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# Birth Order and Executive Risk-Taking: A Study on CEO Behavioral Disposition

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**Abstract**

This paper explores the potential influence of chief executive officers' (CEOs') birth order on corporate decision-making. Drawing upon both theoretical frameworks and existing empirical studies, birth order considerably impacts individual personality attributes and risk aversion tendencies. Our analyses reveal a pronounced positive association between CEO's birth order and their propensity for risk-taking. Specifically, CEOs born later in their familial succession are more inclined to risk-taking than their first-born counterparts, who are more conservative. These findings persist after controlling for CEO characteristics, year, and industry-specific factors. Moreover, further analyses were conducted to mitigate potential selection biases in companies choosing CEOs with specific risk preferences.

**Keywords:** risk preference, birth order, risk aversion, chief executive officers

## 1. Introduction

As former CEO of Citicorp John Reed once said, "In the old days, I would have said it was capital, history, the name of the bank. Garbage—it is about the guy at the top. I am very much a process person, a builder." Empirical studies have shown that various CEO personality traits and characteristics can affect their decision-making process within the firm. CEOs are often perceived as having their own "styles" when making investment, financing, and other strategic decisions, imprinting their marks on the firms they manage (Bertrand & Schoar, 2003). Extensive literature has explored heterogeneity in corporate practices left unexplained after controlling for firm, industry and market-level factors (Titman & Wessels, 1988; Smith & Watts, 1992), in contrast to the simple neoclassical assumption that CEOs are selfless agents. For example, Aabo and Eriksen (2018) provide evidence that corporate risk-taking is significantly related to CEO narcissism. Empirical studies on emerging markets also find that CEOs' risk-taking preferences are related to risk-management implementation and internal audit quality (Mat Ludin, Mohamed, & Mohd-Saleh, 2017). This paper adds to the established literature by further supporting the view that manager-specific characteristics are critical for a wide range of corporate finance topics, including acquisition decisions, dividend policy and capital expenditures.

Birth order, which captures early-life experiences within the family domain, is one of the most fundamental determinants of individual behaviour (Campbell, Jeong, & Graffin, 2019). When engaging in sibling rivalry, siblings use different behaviours to increase their parents' investment in their welfare. Specifically, siblings use different behaviours and adopt different strategies to get additional parental resources (Plomin & Daniels, 1987; Wang, Kruger, & Wilke, 2009; Campbell et al., 2019). We could expect that most first-born children will have most of the resources from their parents, thus adopting relatively conservative strategies to preserve their existing position. However, later-born children have no choice but to take on some risks to get scarce resources (Hertwig, Davis, & Sulloway, 2002). Family science literature also suggests that such early life experiences tend to have long-lasting and remarkable influence on one's personality formation (Sulloway, 1995). This study investigates whether the firm's risk profile is systematically associated with the CEO's birth order. The paper contributes to the literature by taking birth order theory into the corporate setting and shows the applicability of general family science theory on corporate finance topics.

The dataset used in this paper is a unique sample of Chinese firms listed on US stock exchanges. One motivation to use this group is data availability. Many CEOs in the sample are the firm's founders and have been CEOs for over a decade. Media coverage of these individuals and their significant influence on firm policies makes the data collection process possible. It suggests that they have had considerable influence on firm decisions over

time. Data on CEO birth order is manually collected from Google searches and CEO biographies. In contrast, much less information is available on the US public firm CEOs. Adopting the same data collection method of searching through Google, Ancestry.com and CEO biographies, we can only get helpful birth order information on about 30 observations out of Fortune 500 CEOs. Moreover, the general terms such as "brother" and "sister" used in the biographies make it even harder to identify if it is a younger or older sibling of the CEO.

This dataset is able to document risk-related behaviours, such as R&D expenditure, capital expenditure and acquisition transactions. By using CEO-firm-year panel data, this study finds that CEO birth order is positively associated with an aggregate risk measure (logged sum of R&D expenditure, capital expenditure and acquisition expense) after controlling for family size (number of siblings), age, CEO political connections, financial leverage (measured by debt to assets ratio), firm size and industry. Additional control variables such as return on assets and Tobin's Q account for firm performance, as literature suggests an association between risk-taking and firm performance (Walls & Dyer, 1996; Rossi, 2016). The results show that CEO birth order is empirically important for corporate risk-taking, suggesting that first-born CEOs are, on average, more conservative. In contrast, later-born CEOs are likely to adopt more aggressive strategies. Additional results show that CEOs with longer tenure tend to take on more risks than CEOs who serve a shorter tenure, and later-born CEOs with longer tenure are even more aggressive on risky expenditures.

