									
Parental Resources									
Adults/Children	1.041	0.277	0.125	0.686	0.843	1.056	1.222	1.389	2.917
Parental Age	28.08	4.85	9.33	22.43	24.84	27.56	31.00	34.50	55.06
Socio-Economic Resources									
Family Income	47.74	15.88	4.33	27.67	35.90	46.78	58.22	69.38	99.00
Family Unemployment	0.064	0.122	0.000	0.000	0.000	0.000	0.077	0.222	1.000
Adult Human Capital Resources									
Family Education	3.21	1.13	1.00	1.99	2.50	3.00	4.00	5.00	6.00
Family Participation	0.414	0.280	0.000	0.000	0.191	0.400	0.619	0.824	1.000
Sibling Resources									
Mentor	0.243								
Mentee	0.329								

Table 3

Extensive Margin: Equity-Market Participation

Table 3 presents the results of estimating equation (1), the equity-market participation equation, as described in Section V.A. The sample consists of Swedish individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Dependent Variable: *Participate*	(1) Probit		(2) Linear Probability	
	Baseline Estimation	Marginal Effects	Without Family Effects	With Family Effects
Birth Order				
Second	-0.067***	-0.027***	-0.024***	-0.021***
Third	-0.174***	-0.069***	-0.063***	-0.042***
Fourth^{+}	-0.256***	-0.102***	-0.092***	-0.049***
Gender				
Male	0.079***	0.031***	0.028***	0.029***
Childhood Family Environment				
Parental Resources				
Adults/Children	0.044***	0.017***	0.018***	-0.026
Parental Age	0.014***	0.006***	0.005***	0.007***
Socio-Economic Resources				
Family Income	0.009***	0.004***	0.003***	-0.000
Family Unemployment	-0.288***	-0.115***	-0.108***	0.003
Adult Human Capital Resources				
Family Education	0.067***	0.027***	0.024***	-0.029*
Family Participation	1.229***	0.490***	0.448***	0.118***
Sibling Resources				
Mentor	0.022**	0.009*	0.008**	0.008
Mentee	-0.003	-0.001	-0.001	0.009
Local Area Participation	1.138***	0.454***	0.408***	0.104***
Birth-Year × Region Fixed Effects	Yes		Yes	Yes
Family Fixed Effects	No		No	Yes
N	147,829		147,829	147,829
(Pseudo/Adjusted/Within) R^2	0.0960		0.1257	0.0105

Table 4

Intensive Margin: Portfolio Risk and Portfolio Performance

Table 4 presents the results of estimating equation (2) for portfolio risk and portfolio performance, as described in Section V.A. The sample consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980, who featured equity holdings in at least two consecutive annual KURU snapshots. The equity-market participation equation from Table 3, column 1 serves as the selection equation, with the Inverse Mills Ratio calculated as $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$. Dependent variables (portfolio risk and portfolio performance) are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	Portfolio Risk		Portfolio Performance	
Dependent Variables: (Winsorized at 1st and 99th Percentiles)	(1) *Total Risk* (%/month)	(2) *Idiosyncratic Risk* (%/month)	(3) *Sharpe Ratio* (× 100)	(4) *Alpha* (bp/month)
Birth Order				
Second	0.220***	0.215***	-0.951***	-3.2***
Third	0.357***	0.357***	-1.515***	-5.6**
Fourth+	0.298	0.360**	-3.216***	-6.5*
Gender				
Male	1.487***	1.308***	1.472***	2.2***
Childhood Family Environment				
Parental Resources				
Adults/Children	0.373**	0.287*	0.150	-1.6
Parental Age	0.012	0.020	-0.013	0.0
Socio-Economic Resources				
Family Income	-0.004	-0.000	-0.036	-0.1
Family Unemployment	-0.384	-0.467	-1.111	3.6
Adult Human Capital Resources				
Family Education	-0.157	-0.179	-0.681	-2.1
Family Participation	-0.315	-0.325	0.750	11.5**
Sibling Resources				
Mentor	0.126	0.115*	0.679*	1.2
Mentee	0.103	0.079	0.624	1.4
Inverse Mills Ratio	-0.215***	-0.258***	0.134	8.5***
Birth-Year × Region Fixed Effects	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes
N	93,257	93,257	93,257	93,257
Within R^2	0.0869	0.0921	0.0184	0.0191

Table 5

Birth-Order Gap Mechanisms: Moderation by Gender

Table 5 presents the results of relating equity investment outcomes (participation, portfolio risk, and portfolio performance) to birth order variables and the interactions of birth order variables with gender (*Male*). The baseline specifications are augmented with these interactions. Column 1 augments Table 3 column 4; columns 2-5 augment equation (2). The sample in column 1 consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980. The sample in the remaining columns further requires equity holdings in at least two consecutive annual KURU snapshots. The equity-market participation equation is similar to equation (1), as described in Section V.A., augmented with the interaction terms, with the Inverse Mills Ratio calculated as $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$. Portfolio risk and portfolio performance dependent variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Dependent Variables:	(1) *Participate* (Linear Probability Model)	(2) *Total Risk* (%/month)	(3) *Idiosyncratic Risk* (%/month)	(4) *Sharpe Ratio* (× 100)	(5) *Alpha* (bp/month)
Second	-0.015**	0.227***	0.227***	-0.804***	-1.1
Third	-0.040**	0.378***	0.359***	-2.114***	-3.7
Fourth^{+}	-0.041**	0.252	0.289	-3.439***	-4.3
Male	0.036***	1.494***	1.311***	1.399***	4.8***
Male* × *Second	**-0.011**	**-0.013**	**-0.022**	**-0.268**	**-4.2*****
Male* × *Third	**-0.004**	**-0.039**	**-0.003**	**1.148****	**-3.8***
Male* × *Fourth^{+}	**-0.017**	**0.092**	**0.140**	**0.449**	**-4.3**
Controls	Yes	Yes	Yes	Yes	Yes
Birth-Year × Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes	Yes

Table 6

Birth-Order Gaps in Equity Investment:
Moderation by Childhood Parental, Socio-Economic, and Adult Human Capital Resources

Table 6 presents the results of relating equity market participation outcomes (Panel A), portfolio risk outcomes (Panel B), and portfolio performance outcomes (Panel C) to birth order variables and the interactions of birth order variables with several variables capturing parental, socio-economic, and adult human capital resources. Panel A specification implements the linear probability version of equation (1) with family fixed effects, as described in Section V.A, augmented with these interactions. The sample for Panel A consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980. Panel B and C specifications implement equation (2), as described in Section V.A, augmented with these interactions. The sample for Panels B and C consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980, who featured equity holdings in at least two consecutive annual KURU snapshots. The equity-market participation equation pertaining to Panels B and C implements the probit version of equation (1), as described in Section V.A., augmented with the interaction terms, with the Inverse Mills Ratio calculated as $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$. Dependent Panel B and C variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Resource Moderator *M*	*Second*	*Third*	*Fourth*$^{+}$	*M*	***M* × *Second***	***M* × *Third***	***M* × *Fourth*$^{+}$**
Panel A: Equity Market Participation							
Adults/Children	-0.039**	-0.067***	-0.026	-0.036	**0.020**	**0.028**	**-0.032**
Parental Age	-0.057**	-0.148***	0.005	0.007***	**0.001***	**0.004*****	**-0.002**
Family Income	-0.032***	-0.053***	-0.049	-0.001	**0.000**	**0.000**	**-0.000**
Family Unemployment	-0.017***	-0.032***	-0.039**	0.143	**-0.075****	**-0.139*****	**-0.141***
Family Education	-0.021*	-0.032*	-0.046	-0.029*****	**0.000**	**-0.003**	**-0.001**
Family Participation	-0.041***	-0.077***	-0.077**	0.048	**0.056****	**0.103*****	**0.078****