The paper is organized as follows: introduction, literature review, methodology, results and conclusion. The rest of this paper will be in such order: Section 2 reviews the literature and develops the hypothesis. Section 3 discusses the methodology and empirical strategy. Section 4 shows empirical results and develops robustness and validation tests. Section 5 concludes with a discussion of the implications and limitations of this paper.

## 2. Literature Review

### *2.1 Heterogeneous Effects of CEO Characteristics on Corporate Decisions*

The finance and economics literature has evolved from neoclassical models assuming homogeneous agents to agency models where managers consider their interests when making corporate decisions (Bertrand & Schoar, 2003). Under a neoclassical model, managers serve as substitutes for one another. This narrow assumption suggests that managers do not matter in corporate decisions since these decisions are too big to be influenced by a single individual. Therefore, none of the managers' personalities, risk preferences or abilities should, at least directly, translate into firm decisions.

Contrarily, agency models show that managers have the power to influence corporate decisions. Instead of being selfless agents, they may act in their interests rather than creating value for shareholders. Many scholars have argued that a CEO's personality influences a firm's success (Miller & Toulouse, 1985). Hambrick and Mason (1984) theorize that CEO characteristics matter for the performance of firms because executives' cognitive base and values influence their decisions taken on behalf of the firm they manage. CEO's education, ability, skills and values are therefore determinative in the decision-making process (Hambrick, 2007). In agency models, heterogeneity among managers is allowed in terms of risk preference, abilities, choices and other traits. An extension of the standard agency model allows managers to imprint idiosyncratic traits on the firms they manage.

There is also substantial literature that addresses the relationship between various characteristics of CEOs and corporate behaviour. Shefrin (2001) shows that the CEO's sociological and physiological characteristics matter for management decisions in a case study of Sony Corporation. Byrnes, Miller and Schafer (1999) document that CEO's gender matters for risk-taking attitudes and found a systematic difference between male and female managers in risk preference. Brown & Sarma (2007) investigated the relationship between CEO's confidence and acquisitions transactions and found that overconfident and dominant CEOs are more likely to impose their views on firm decisions. Barros and Di Miceli da Silveira's (2007) investigation on CEO optimism and corporate leverage motivates this study to include the leverage ratio as one of the variables in this study. The inclusion of CEO age as a control is motivated by Bamber, Jiang and Wang's (2010) study on the age of CEOs and disclosure choice. Moreover, Li, Selover and Stein (2011) and Serfling (2014) support the argument that the age of CEOs matters for investment decisions. Chatterjee and Hambrick (2011) found heterogeneity in company strategy and performance between narcissistic chief executive officers and their non-narcissistic peers.

Another explanation of heterogeneity among CEO characteristics is that firms purposefully choose specific individuals to implement a particular strategy. For example, a firm in great need of internal reform will select an aggressive management style CEO to implement a hostile strategy. Bertrand and Schoar (2003) suggest that the distinct impact of a manager on corporate practices becomes apparent only when a firm's strategies evolve. If a firm's strategies remain unchanged, a new manager would likely follow the same approach as the previous one. The above discussion points out the limitations of studies on CEO-specific characteristics. We cannot establish

whether the CEO birth order affects corporate behaviours or whether the firm wants a specific type of CEO to implement its corporate strategies.

### *2.2 CEO Birth Order as the Main Variable of Interest*

The definition of risk in this paper follows the Chatterjee and Hambrick (2011) approach by logging the sum of three different types of risky expenditures known to have highly uncertain returns to compose a risk index. These three components are widely accepted as risk measures and are often seen as substitutes for each other. Each of the three spending categories provides a partial picture of overall risky spending. Therefore, according to Sanders and Hambrick (2007), the logged sum of all three expenditures serves well as the aggregate indicator of risk measure of firms. Birth order as the key independent variable is the main focus of this study. Sibling rivalry literature shows that siblings compete for parental resources and investment (Buss, 2007; Sulloway,1996). Humans tended to engage in sibling rivalry since, historically, many children did not survive adulthood (Buss, 2007). By engaging in sibling rivalry, siblings compete for parental investment, which may lead to resource allocation differences that historically increase the likelihood of survival (Campbell et al., 2019). The influence of early childhood rivalry extends to adulthood and later significantly affects the formation of one's personality. Evolutionary theory suggests that an individual's birth order directly relates to the tendency to engage in risky behaviours (Sulloway & Zweigenhaft, 2010). Parents invest more in earlier-born children, and these individuals have a greater tendency to "not take unnecessary chances or risks" (Grable & Joo, 2004). In contrast, later-born children tend to receive parental investment and resources (Hertwig et al., 2002). The evolutionary theory thus suggests that younger siblings are more likely to engage in risky behaviours to "recalibrate parental investment in their favour" (Sulloway & Zweigenhaft, 2010, p. 414; Campbell et al., 2019).