Table 6 (continued)

Resource Moderator *M*	*Second*	*Third*	*Fourth*$^{+}$	*M*	***M* × *Second***	***M* × *Third***	***M* × *Fourth*$^{+}$**
Panel B: Portfolio Risk							
			Total Risk				
Adults/Children	0.142	0.003	0.059	0.077	**0.102**	**0.441**	**0.335**
Parental Age	-0.101	0.116	-0.374	0.005	**0.012**	**0.010**	**0.024**
Family Income	0.167	0.171	0.126	-0.004	**0.001**	**0.004**	**0.004**
Family Unemployment	0.249***	0.389***	0.248	0.157	**-0.544***	**-0.508**	**0.461**
Family Education	-0.078	-0.135	-0.682	-0.090	**0.087*****	**0.144*****	**0.297*****
Family Participation	0.280***	0.390***	0.113	-0.289	**-0.122**	**-0.054**	**0.441**
			Idiosyncratic Risk				
Adults/Children	0.195	0.118	0.167	0.091	**0.034**	**0.300**	**0.261**
Parental Age	-0.017	0.330	-0.157	-0.005	**0.009**	**0.002**	**0.019**
Family Income	0.177*	0.227	0.230	-0.007	**0.001**	**0.004**	**0.004**
Family Unemployment	0.240***	0.387***	0.289*	-0.061	**-0.466**	**-0.442**	**0.726**
Family Education	-0.004	-0.017	-0.310	-0.130	**0.064*****	**0.109****	**0.202****
Family Participation	0.247***	0.366***	0.252	-0.318	**-0.065**	**-0.008**	**0.259**
Panel C: Portfolio Performance							
			Sharpe Ratio				
Adults/Children	-2.546***	-3.258**	-4.970***	-1.907	**1.775****	**2.283**	**2.486**
Parental Age	-2.760**	-2.759	-10.511**	-0.062	**0.071***	**0.055**	**0.252***
Family Income	-1.652***	-2.836***	-5.033***	-0.044	**0.015***	**0.032**	**0.046**
Family Unemployment	-1.075***	-1.744***	-3.321***	-4.945	**2.455**	**3.773**	**1.999**
Family Education	-1.672***	-3.678***	-6.081***	-0.456	**0.210**	**0.642****	**0.865***
Family Participation	-1.674***	-2.307***	-5.250***	-1.247	**1.650*****	**1.943***	**4.750****
			Alpha				
Adults/Children	-0.3	-3.4	-4.1	1.3	**-3.2**	**-2.9**	**-3.5**
Parental Age	-4.1	-5.2	-11.6	0.0	**0.0**	**-0.0**	**0.2**
Family Income	0.3	-6.4	-11.7	-0.0	**-0.1***	**0.0**	**0.1**
Family Unemployment	-4.1***	-7.0***	-7.9**	-23.8*	**17.9*****	**23.8****	**22.2**
Family Education	-2.6	-5.4	-10.3	-2.2	**-0.2**	**-0.0**	**1.2**
Family Participation	-3.7**	-9.4***	-11.9**	6.6	**1.5**	**8.9****	**12.2**

Table 7
Birth-Order Gap Mechanisms: Moderation by Confluence

Table 7 presents the results of relating equity investment outcomes (participation, portfolio risk, and portfolio performance) to birth order variables and interactions of birth order variables with confluence variables (*Mentor*, *Mentee*). The baseline specifications are augmented with these interactions. Column 1 augments Table 3, column 4; columns 2-5 augment equation (2). *Mentee* appears only in interactions because firstborns cannot be mentees. The sample in column 1 consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980. The sample in the remaining columns further requires equity holdings in at least two consecutive annual KURU snapshots. The equity-market participation equation is similar to equation (1), as described in Section V.A., augmented with the interaction terms, with the Inverse Mills Ratio calculated as $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$. Portfolio risk and portfolio performance dependent variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Dependent Variables:	(1) *Participate* (Linear Probability Model)	(2) *Total Risk* (%/month)	(3) *Idiosyncratic Risk* (%/month)	(4) *Sharpe Ratio* (× 100)	(5) *Alpha* (bp/month)
Second	-0.015**	0.244***	0.233***	-0.987***	-3.7***
Third	-0.048***	0.313**	0.259**	-1.246*	-5.1
Fourth^{+}	-0.054**	0.674**	0.564**	-2.081	-5.8
Mentor	0.012	0.137	0.087	0.653	1.6
Mentor × Second	**-0.010**	**-0.049**	**-0.025**	**0.338**	**1.1**
Mentor × Third	**0.007**	**0.114**	**0.242**	**0.084**	**0.6**
Mentor × Fourth^{+}	**0.028**	**-0.462**	**-0.178**	**-0.279**	**10.8**
Mentee × Second	**0.008**	**0.095**	**0.039**	**0.831***	**3.2**
Mentee × Third	**0.017**	**0.193**	**0.199**	**0.575**	**2.0**
Mentee × Fourth^{+}	**0.007**	**-0.278**	**-0.121**	**-0.445**	**1.0**
Controls	Yes	Yes	Yes	Yes	Yes
Birth-Year × Region Fixed Effects	Yes	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes	Yes