Drawing on the above theoretical and empirical observations, this study hypothesizes that birth order is positively related to CEO's risk-taking. Specifically, later-born CEOs are more likely to be involved in risky decisions. Presented in null form, the hypothesis is that there is no significant relationship between CEO birth order and firm risk-taking. The following sections test the hypothesis by controlling for CEO characteristics such as age, political connections, CEO tenure and family size. In addition, this study examines cross-sectional heterogeneity in risk-taking for firms with various sizes, performance levels and leverage. Robustness tests are included using alternative risk measures, different subsamples, and propensity score matches.

## 3. Methodology

### *3.1 Sample Description*

The dataset used in this study is built from all Chinese firms listed on US stock exchanges (NASDAQ, NYSE and AMEX) as ADRs (American depositary receipt) for fiscal years ending between January 1998 and December 2019, where 1998 is the first year that a Chinese firm was listed in the US. The motivation behind building the paper on this specific dataset is related to the SEC's recent warning on the risks of investing in emerging markets, particularly Chinese firms listed on US exchanges. After the shocking fraudulent charge on Luckin Coffee in 2020, Luckin's share was halted from trading after losing over 80% of its value in weeks. Interestingly, the chairman of Luckin is the youngest among his siblings. One data point is far from convincing, but this incident made it particularly interesting to investigate birth order and risk for a sample of firms that may be particularly risky and where data availability makes the discovery of birth order possible.

This CEO-firm panel data consists of 78 firms, 96 CEOs and 508 firm-years, manually collected from internet searches, media coverage and CEO biographies. Additional information such as CEO tenure, CEO sibling age gap and whether any siblings of the CEO serve as CEO in other firms are collected. Personal-level data are merged with firm-level financial data obtained from the COMPUSTAT database. Notably, many CEOs in the sample are the firm's founder and CEO. The founder-manager identity implies a longer CEO tenure on average, which mitigates the concern of CEO firm matching selection bias. A longer tenure can potentially allow CEOs to have a more significant influence on corporate decisions. At the same time, a founder makes it less likely to be subject to the bias of being purposefully selected by the firms to fit a particular risk profile.

### *3.2 Variable Description*

The variable of interest, birth order, is defined as first-born individuals being assigned a birth order of 1, second born an order of 2 and so on. The dependent variable, named risk measure, is the logged sum of expenditures on R&D, capital expenditure and acquisition transactions. The choice of this dependent variable is consistent with literature claiming that those three components are associated with risk, uncertainty and negative abnormal returns (Chatterjee & Hambrick, 2011). To test the robustness of the risk measure, these three expenditures on R&D, capital expenditure and acquisition transactions are used as dependent variables as alternative proxies for risks.

In addition to birth order, the CEO's age is included. Family size is controlled since it is believed to be positively related to sibling competition (Sulloway, 1995). CEO political connections are included to control for the substantial influence of political connections on firm acquisition decisions and firm performance. It is well known that political connections play a vital role in the Chinese corporate world. CEOs who are members of the National Committee of CPPCC or have a direct family relationship with those members are defined as "Having political connections" and thus coded "1" for a political connection indicator. CEO tenure is included to mitigate the selection bias between firms and managers. A description of the variables is included in Table 1. Firm size is defined as the natural log of yearly total assets. ROA is calculated as net income divided by total assets. Tobin's Q is the asset's market value divided by the asset's book value. A firm's financial leverage is its long-term debt plus debt in current liabilities over long-term debt plus current liabilities plus the book value of common equity. Four risk proxies are included as well. In order to stay consistent with the risk index, R&D expense is the natural log of R&D expenditure, capital expenditure is the natural log of capital expense, and acquisition transaction is the natural log of the acquisition value. The risk index, the primary risk measure in this study, is the logged sum of all three risk proxies discussed: R&D expenditure, capital expenditure and acquisition. All risk measures are winsorized at 99% and 1% to omit extremes. All firm-level variables are measured annually, and all currencies are converted to US dollars.