Appendix

Table A1: Variable Definitions

Variable	Definition
Dependent Variables	
Participate	Set to 1 if individual *i* participated in equity markets by holding at least 5,000 SEK in equities or shares of equity mutual funds in at least one annual KURU snapshot during the 1999-2007 period and set to 0 otherwise.
Total Risk (%/month)	Standard deviation of participating individual *i*'s portfolio monthly returns (minimum 24 months).
Idiosyncratic Risk (%/month)	Standard deviation of participating individual *i*'s portfolio monthly idiosyncratic returns (minimum 24 months). Adjusted for a six-factor model encapsulating three standard Fama-French factors for Sweden and three standard Fama-French factors for the world portfolio.
Sharpe Ratio (× 100)	Ratio of individual *i*'s average monthly excess portfolio returns and standard deviation of monthly portfolio returns (minimum 24 months), scaled by 100 for readability.
Alpha (bp/month)	Risk-adjusted return of participating individual *i*'s portfolio monthly returns (minimum 24 months). Adjusted for a six-factor model encapsulating three standard Fama-French factors for Sweden and three standard Fama-French factors for the world portfolio.
Independent Variables	
Birth Order	
Second	Set to 1 if individual *i* is second-born and set to 0 otherwise.
Third	Set to 1 if individual *i* is third-born and set to 0 otherwise.
Fourth^{+}	Set to 1 if individual *i* is fourth- or later-born and set to 0 otherwise.
Gender	
Male	Set to 1 if individual *i* is male and set to 0 otherwise.
Childhood Family Environment	
Parental Resources	
Adults/Children	Average annual number of adults per child present in the household over the course of individual *i*'s childhood.
Parental Age	Household adults' average age at the time of individual *i*'s birth.
Socio-Economic Resources	
Family Income	Average annual household income per capita percentile over the course of individual *i*'s childhood.
Family Unemployment	Fraction of individual *i*'s childhood years in which there was unemployment among the household adults.
Adult Human Capital Resources	
Family Education	Average annual household adult educational level over the course of individual *i*'s childhood.
Family Participation	Fraction of individual *i*'s childhood years in which household adults have been invested in equity markets.
Sibling Resources	
Mentor	Set to 1 if age gap between individual *i* and any of the younger siblings is at least three years and set to 0 otherwise.
Mentee	Set to 1 if the age gap between individual *i* and any of the older siblings is at least three years and set to 0 otherwise.
Local Area Participation	Average over the period from 1999 to 2007 of the annual equity-market participation rate among all other LINDA individuals in *i*'s immediate vicinity (at the postal-code level).

Table A2: Firstborn Advantage

This table presents complementary specifications that replace the birth-order indicators *Second*, *Third*, and *Fourth+* with *Firstborn*, defined as *Firstborn* = 1 - *Second* - *Third* - *Fourth+*. Panel A reports baseline firstborn-premium estimates. Panel B interacts *Firstborn* with *Male*; Panels C through H interact *Firstborn* with *Adults/Children*, *Parental Age*, *Family Income*, *Family Unemployment*, *Family Education*, and *Family Participation*, respectively. The participation specification follows the family-fixed-effects linear probability model in Table 3, column 4, augmented as indicated. The portfolio-risk and portfolio-performance specifications follow equation (2), augmented as indicated. The equity-market participation equation from Table 3 column 1 serves as the selection equation, with the Inverse Mills Ratio calculated as $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$. Portfolio-risk and portfolio-performance dependent variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family and omitted for brevity. All specifications include the baseline controls, birth-year × region fixed effects, and family fixed effects. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Dependent Variables:	(1) *Participate* (Linear Probability Model)	(2) *Total Risk* (%/month)	(3) *Idiosyncratic Risk* (%/month)	(4) *Sharpe Ratio* (× 100)	(5) *Alpha* (bp/month)
Panel A: Firstborn Premium					
Firstborn	0.013**	-0.188***	-0.177***	0.614**	2.7**
Panel B: Firstborn Premium by *Male*					
Firstborn	0.009	-0.194***	-0.180***	0.677**	0.6
Male	0.026***	1.483***	1.306***	1.510***	0.7
Male × Firstborn	0.010	0.011	0.006	-0.120	4.1***
Panel C: Firstborn Premium by *Adults/Children*					
Firstborn	0.045***	-0.210	-0.260*	2.621***	1.5
Adults/Children	-0.027	0.387**	0.302**	0.020	-2.0
Adults/Children × Firstborn	-0.033**	0.022	0.086	-2.065**	1.2

Table A2 (continued)

Dependent Variables:	(1) *Participate* (Linear Probability Model)	(2) *Total Risk* (%/month)	(3) *Idiosyncratic Risk* (%/month)	(4) *Sharpe Ratio* (× 100)	(5) *Alpha* (bp/month)
Panel D: Firstborn Premium by *Parental Age*					
Firstborn	0.054**	0.131	0.043	2.449**	3.3
Parental Age	0.008***	0.016	0.002	0.027	0.1
Parental Age × Firstborn	-0.002*	-0.012	-0.008	-0.070*	-0.0
Panel E: Firstborn Premium by *Family Income*					
Firstborn	0.028**	-0.144	-0.154*	1.500***	0.0
Family Income	-0.000	-0.004	-0.007	-0.021	-0.1
Family Income × Firstborn	-0.000	-0.001	-0.000	-0.018*	0.1
Panel F: Firstborn Premium by *Family Unemployment*					
Firstborn	0.009	-0.215***	-0.200***	0.733***	3.5***
Family Unemployment	0.026	-0.206	-0.317	-1.925	-2.4
Family Unemployment × Firstborn	0.077**	0.547*	0.470*	-2.406	-17.6***
Panel G: Firstborn Premium by *Family Education*					
Firstborn	0.012	0.123	0.052	1.423***	2.2
Family Education	-0.028*	-0.029	-0.088	-0.243	-2.3
Family Education × Firstborn	0.000	-0.092***	-0.067***	-0.238*	0.1
Panel H: Firstborn Premium by *Family Participation*					
Firstborn	0.036***	-0.245***	-0.208***	1.385***	3.5**
Family Participation	0.121***	-0.327	-0.331	0.847	11.7**
Family Participation × Firstborn	-0.060***	0.124	0.067	-1.672***	-1.9

Individuals' Equity Investment and Birth Order

Ranadeb Chaudhuri, Zoran Ivković, and Andrei Simonov

Supplementary Materials

(Internet Appendix)

Internet Appendix IA1: Within-Family Distributions

Table IA1.1
Within-Family Summary Statistics for Independent Variables in Full and Participant Samples

Table IA1.1 reports within-family summary statistics for all continuous independent variables used in the main regressions. Panel A presents statistics for the full sample (corresponding to Table 1), and Panel B presents statistics for the equity-market participant subsample (corresponding to Table 2). Within-family values are defined as deviations from family means, consistent with the family fixed-effects specifications in the main text.

	Mean	S.D.	Min	10th	25th	Median	75th	90th	Max
Panel A: Full Sample									
Childhood Family Environment									
Parental Resources									
Adults/Children	-0.000	0.097	-0.885	-0.097	-0.028	0	0.028	0.083	1.046
Parental Age	-0.002	1.476	-15	-1.565	-0.532	0	0.500	1.588	15
Socio-Economic Resources									
Family Income	0.011	1.975	-45.040	-1.754	-0.388	0	0.318	1.748	31.296
Family Unemployment	-0.000	0.028	-0.597	-0.007	0	0	0	0.003	0.545
Adult Human Capital Resources									
Family Education	-0.000	0.072	-2	-0.035	0	0	0	0.035	2
Family Participation	0.000	0.059	-0.639	-0.068	-0.009	0	0.010	0.068	0.5
Local Area Participation	-0.000	0.028	-0.291	-0.023	0	0	0	0.024	0.242
Panel B: Participating Sample									
Childhood Family Environment									
Parental Resources									
Adults/Children	-0.001	0.098	-0.792	-0.105	-0.028	0	0.028	0.083	1.046
Parental Age	-0.001	1.401	-11.16	-1.5	-0.550	0	0.500	1.500	11.694
Socio-Economic Resources									
Family Income	0.006	1.927	-33.483	-1.778	-0.431	0	0.331	1.750	31.296
Family Unemployment	-0.000	0.026	-0.333	-0.002	0	0	0	0	0.407
Adult Human Capital Resources									
Family Education	-0.000	0.067	-2	-0.038	0	0	0	0.035	2
Family Participation	-0.000	0.059	-0.636	-0.069	-0.014	0	0.013	0.069	0.5

Internet Appendix IA2: Robustness Checks

Table IA2.1

Baseline Results With or Without Family Fixed Effects or Current Characteristics

The five panels of this table present variants of baseline results reported in Tables 3 and 4 of the main paper. In each panel, the first two columns present estimates without controls for current characteristics, whereas the last two columns present estimates with controls for current characteristics. The first of the two columns in each group of columns presents estimates without family fixed effects, whereas the second of the two columns in each group of columns presents estimates with family fixed effects. In each panel, columns highlighted in boldfaced font feature the estimates reported in Tables 3 and 4 of the main paper. Portfolio risk and portfolio performance dependent variables are winsorized at the 1st and 99th percentiles. The current characteristics, recorded in 2000, are income, wealth, employment status, and education.

Table IA2.1 (continued)

Dependent Variable: *Participate* (Linear Probability Model)	Current Characteristics: **No**		Current Characteristics: **Yes**	
	(1)	**(2)**	(3)	(4)
	Without Family Fixed Effects	**With Family Fixed Effects**	Without Family Fixed Effects	With Family Fixed Effects
Birth Order				
Second	**-0.024*****	**-0.021*****	-0.017***	-0.014**
Third	**-0.063*****	**-0.042*****	-0.044***	-0.032***
Fourth^{+}	**-0.092*****	**-0.049*****	-0.065***	-0.039**
Gender				
Male	**0.028*****	**0.029*****	0.013***	0.018***
Childhood Family Environment				
Parental Resources				
Adults/Children	**0.018*****	**-0.026**	0.008	-0.011
Parental Age	**0.005*****	**0.007*****	0.003***	0.007***
Socio-Economic Resources				
Family Income	**0.003*****	**-0.000**	0.003***	-0.001
Family Unemployment	**-0.108*****	**0.003**	-0.081***	0.001
Adult Human Capital Resources				
Family Education	**0.024*****	**-0.029***	0.021***	-0.006*
Family Participation	**0.448*****	**0.118*****	0.290***	0.059*
Sibling Resources				
Mentor	**0.008****	**0.008**	0.008***	0.008
Mentee	**-0.001**	**0.009**	0.001	0.009
Current Characteristics				
Income Percentile			0.003***	0.002***
Income Missing?			0.213***	0.141***
Unemployed?			-0.021***	-0.000
Education Above Median?			0.067***	0.031***
Education Missing?			0.017***	-0.013*
Wealth			0.005***	0.004***
Local Area Participation	**0.408*****	**0.104*****	0.275***	0.055
Birth-Year × Region Fixed Effects	**Yes**	**Yes**	Yes	Yes
N	**147,829**	**147,829**	147,829	147,829
Adjusted/Within R^2	**0.1257**	**0.0105**	0.2021	0.0555

Table IA2.1 (continued)

Dependent Variable: *Total Risk* (%/month)	Current Characteristics: **No**		Current Characteristics: **Yes**	
	(1)	**(2)**	(3)	(4)
	Without Family Fixed Effects	**With Family Fixed Effects**	Without Family Fixed Effects	With Family Fixed Effects
Birth Order				
Second	0.209***	**0.220*** **	0.217***	0.224***
Third	0.438***	**0.357*** **	0.457***	0.359***
Fourth^{+}	0.857***	**0.298**	0.884***	0.295
Gender				
Male	1.615***	**1.487*** **	1.605***	1.480***
Childhood Family Environment				
Parental Resources				
Adults/Children	-0.237***	**0.373** **	-0.229***	0.408**
Parental Age	-0.003	**0.012**	-0.006**	0.014
Socio-Economic Resources				
Family Income	0.009***	**-0.004**	0.008***	-0.006
Family Unemployment	0.344***	**-0.384**	0.372***	-0.403
Adult Human Capital Resources				
Family Education	0.079***	**-0.157**	0.071***	-0.085
Family Participation	-0.017	**-0.315**	-0.111**	-0.380
Sibling Resources				
Mentor	-0.073**	**0.126**	-0.077**	0.128
Mentee	-0.117***	**0.103**	-0.115***	0.103
Current Characteristics				
Income Percentile			0.001	0.002
Income Missing?			0.189**	0.234*
Unemployed?			-0.108***	-0.013
Education Above Median?			0.192***	0.112**
Education Missing?			0.088**	-0.109
Wealth			0.003***	0.000
Inverse Mills Ratio	-0.096***	**-0.215*** **	-0.158***	-0.242***
Birth-Year × Region Fixed Effects	Yes	**Yes**	Yes	Yes
N	93,257	**93,257**	93,257	93,257
Adjusted/Within R^2	0.0760	**0.0869**	0.0783	0.0911

Table IA2.1 (continued)

Dependent Variable: *Idiosyncratic Risk* (%/month)	Current Characteristics: **No**		Current Characteristics: **Yes**	
	(1)	**(2)**	(3)	(4)
	Without Family Fixed Effects	**With Family Fixed Effects**	Without Family Fixed Effects	With Family Fixed Effects
Birth Order				
Second	0.221***	**0.215*** **	0.226***	0.218***
Third	0.467***	**0.357*** **	0.479***	0.357***
Fourth^{+}	0.856***	**0.360** **	0.873***	0.353**
Gender				
Male	1.430***	**1.308*** **	1.426***	1.308***
Childhood Family Environment				
Parental Resources				
Adults/Children	-0.195***	**0.287** *	-0.182***	0.322**
Parental Age	-0.000	**0.020**	-0.003	0.002
Socio-Economic Resources				
Family Income	0.005***	**-0.000**	0.005***	-0.008
Family Unemployment	0.373***	**-0.467**	0.387***	-0.487
Adult Human Capital Resources				
Family Education	0.052***	**-0.179**	0.046***	-0.103
Family Participation	-0.157***	**-0.325**	-0.194***	-0.389
Sibling Resources				
Mentor	-0.073**	**0.115** *	-0.076***	0.118*
Mentee	-0.120***	**0.079**	-0.121***	0.079
Current Characteristics				
Income Percentile			-0.000	0.001
Income Missing?			0.072	0.146
Unemployed?			-0.074**	0.018
Education Above Median?			0.126***	0.104**
Education Missing?			0.106***	-0.079
Wealth			0.002***	-0.001
Inverse Mills Ratio	-0.171***	**-0.258*** **	-0.219***	-0.278***
Birth-Year × Region Fixed Effects	Yes	**Yes**	Yes	Yes
N	93,257	**93,257**	93,257	93,257
Adjusted/Within R^2	0.0851	**0.0921**	0.0874	0.0977