Table 1. Variable Definitions

| Variables | Definitions | Source | Unit |
|---|---|---|---|
| *Dependent variables* | | | |
| Risk Index | The natural logarithm of the sum of Capital expenditure, R&D expenditure and Acquisition Transactions | COMPUSTAT and author's calculations | Natural logarithm of US dollar |
| Capital Expenditure | The natural logarithm of capital expense | COMPUSTAT and author's calculations | Natural logarithm of US dollar |
| R&D expenditures | The natural logarithm of R&D expenditures | COMPUSTAT and author's calculations | Natural logarithm of US dollar |
| Acquisition Transactions | The natural logarithm of acquisition value | COMPUSTAT and author's calculations | Natural logarithm of US dollar |
| *Independent variables* | | | |
| ROA | Net income divided by total assets. | COMPUSTAT | Ratio |
| Firm size | The natural logarithm of total assets | COMPUSTAT | Natural logarithm of US dollar |
| Leverage | Long-term debt plus debt in current liabilities over long-term debt plus debt in current liabilities plus the book value of common equity. | COMPUSTAT | Ratio |
| Tobin's Q | Market value of assets divided by the book value of assets market value of assets. It is also book value of assets plus the market value of common equity less the sum of the book value of common equity and balance sheet deferred taxes | COMPUSTAT | Ratio |
| Number of Siblings | Number of siblings in the family | Media coverage, biography and Google | Number |
| Birth Order | The first born is assigned the value 1, and so on. | Media coverage, biography and Google | Number |
| Age | Age of CEO | Media coverage, biography and Google | Number |
| Political Connections | CEOs who are members of the National Committee of CPPCC or direct family relationship with those members are defined as "Have political connections" and thus coded "1" for political connection indicator. 0 otherwise. | Media coverage, biography and Google | Indicator (0 or 1) |
| Industry | "Manufacturing" if firm's sic code is between 3600 and 3812; "life science" if sic is between 3812 and 3873; "energy transportation" if sic is between 4000 and 4799; "technology" is sic is between 4800 and 5000 or between 7370 and 7374; "trade and service" if sic is between 5000 and 6000 or between 7200 and 7369 or between 7377 and 7997 or between 8111 and 8744; and "finance" if sic is between 6000 and 6411. | COMPUSTAT | Indicator 1-6<br>1- Manufacturing<br>2- Life Science<br>3- Energy & Transportation<br>4- Technology<br>5- Trade & Service<br>6- Finance |
| CEO Tenure | Length of CEO tenure. | SEC filings | Number of years |

### *3.3 Empirical Methodology*

To estimate the association between CEO birth order and their risk-taking behaviour, the risk measure variable is regressed on CEO birth order and CEO personal characteristic controls, firm-level controls, year and industry controls. Regressions are pooled across annual observations spanning both companies and time. CEO personal characteristic controls include family size, age, political connections, and interaction terms among birth order, age and CEO tenure length. Firm-level controls include firm size, leverage, and firm performance measures such as ROA and Tobin's Q. Year and industry controls are added to control for heterogeneity across time and among different industries. Industry categories are defined as "manufacturing" if a firm's SIC code is between 3600 and 3812; "life science" if SIC is between 3813 and 3873; "energy transportation" if SIC is between 4000 and 4799; "technology" if SIC is between 4800 and 5000 or between 7370 and 7374; "trade and service" if SIC is between 5000 and 6000, 7200 and 7369, 7377 and 7997, or 8111 and 8744. The industry "finance" applies to SICs between 6000 and 6411.

$$\text{Firm Risk Taking}_{i,t} = \alpha + \beta\text{CEO Birth Order}_{i,t} + \gamma_1\text{CEO level Controls}_{i,t} + \gamma_2\text{Firm Controls}_{i,t} + \gamma_3\text{Year Controls} + \gamma_4 \text{Industry Controls} + \gamma_5\text{Birth Order}_{i,t} * \text{Age}_{i,t} + \gamma_5\text{Birth Order}_{i,t} * \text{Tenure}_{i,t} + \varepsilon_{i,t} \quad (1)$$

Equation (1) outlines that firm risk-taking (measured as the risk index) in year *t* for firm *i* is a function of the birth order of the firm *i*'s CEO of year *t*; CEO level controls corresponding to company *i* at year *t*; firm level controls of year *t*; year dummies; industry controls; an interaction term between CEO's birth order and age of CEO *i* of year *t*; an interaction term between CEO's birth order and tenure of CEO *i* of year *t*; and a residual term (ε). Standard errors are clustered at the firm level, and the regressions are in ordinary least squares forms.