Table IA2.1 (continued)

Dependent Variable: *Sharpe Ratio* (× 100)	Current Characteristics: **No**		Current Characteristics: **Yes**	
	(1)	**(2)**	(3)	(4)
	Without Family Fixed Effects	**With Family Fixed Effects**	Without Family Fixed Effects	With Family Fixed Effects
Birth Order				
Second	-0.906***	**-0.951*** **	-0.852***	-0.968***
Third	-1.324***	**-1.515*** **	-1.174***	-1.513***
Fourth^{+}	-1.917***	**-3.216*** **	-1.723***	-3.205***
Gender				
Male	1.817***	**1.472*** **	1.712***	1.399***
Childhood Family Environment				
Parental Resources				
Adults/Children	-0.359	**0.150**	-0.400	0.095
Parental Age	0.072***	**-0.013**	0.053***	-0.046
Socio-Economic Resources				
Family Income	0.055***	**-0.036**	0.050***	-0.046
Family Unemployment	-1.278**	**-1.111**	-1.074**	-1.150
Adult Human Capital Resources				
Family Education	0.600***	**-0.681**	0.559***	-0.601
Family Participation	5.538***	**0.750**	4.397***	-0.020
Sibling Resources				
Mentor	-0.128	**0.679***	-0.136	0.683*
Mentee	-0.026	**0.624**	0.054	0.637
Current Characteristics				
Income Percentile			0.005	0.003
Income Missing?			0.528	0.137
Unemployed?			-0.558***	-0.505
Education Above Median?			0.711***	0.063
Education Missing?			0.252	-0.509
Wealth			0.036***	0.021***
Inverse Mills Ratio	0.300***	**0.134**	0.010	-0.021
Birth-Year × Region Fixed Effects	Yes	**Yes**	Yes	Yes
N	93,257	**93,257**	93,257	93,257
Adjusted/Within R^2	0.0270	**0.0184**	0.0309	0.0199

Table IA2.1 (continued)

Dependent Variable:	Current Characteristics: **No**		Current Characteristics: **Yes**	
	(1)	**(2)**	(3)	(4)
Alpha (bp/month)	Without Family Fixed Effects	**With Family Fixed Effects**	Without Family Fixed Effects	With Family Fixed Effects
Birth Order				
Second	-3.3***	**-3.2***	-3.1***	-3.2***
Third	-5.2***	**-5.6****	-4.8***	-5.4**
Fourth^{+}	-10.6***	**-6.5***	-10.0***	-6.1
Gender				
Male	1.5**	**2.2***	1.2***	1.9**
Childhood Family Environment				
Parental Resources				
Adults/Children	-2.0**	**-1.6**	-2.2**	-2.0
Parental Age	0.3***	**0.0**	0.2***	-0.0
Socio-Economic Resources				
Family Income	0.2***	**-0.1**	0.2***	-0.1
Family Unemployment	-6.0***	**3.6**	-5.5***	0.9
Adult Human Capital Resources				
Family Education	2.1***	**-2.1**	2.0***	-2.7
Family Participation	23.6***	**11.5****	20.0***	10.9*
Sibling Resources				
Mentor	0.2	**1.2**	0.2	1.1
Mentee	0.4	**1.4**	0.4	1.4
Current Characteristics				
Income Percentile			0.0	0.0
Income Missing?			0.9	0.8
Unemployed?			-0.4	-2.5*
Education Above Median?			1.4***	-0.4
Education Missing?			1.0	1.2
Wealth			0.1***	0.1***
Inverse Mills Ratio	8.0***	**8.5*****	7.8***	8.3***
Birth-Year × Region Fixed Effects	Yes	**Yes**	Yes	Yes
N	93,257	**93,257**	93,257	93,257
Adjusted/Within R^2	0.0280	**0.0191**	0.0287	0.0216

Table IA2.2

Intensive Margin: Portfolio Risk and Portfolio Performance Without Inverse Mills Ratio

This table presents portfolio risk and portfolio performance birth-order gaps estimated with the inclusion of the Inverse Mills Ratio (column 1, restated from Table 4) and without the inclusion of the Inverse Mills Ratio (column 2). Dependent variables (portfolio risk and portfolio performance) are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Inverse Mills Ratio:	**Included**	**Not Included**
Total Risk **(Table 4 column 1)**		
Second	0.220***	0.213***
Third	0.357***	0.338***
Fourth^{+}	0.298	0.273
Idiosyncratic Risk **(Table 4 column 2)**		
Second	0.215***	0.207**
Third	0.357***	0.334***
Fourth^{+}	0.360**	0.329**
Sharpe Ratio **(Table 4 column 3)**		
Second	-0.951***	-0.947***
Third	-1.515***	-1.503***
Fourth^{+}	-3.216***	-3.200***
Alpha **(Table 4 column 4)**		
Second	-3.2***	-3.0**
Third	-5.6**	-4.9**
Fourth^{+}	-6.5*	-5.5

Table IA2.3

Intensive Margin: Portfolio Risk and Portfolio Performance Without Winsorization at the 1st and 99th Percentiles

Dependent variables (portfolio risk and portfolio performance) are not winsorized at the 1st and 99th percentiles. The remaining details are as in Table 4.

	Portfolio Risk		Portfolio Performance	
	(1)	(2)	(3)	(4)
Dependent Variables:	*Total Risk* (%/month)	*Idiosyncratic Risk* (%/month)	*Sharpe Ratio* (× 100)	*Alpha* (bp/month)
Birth Order				
Second	0.227***	0.223***	-0.965***	-3.4**
Third	0.364***	0.376***	-1.621**	-7.7***
Fourth+	0.317	0.378**	-3.634***	-8.4*
Gender				
Male	1.499***	1.324***	1.488***	1.8**
Childhood Family Environment				
Parental Resources				
Adults/Children	0.383**	0.289**	0.528**	0.6
Parental Age	0.015	0.002	-0.008	0.1
Socio-Economic Resources				
Family Income	-0.005	-0.008	-0.038	-0.1
Family Unemployment	-0.392	-0.466	-1.870	0.4
Adult Human Capital Resources				
Family Education	-0.140	-0.134	-0.751	-0.8
Family Participation	-0.240	-0.172	0.719	13.8**
Sibling Resources				
Mentor	0.115	0.095	0.600	1.6
Mentee	0.090	0.061	0.483	2.0
Inverse Mills Ratio	-0.209**	-0.260***	0.088	8.6***
Birth-Year × Region Fixed Effects	Yes	Yes	Yes	Yes
Family Fixed Effects	Yes	Yes	Yes	Yes
N	93,257	93,257	93,257	93,257
Within R^2	0.0898	0.0965	0.0183	0.0213

Table IA2.4

Birth-Order Gaps in Equity Investment:
Moderation by Childhood Parental, Socio-Economic, and Adult Human Capital Resources