### *3.4 Addressing Endogeneity*

Establishing causal inference in this study is challenging even after controlling for firm and manager-level effects. The matching story between firms and CEOs is the main obstacle to the identification strategy. Whether firms purposefully want to hire later-born CEOs in the first place or later-born CEOs cause the firm to take on riskier strategies is hard to identify. The propensity score matching test is performed to match each CEO to another CEO with similar family size, age, size of firms that they manage, leverage and performance of the firms, and tenure. The pairwise comparison between the treated (first-born CEOs) and the not-treated (later-born CEOs) is limited to observations which are similar except for the treatment (birth order). In other words, the average treatment effect on the treated (ATT), which focuses explicitly on the effects on those for whom the treatment is intended, is given by equation (2):

$$\tau_{ATT} = E(\tau \mid D = 1) = E[Y(1) \mid D = 1] - E[Y(0) \mid D = 1] \quad (2)$$

The average treatment effect on treated is the difference in risk-taking between first-born CEOs (E [Y (1) |D = 1] ) and first-born CEOs if they were later-born CEOs (E [Y (0) |D = 1]). To perform the propensity score match, equation (3) is estimated with binary treatment $D$ on the left-hand-side and observables $X$ (number of siblings, age of CEO, size of firms that they manage, leverage and performance of the firms and CEO tenure) on the right-hand-side using a probit model. Then, we use the estimated coefficients to calculate the predicted probability of treatment: $\hat{p}=\gamma X$. The propensity score is the predicted conditional probability of treatment or the fitted value for each unit.

$$Prob\ (D=1|X) = \gamma X + e \quad (3)$$

Each first-born CEO is paired with one comparable later-born CEO (non-first-born CEO), where comparability is in proximity to the estimated propensity score. Associated with the treatment unit's outcome, a matched outcome is given by the weighted outcomes of its neighbours in the control group. In this study, the nearest neighbour method is adopted to match one nearest neighbour of the first-born CEO with a replacement. Finally, the average treatment effect on the treated is calculated according to equation (2).

### *3.5 Robustness Tests*

To check the robustness of the results, the main estimation of equation (1) is repeated on different dependent variables: risk index, capital expenditure, R&D expenditure and acquisition transaction as alternative proxies of risk-taking. If the results in the main regression are valid, we should expect a more significant birth order effect among later-born CEOs. Therefore, this test further partitions the entire sample into two subsamples: one with first-born CEOs and the other with later-born CEOs to explore the heterogeneity between the two groups.

## 4. Results

### *4.1 Descriptive Results*

A summary of firm-level variables in Panel B of Table 2 shows that average firms in the sample have a mean risk

index of 2.56. Log of total assets as firm size proxy has a mean of 5.04. The mean return on assets of the sample is -0.06, indicating an overall weak performance. Panel A of Table 2 presents the mean, standard deviation, and other distributional characteristics of all CEO personal characteristics, while Panel B presents firm-level variables. On average, CEOs in the sample are in their mid-40s; about 45% of CEOs have more than one sibling, 47% have political connections, and have a tenure of 10.6 years. Unreported statistics show there are only 12 observations that were born after 1980 when the "single child" policy became broadly effective in China. A mean birth year of 1970 also suggests that the single-child policy is unlikely to confound the data sample. The variable of interest, birth order, ranges from 1 to 6, with a mean of 1.49. Accordingly, the number of siblings of the CEOs ranges from 0 to 5. Interestingly, I have just about half of CEOs who have a first birth order. This observation is consistent with the common understanding that the corporate world is overrepresented by first-born CEOs (Sulloway, 1995).

Table 2. Panel A. Personal Characteristics Descriptive Statistics

| Variable | Sample | Mean | Std. | Min | 25th | 75th | Max |
|---|---|---|---|---|---|---|---|
| Age | 503 | 42.85 | 6.8 | 27 | 38 | 48 | 61 |
| CEO Tenure | 503 | 10.60 | 4.6 | 2 | 7 | 14 | 20 |
| Political Connections | 508 | 0.47 | 0.5 | 0 | 0 | 1 | 1 |
| Birth Order | 508 | 1.49 | 1.0 | 1 | 1 | 2 | 6 |
| Number of Siblings | 508 | 0.89 | 1.2 | 0 | 0 | 1 | 5 |

This table presents summary statistics of CEO characteristics with percentile statistics. Age is the CEO's age in 2019. CEOs who are members of the National Committee of CPPCC or have direct family relationships with those members are defined as "Having political connections" and thus coded "1" for the political connection indicator. The first born CEO has a birth order of 1, and so on.

Table 2. Panel B. Firm Characteristics Descriptive Statistics

| Variable | Sample | Mean | Std. | Min | 25th | 75th | Max |
|---|---|---|---|---|---|---|---|
| Firm Size | 484 | 5.04 | 1.95 | -3.36 | 3.82 | 6.52 | 10.17 |
| ROA | 482 | -0.06 | 0.35 | -3.47 | -0.11 | 0.12 | 0.48 |
| Tobin's Q | 484 | 0.63 | 0.82 | 0.00 | 0.24 | 0.67 | 7.32 |
| Financial Leverage | 482 | 0.45 | 0.33 | 0.01 | 0.25 | 0.68 | 3.50 |
| Risk Index | 479 | 2.56 | 2.03 | -3.52 | 1.00 | 4.08 | 7.79 |
| R&D Expense | 385 | 2.16 | 2.09 | 0.00 | 0.70 | 3.48 | 6.76 |
| Capital Expenditure | 476 | 14.80 | 21.70 | 0.23 | 0.76 | 18.48 | 64.89 |
| Acquisition Transactions | 474 | 2.17 | 4.34 | 0.00 | 0.00 | 1.17 | 13.23 |

This table presents summary statistics of firm-level variables. Tobin's Q is the market value of assets divided by the book value of assets. The financial leverage of a firm is its long-term debt plus debt in current liabilities over long-term debt plus debt in current liabilities plus the book value of common equity. R&D expense is the natural log of R&D expenditure (COMPUSTAT XRD), capital expenditure is the natural log of capital expense (COMPUSTAT CAPEX), and acquisition transaction is the natural log of acquisition value (COMPUSTAT AQC). The risk index, the main risk measure in this study, is the logged sum of all three risk proxies discussed: R&D expenditure, capital expenditure and acquisition.

Correlations reported in Table 3 show that the three components of the risk measure, R&D expenditure, capital expenditure and acquisition transactions, are closely correlated. This supports the claim that the measures are often seen as substitutes for each other, and each of the three spending categories contributes roughly equally to the overall risk proxy (Chatterjee & Hambrick, 2011). It is also worth noting that birth order positively correlates with all four risk proxies, suggesting a tendency for riskier behaviour among later-born CEOs.

Table 3. Correlation Matrix

| | Birth order | Age | Firm size | ROA | Tobin's Q | Leverage | Risk | R&D | Capital expenditure | Acquisition |
|---|---|---|---|---|---|---|---|---|---|---|
| Birth order | 1 | | | | | | | | | |
| Age | 0.1777 | 1 | | | | | | | | |
| Firm size | 0.1268 | 0.2449 | 1 | | | | | | | |
| ROA | 0.3543 | 0.1967 | 0.1409 | 1 | | | | | | |
| Tobin's Q | -0.1733 | 0.1194 | 0.0703 | 0.0834 | 1 | | | | | |
| Leverage | 0.0059 | -0.0422 | 0.1805 | -0.1407 | 0.1654 | 1 | | | | |
| Risk | 0.1311 | 0.302 | 0.9298 | 0.153 | 0.1108 | 0.1713 | 1 | | | |
| R&D | 0.0561 | 0.1181 | 0.8701 | 0.1388 | 0.0605 | 0.129 | 0.9085 | 1 | | |
| Capital | 0.2063 | 0.4174 | 0.8137 | 0.1927 | 0.1526 | 0.1956 | 0.8832 | 0.7223 | 1 | |
| Acquisition | 0.1776 | 0.3119 | 0.5809 | 0.1344 | 0.1356 | 0.0354 | 0.6618 | 0.4731 | 0.5104 | 1 |

This table presents the correlation matrix among variables. ROA is calculated as net income divided by total assets. Tobin's Q is the market value of assets divided by the book value of assets. The financial leverage of a firm is its long-term debt plus debt in current liabilities over long-term debt plus debt in current liabilities plus the book value of common equity. R&D expense is the natural log of R&D expenditure (COMPUSTAT XRD), capital expenditure is the natural log of capital expense (COMPUSTAT CAPEX), and acquisition transaction is the natural log of acquisition value (COMPUSTAT AQC). The risk index, the main risk measure in this study, is the logged sum of all three risk proxies discussed: R&D expenditure, capital expenditure and acquisition.