This table presents the results of relating equity market participation outcomes (Panel A), portfolio risk outcomes (Panel B), and portfolio performance outcomes (Panel C) to birth order variables and the interactions of birth order variables with several variables capturing parental, socio-economic, and adult human capital resources. In all the interactions in this table, the moderating variables M^f, have been calculated as family averages across all family siblings. Panel A specification implements the linear probability version of equation (1) with family fixed effects, as described in Section V.A, augmented with these interactions. The sample for Panel A consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980. Panel B and C specifications implement equation (2), as described in Section V.A, augmented with these interactions. The sample for Panels B and C consists of Swedish LINDA individuals from sibships of size at least two, with complete family histories, born in the period from 1970 to 1980, who featured equity holdings in at least two consecutive annual KURU snapshots. The equity-market participation equation pertaining to Panels B and C implements the probit version of equation (1), as described in Section V.A., augmented with the interaction terms, with the Inverse Mills Ratio calculated as $\lambda_i = \phi(Z_i\hat{\gamma})/\Phi(Z_i\hat{\gamma})$. Dependent Panel B and C variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

Resource Moderator *M*	*Second*	*Third*	*Fourth*$^{+}$	*M*	$M^f \times$ ***Second***	$M^f \times$ ***Third***	$M^f \times$ ***Fourth***$^{+}$
Panel A: Equity Market Participation							
Adults/Children	-0.048**	-0.112***	-0.112**	-0.043**	**0.031***	**0.089*****	**0.090**
Parental Age	-0.058**	-0.164***	-0.134*	0.008***	**0.001***	**0.005*****	**0.003**
Family Income	-0.033**	-0.053***	-0.046	-0.000	**0.000**	**0.000**	**-0.000**
Family Unemployment	-0.016**	-0.032***	-0.038**	0.065	**-0.068****	**-0.127****	**-0.149***
Family Education	-0.020*	-0.030	-0.040	-0.031*	**-0.000**	**-0.004**	**-0.001**
Family Participation	-0.043***	-0.077***	-0.085***	0.093*	**0.056*****	**0.110*****	**0.107*****

Table IA2.4 (continued)

Resource Moderator *M*	*Second*	*Third*	*Fourth*$^{+}$	*M*	***M* × *Second***	***M* × *Third***	***M* × *Fourth*$^{+}$**
Panel B: Portfolio Risk							
			Total Risk				
Adults/Children	0.223	-0.002	-0.301	0.249	**0.007**	**0.448**	**0.823**
Parental Age	-0.009	0.183	-0.433	-0.001	**0.008**	**0.007**	**0.028**
Family Income	0.180*	0.250	0.145	-0.006	**0.001**	**0.003**	**0.006**
Family Unemployment	0.251***	0.392***	0.244	-0.094	**-0.563***	**-0.608**	**0.674**
Family Education	-0.076	-0.110	-0.663	-0.024	**0.086*****	**0.136*****	**0.290*****
Family Participation	0.285***	0.376**	-0.011	-0.345	**-0.138**	**-0.033**	**0.810***
			Idiosyncratic Risk				
Adults/Children	0.278**	0.232	-0.030	0.228	**-0.061**	**0.156**	**0.522**
Parental Age	-0.086	-0.197	-1.118	0.013	**0.012**	**0.021**	**0.051**
Family Income	0.170	0.182	-0.018	-0.003	**0.001**	**0.004**	**0.008**
Family Unemployment	0.241***	0.386***	0.298	-0.242	**-0.480***	**-0.513**	**0.785**
Family Education	-0.001	0.008	-0.291	-0.083	**0.063*****	**0.101****	**0.196****
Family Participation	0.251***	0.367**	0.160	-0.344	**-0.078**	**-0.016**	**0.523**
Panel C: Portfolio Performance							
			Sharpe Ratio				
Adults/Children	-2.253***	-2.932*	-5.984*	-0.332	**1.380**	**1.841**	**3.842**
Parental Age	-2.895**	-3.040	-10.344**	-0.007	**0.073***	**0.059**	**0.252**
Family Income	-1.660***	-2.837***	-5.742***	-0.028	**0.014**	**0.031**	**0.066**
Family Unemployment	-1.079***	-1.740***	-3.334***	-3.029	**2.200**	**3.681**	**2.077**
Family Education	-1.694***	-3.704***	-6.213***	-0.234	**0.215***	**0.648****	**0.903***
Family Participation	-1.713***	-2.439***	-5.670***	-0.075	**1.581*****	**2.087****	**6.143*****
			Alpha				
Adults/Children	0.1	-4.5	-2.5	-1.1	**-3.4**	**-1.6**	**-5.4**
Parental Age	-4.3	-5.0	-8.2	0.1	**-0.0**	**-0.0**	**0.1**
Family Income	0.2	-6.2	-10.6	-0.1	**-0.1***	**0.0**	**0.1**
Family Unemployment	-4.2***	-7.1***	-8.1**	-11.0	**16.7*****	**24.3****	**24.9**
Family Education	-2.7	-5.6	-10.4	-2.2	**-0.2**	**0.0**	**1.2**
Family Participation	-3.7	-8.9***	-10.0*	9.7	**1.0**	**7***	**8.5**

Table IA2.5

Auxiliary Specifications with Post-Treatment Outcomes and Nonlinear Controls

Panel A presents equity-market participation, portfolio risk, and portfolio performance birth-order gaps based on linear continuous controls, restated from Tables 3 and 4 in its first column, augmented with current controls available for all observations (education, current income, current unemployment, current wealth) in its second column, and further augmented with IQ scores, available only for male individuals from our sample, in its third column. Panel B features the birth-order gaps based on nonlinear continuous controls. We calculate each nonlinear continuous control in the spirit of Knüpfer, Rantapuska, and Sarvimäki (2017), as described in Section VIII.B. Portfolio risk and portfolio performance dependent variables are winsorized at the 1st and 99th percentiles. Standard errors are clustered by family; they are omitted from the table for brevity. ***, **, and * denote statistical significance at 1%, 5%, and 10% levels, respectively.

	Panel A: Linear Controls			**Panel B: Nonlinear Controls**
Specifications	**Baseline**	**Baseline + Current Controls**	**Baseline + Current Controls + IQ (men only)**	**Baseline + Nonlinear Continuous Controls**
		Participate **(Table 3 column 4)**		
Second	-0.021***	-0.014**	-0.021*	-0.022***
Third	-0.042***	-0.032***	-0.047**	-0.043***
Fourth+	-0.049***	-0.039**	-0.082**	-0.049***
		Total Risk **(Table 4 column 1)**		
Second	0.220***	0.224***	0.493***	0.225***
Third	0.357***	0.359***	0.633**	0.372***
Fourth+	0.298	0.295	0.740*	0.320
		Idiosyncratic Risk **(Table 4 column 2)**		
Second	0.215***	0.218***	0.446***	0.216***
Third	0.357***	0.357***	0.602***	0.372***
Fourth+	0.360**	0.353**	0.774**	0.385**
		Sharpe Ratio **(Table 4 column 3)**		
Second	-0.951***	-0.968***	-1.416**	-0.963***
Third	-1.515***	-1.513***	-2.217**	-1.356**
Fourth+	-3.216***	-3.205***	-3.344*	-3.026***
		Alpha **(Table 4 column 4)**		
Second	-3.2***	-3.2***	-6.6**	-3.5***
Third	-5.6**	-5.4**	-10.1*	-6.3***
Fourth+	-6.5*	-6.1	-10.5	-6.9*

Internet Appendix IA3:
Collapsing Birth-Order Indicators into *Laterborn*

The key insight this note delivers is that the "flattened" regression coefficient associated with *Laterborn*, the complement of the *Firstborn* indicator reported in Appendix Table A2, need not correspond to the frequency-weighted average of "granular" birth-order coefficients (as reported in the main body of the paper).