*4.2 Empirical Results*

The results of estimating equation (1) are reported in Table 4. The baseline result supports the alternative hypothesis by showing a significant positive relation between firm risk-taking and CEO birth order at a 0.01 significance level. One unit increase in birth order ranking increases the log sum of R&D, capital expense and acquisition transaction by 3.413 units. All columns in Table 4 show a consistent positive significant relationship between CEO birth order and firm risk-taking. The magnitude of the coefficient of the birth order variable is consistent with alternative estimations if the year and industry controls or some firm-level controls are dropped or different CEO-level controls are used. Family size is believed to be positively related to risk-taking (Sulloway, 1995), although no significant relationship is found in any specification in Table 4. Baseline results in Table 4 show a similar positive association between firm risk-taking and political connections to what Xu and Xiao (2014) have found. Results of Table 4 support McClelland, Barker and Oh's (2012) argument, suggesting CEOs with longer tenure are more likely to increase firm risk-taking behaviour. Table 4 results also support the argument that firm size is positively linked to firm risk-taking. No significant relationship between firm leverage and risk-taking has been found in this particular sample. No significant association has been found between Tobin's Q and firm risk-taking. However, the results in Table 4 show a negative relationship between ROA and firm risk-taking, indicating an overall weak performance among firms that take on more risks. One possible explanation is that the firms in this sample are in an emerging market. Therefore, heavy capital and R&D expenditures are made, but positive returns are not expected in the short run.

Table 4. Baseline Results of Birth Order Effects on Risk-Taking

| Variables | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| Number of Siblings | | 0.138 | 0.124 | 0.018 |
| | | (1.69) | (1.52) | (0.20) |
| Birth Order | 2.857*** | 2.885*** | 2.645** | 3.413*** |
| | (3.82) | (3.34) | (3.06) | (3.81) |
| Age | 0.066*** | 0.063** | 0.053** | 0.053** |
| | (3.89) | (3.23) | (2.67) | (2.71) |
| Political Connections | 0.276** | 0.188 | 0.186 | 0.210* |
| | (2.65) | (1.74) | (1.74) | (1.97) |
| Firm Size | 0.975*** | 0.968*** | 0.960*** | 0.945*** |
| | (32.40) | (31.71) | (31.44) | (30.74) |
| ROA | -0.963*** | -0.955*** | -0.984*** | -0.939*** |
| | (-6.27) | (-6.22) | (-6.43) | (-6.16) |
| Tobin's Q | | 0.050 | 0.081 | 0.088 |
| | | (0.85) | (1.36) | (1.48) |
| Financial Leverage | -0.031 | -0.077 | -0.130 | -0.106 |
| | (-0.20) | (-0.46) | (-0.78) | (-0.64) |
| Birth Order*Age | -0.054*** | -0.058*** | -0.053** | -0.058*** |
| | (-3.89) | (-3.58) | (-3.26) | (-3.57) |
| CEO Tenure | | | 0.030* | 0.087*** |
| | | | (2.39) | (3.78) |
| Birth*Tenure | | | | -0.037** |
| | | | | (-2.95) |
| _cons | -2.831*** | -2.657*** | -2.615** | -3.398*** |
| | (-3.69) | (-3.25) | (-3.22) | (-4.00) |
| N | 472 | 472 | 472 | 472 |
| Year Controls | Yes | Yes | Yes | Yes |
| Industry Controls | Yes | Yes | Yes | Yes |

This table reports the association between CEO birth order and firm risk-taking (the aggregate risk index) by estimating equation 1. First two columns are results of a short model:

$$\text{Firm Risk Taking}_{i,t} = \alpha + \beta \text{CEO Birth Order}_{i,t} + \gamma_1 \text{CEO level Controls}_{i,t} + \gamma_2 \text{Firm Controls}_{i,t} + \gamma_3 \text{Year Controls} + \gamma_4 \text{Industry Controls} + \gamma_5 \text{Birth Order}_{i,t} * \text{Age}_{i,t} + \varepsilon_{i,t}$$