Granular versus Flattened

Let $D_i = (Second_i, Third_i, Fourth_i^+)$ so that $D = [Second \quad Third \quad Fourth^+]$ denotes the three-column matrix containing *Second*, *Third*, and *Fourth+* for all observations.

In the unrestricted (granular) model,

$$Y = D\beta + X\gamma + \varepsilon,$$

X contains the other, non-BO controls (gender, childhood variables) and fixed effects (family, birth-year × region).

In the restricted (flattened) model, let

$$\mathbf{\iota} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

so that $L = D\mathbf{\iota} = Second + Third + Fourth^+ = LaterBorn$ replaces the three columns of D.

(Also, mechanically, $Firstborn_i = 1 - LaterBorn_i$)

The restricted (flattened) model is then

$$Y = Lb_L + X\gamma_L + u.$$

Define M_X, the residual-maker matrix associated with X. Formally, when X has full column rank,

$$M_X = I - X(X'X)^{-1}X'.$$

Here, the matrix $P_X = X(X'X)^{-1}X'$ projects a variable onto the space explained by X. Therefore,

$$M_X = I - P_X$$

removes the part explained by X.

For any variable Z, $M_X Z$ is the vector of residuals from regressing Z on all the variables in X.

Therefore, $M_X Y$ is the outcome after removing the effects of family fixed effects, birth-year × region fixed effects, controls, and so forth.

Also, $M_X D$ is the set of birth-order indicators after removing their associations with those same variables.

In sum, M_X residualizes variables with respect to all other regressors (other than BO variables in our instance) and fixed effects used in the model.

Applying the residual-maker M_X to the **unrestricted (granular) regression**

$$Y = D\beta + X\gamma + \varepsilon$$

removes everything explained by X.

Specifically, because $M_X X = 0$, the terms involving the controls disappear:

$$M_X Y = M_X D\beta + M_X X\gamma + M_X \varepsilon = M_X D\beta + M_X \varepsilon$$

The flexible OLS regression chooses $\widehat{\boldsymbol{\beta}}$, in our instance

$$\widehat{\boldsymbol{\beta}} = \begin{bmatrix} \hat{\beta}_{Second} \\ \hat{\beta}_{Thir} \\ \hat{\beta}_{\text{Fourth+}} \end{bmatrix}.$$

The residualized regression residual is orthogonal to every column of D. Its first-order condition is:

$$0 = (M_X D)'(M_X Y - M_X D\widehat{\boldsymbol{\beta}}).$$

The residual-maker M_X is symmetric and idempotent:

$$M_X' = M_X \text{ and } M_X M_X = M_X.$$

Therefore, this first-order condition expands to:

$$0 = D'M_X Y - D'M_X D\widehat{\boldsymbol{\beta}}$$

Rearranging yields the OLS normal equation identity:

$$D'M_X Y = D'M_X D\widehat{\boldsymbol{\beta}}$$

It follows that

$$\widehat{\boldsymbol{\beta}} = (D'M_X D)^{-1} D'M_X Y.$$

Intuitively, $D'M_X Y$ contains the residualized cross-products of the detailed birth-order indicators with the outcome. OLS makes those same cross-products equal to the cross-products generated by the fitted birth-order component $M_X D\widehat{\boldsymbol{\beta}}$ (because the remaining regression residual is orthogonal to every column of D).

Starting from the **restricted (flattened) regression**:

$$Y = Lb_L + X\gamma_L + u$$

analogous steps yield

$$\hat{b}_L = (L'M_X L)^{-1} L'M_X Y$$

In our instance, because the denominator is a scalar, the expression can be simplified:

$$\hat{b}_L = \frac{L'M_X Y}{L'M_X L}$$

Connection between $\widehat{b}_L$ and $\widehat{\boldsymbol{\beta}}$

There is a strong connection between the expression for $\hat{b}_L$ (the restricted coefficient, a scalar) and the expression for $\widehat{\boldsymbol{\beta}}$ (the unrestricted, 3 × 1 vector).

Take the flattened coefficient, $\hat{b}_L = (L'M_X L)^{-1}L'M_X Y$, and substitute the pooled indicator definition:

$$\hat{b}_L = [(D\boldsymbol{\iota})'M_X(D\boldsymbol{\iota})]^{-1}(D\boldsymbol{\iota})'M_X Y$$

Use the transpose rule for a matrix product to simplify:

$$\hat{b}_L = [\boldsymbol{\iota}'D'M_X D\boldsymbol{\iota}]^{-1}\boldsymbol{\iota}'D'M_X Y\ .$$

One of the preceding steps in deriving the granular coefficient expression is $D'M_X Y = D'M_X D\widehat{\boldsymbol{\beta}}$.

Substituting it into the above expression yields

$$\begin{aligned}\hat{b}_L &= [\boldsymbol{\iota}'D'M_X D\boldsymbol{\iota}]^{-1}\boldsymbol{\iota}'D'M_X D\widehat{\boldsymbol{\beta}} \\ &= \frac{\boldsymbol{\iota}'D'M_X D}{\boldsymbol{\iota}'D'M_X D\boldsymbol{\iota}}\widehat{\boldsymbol{\beta}} \\ &= w'\widehat{\boldsymbol{\beta}}\ ,\end{aligned}$$

showing that the pooled *Laterborn* coefficient is algebraically related to the three unrestricted coefficients:

$$w' = \frac{\boldsymbol{\iota}'D'M_X D}{\boldsymbol{\iota}'D'M_X D\boldsymbol{\iota}}, \quad w'\boldsymbol{\iota} = 1.$$

The weights sum to one, but they are based on the **residualized birth-order indicators**, not on the raw proportions of second-, third-, and fourth+-born individuals.

(The corresponding *Firstborn* coefficient is $-\hat{b}_L$).

In a nutshell, birth-order effects are residualized against numerous covariates, including any number of childhood controls, (thousands of) family fixed effects, and birth-year × region fixed effects, so the residualized regression weights need not be proportional to raw category frequencies.

That is, the weights w' need not be the unconditional frequencies of *Second*, *Third*, and *Fourth+*.

In fact, individual weights can be negative, so the pooled coefficient need not even lie inside the range of the unrestricted coefficients.

Simple numerical example

In this example, X is *Family Income*, measured in units of 10 percentile points, and Y is an outcome expressed in percentage-point units. There are two families, each with three children. Therefore, both specifications below—granular and flattened—include the same family fixed effects.

Family	**Birth rank**	X **(Family Income)**	Y **(Outcome)**	*Laterborn*	$\tilde{X}$	$\widetilde{LaterBorn}$	$\tilde{Y}$
A	Firstborn	6	60	0	5/3	-2/3	10/3
A	Second	4	56	1	-1/3	1/3	-2/3
A	Third	3	54	1	-4/3	1/3	-8/3
B	Firstborn	7	70	0	1	-2/3	8/3
B	Second	6	67	1	0	1/3	-1/3
B	Third	5	65	1	-1	1/3	-7/3

Granular specification

Estimate

$$Y_{if} = \alpha_f + \theta X_{if} + \beta_2 Second_{if} + \beta_3 Third_{if} + \varepsilon_{if}.$$

The data from the first four columns fit this model exactly with

$$\hat{\alpha}_A = 54, \quad \hat{\alpha}_B = 63, \ \hat{\theta} = 1, \quad \hat{\beta}_2 = -2, \quad \hat{\beta}_3 = -3 \ :$$

Family A

$$\begin{aligned} Firstborn &: 54 + 1(6) = 60, \\ Second &: 54 + 1(4) - 2 = 56, \\ Third &: 54 + 1(3) - 3 = 54. \end{aligned}$$

Family B

$$\begin{aligned} Firstborn &: 63 + 1(7) = 70, \\ Second &: 63 + 1(6) - 2 = 67, \\ Third &: 63 + 1(5) - 3 = 65. \end{aligned}$$

The family fixed effects absorb the different family levels. After controlling for *Family Income*, the estimated *Second* and *Third* gaps are exactly

$$\boxed{\hat{\beta}_2 = -2, \qquad \hat{\beta}_3 = -3.}$$

Flattened specification

Replace *Second* and *Third* with *Laterborn* = *Second* + *Third* and estimate

$$Y_{if} = \alpha_f^{\star} + \theta^{\star} X_{if} + \delta Laterborn_{if} + u_{if}.$$

The same family fixed effects and the same *Family Income* control remain in the model. The only change is the restriction that *Second* and *Third* must now have one common coefficient.

Demeaning within each family removes family fixed effects; the values appear in the last three columns of the table.

The relevant cross-products are

$$\sum \tilde{X}^2 = \frac{20}{3}, \qquad \sum \tilde{X}\widetilde{LaterBorn} = -\frac{8}{3}, \sum \widetilde{LaterBorn}^2 = \frac{4}{3}, \sum \tilde{X}\tilde{Y} = \frac{43}{3}, \qquad \sum \widetilde{LaterBorn}\tilde{Y} = -6.$$

Therefore, the OLS normal equations are

$$\frac{20}{3}\theta^\star - \frac{8}{3}\delta = \frac{43}{3},$$

and

$$-\frac{8}{3}\theta^\star + \frac{4}{3}\delta = -6.$$

Solutions are

$$\boxed{\hat{\theta}^\star = \frac{7}{4} = 1.75, \qquad \hat{\delta} = -1.}$$

Thus:

Granular BO coefficients: -2, -3; Flattened *Laterborn* coefficient: -1
(the corresponding *Firstborn* coefficient is +1).

Because the example contains two second-born and two third-born observations, the population-frequency weights among later-born siblings are plainly

$$\left(\frac{1}{2}, \frac{1}{2}\right).$$

Those weights would imply $\frac{1}{2}(-2) + \frac{1}{2}(-3) = -2.5$, not -1.

The flattened weights to be applied to granular coefficients (details below) are $w_2 = 2,\ w_3 = -1$.

The weights sum to one, but they are not the raw 50–50 frequencies. One is negative because the weights arise after partialling out *Family Income* and the family fixed effects.

Consequently, $\hat{\delta} = 2(-2) - 1(-3) = -1$.

Therefore, the flattened coefficient not only is different from the value of -2.5 implied by the sample-frequency weights but is also outside of the [-3, -2] interval altogether.

Calculating the flattened weights

Calculating the regression weights in the flattened case rests upon

$$w' = \frac{\iota' D' M_X D}{\iota' D' M_X D \iota}.$$

For these six observations, after removing *Family Income* and the family fixed effects, a few steps yield

$$D'M_X D = \begin{bmatrix} 79/60 & -47/60 \\ -47/60 & 31/60 \end{bmatrix}.$$

Then

$$\iota' D'M_X D = [1 \quad 1]\begin{bmatrix} 79/60 & -47/60 \\ -47/60 & 31/60 \end{bmatrix} = [8/15 \quad -4/15].$$

The denominator is

$$\iota' D'M_X D\iota = \frac{8}{15} - \frac{4}{15} = \frac{4}{15}.$$

Therefore,

$$w' = \frac{[8/15 \quad -4/15]}{4/15} = \boxed{[2 \quad -1]}.$$

Example from the reported Tables

This example reconciles the flattened 0.013 *Firstborn* coefficient from the linear probability equity-participation estimation with family fixed effects (Appendix Table A2, Panel A) with the granular -0.021, -0.042, and -0.049 birth-order coefficients from the linear probability equity-participation estimation with family fixed effects (Table 3, column 4).

Mechanically, the 0.013 *Firstborn* coefficient translates into the -0.013 *Laterborn* coefficient.

The table below summarizes the steps that calculate the flattened weights:

(1)	(2)	(3)	(4)
Birth-order indicator	Granular coefficient (Table 3, column 4)	Flattened weights	Weighted contribution (2) * (3)
Second	**-0.021**	1.2976	-0.02680
Third	**-0.042**	-0.1822	0.00760
Fourth$^+$	**-0.049**	-0.1154	0.00571
		(Total = 1.0000)	(Sum = **-0.01349**)

Using estimates reported to greater precision yields:

$\hat{b}_L$ = 1.2975957(-0.0206504) - 0.1822230(-0.0417029) - 0.1153727(-0.0494652) = -0.0134898

Therefore, these calculations reproduce the negative of the regression coefficient from Appendix Table A2, Panel A, obtained by directly estimating the flattened regression.

This is a revealing example because granular coefficients lie in the interval [-0.049, -0.021], whereas the flattened coefficient, -0.013, lies outside the interval (and is closer to zero than any of the granular coefficients).

This example solidifies the central intuition behind this methodology because any sample-share-weighted average $s_2\hat{\beta}_2 + s_3\hat{\beta}_3 + s_{4+}\hat{\beta}_{4+}$, where $s_j \geq 0,\ s_2 + s_3 + s_{4+} = 1$, constitutes a convex combination of the granular coefficients and, as such, must lie between the minimum and maximum granular coefficients.

Sources

The outlined residualization approach that reconciles granular and flattened weights rests on the Frisch–Waugh–Lovell theorem. The canonical references are the original Frisch and Waugh (1933) and Lovell (1963) papers, and standard econometrics texts such as Davidson and MacKinnon (2004) and Greene (2018).

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Lovell, M. C. "Seasonal Adjustment of Economic Time Series and Multiple Regression Analysis." *Journal of the American Statistical Association*, 58(1963), 993–1010.