Last two columns are results of full model:

$$\text{Firm Risk Taking}_{i,t} = \alpha + \beta\text{CEO Birth Order}_{i,t} + \gamma_1\text{CEO level Controls}_{i,t} + \gamma_2\text{Firm Controls}_{i,t} + \gamma_3\text{Year Controls} + \gamma_4 \text{Industry Controls} + \gamma_5\text{Birth Order}_{i,t} * \text{Age}_{i,t} + \gamma_5\text{Birth Order}_{i,t} * \text{Tenure}_{i,t} + \varepsilon_{i,t}$$

T-statistics are reported below the coefficients. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

*4.4 Propensity Score Matching Results*

ATT shown in Table 5 suggests that the average risk-taking (measured by the aggregate risk index) will be 3.733 units more if the first-born CEO was instead a later-born CEO. Repeating the above matching procedure on three different risk proxies (capital expenditures, R&D expenditures and transaction values) yields similar results: first-born CEOs are less likely to take on risks compared to their counterfactuals with similar number of siblings, age, size of firms that they manage, leverage, performance of the firms and CEO tenure.

Table 5. Propensity Score Matching on family size, age, firm size, tenure and education

| | Risk | R&D Expenditure | Capital Expenditure | Acquisition Transactions |
|---|---|---|---|---|
| Treated (First Born CEOs) | -0.656** | -0.351 | -1.005*** | -0.455 |
| | (-2.86) | (-1.31) | (-4.14) | (-1.60) |
| Control (Later Born CEOs) | 3.077*** | 2.438*** | 2.081*** | 1.165*** |
| | (-15.04) | (10.15) | (-9.59) | (4.87) |
| N | 474 | 380 | 471 | 179 |

Table 5 shows the result of matching CEO to another CEO with similar family size, age, size of firms that they manage, leverage and performance of the firms as well as their tenure. The results suggest average aggregate risk index for first born CEOs (the treated) is -0.656 while average risk-taking index for later born CEOs (the control) is 3.077, showing a significant difference between these two groups. Average treatment effect on the treated is obtained using equation (2): $\tau ATT = E(\tau \mid D = 1) = E[Y(1) \mid D = 1] - E[Y(0) \mid D = 1]$, suggesting a significant 3.733 difference on risk taking measure between the two groups. Repeating the above matching procedure on different risk proxies yields similar results as shown in last three columns. T-statistics are reported below the coefficients in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

*4.4 Robustness Tests Results*

In Table 6, we could see a consistent positive significant relationship between birth order and risk measure with similar coefficient magnitude among alternative dependent variables: risk, capital expenditure and R&D expenditure. Acquisition transaction as an alternative dependent variable fails to provide a significant result due to a tiny sample of acquisition observations with merely 179 reported acquisition values.

Table 6. Robustness Tests

| Variable | Risk | R&D | Capex | Acquisition |
|---|---|---|---|---|
| Number of Siblings | 0.018 | -0.026 | 0.128 | 0.187 |
| | (0.20) | (-0.30) | (1.18) | (0.83) |
| Birth Order | 3.413*** | 3.496** | 4.058*** | 0.238 |
| | (3.81) | (3.31) | (3.70) | (0.08) |
| Age | 0.053** | 0.076** | 0.0966*** | 0.011 |
| | (2.71) | (3.06) | (4.02) | (0.16) |
| Political Connections | 0.210* | 0.765*** | 0.204 | -0.421 |
| | (1.97) | (6.37) | (1.11) | (-1.23) |
| Firm Size | 0.945*** | 0.887*** | 0.943*** | 0.612*** |
| | (30.74) | (25.97) | (25.10) | (7.00) |
| ROA | -0.939*** | -0.829*** | -0.634*** | -0.523 |
| | (-6.16) | (-5.13) | (-3.41) | (-0.61) |
| Tobin's Q | 0.088 | 0.095 | -0.00549 | 0.161 |
| | (1.48) | (1.61) | (-0.07) | (1.05) |
| Financial Leverage | -0.106 | -0.0683 | 0.126 | -0.010 |
| | (-0.64) | (-0.39) | (0.62) | (-0.01) |
| Birth Order*Age | -0.058*** | -0.0708*** | -0.0709*** | 0.001 |
| | (-3.57) | (-3.56) | (-3.57) | (0.02) |
| CEO Tenure | 0.087*** | 0.114*** | 0.0381 | -0.012 |
| | (3.78) | (3.71) | (1.35) | (-0.34) |
| Birth*Tenure | -0.037** | -0.0524** | -0.0268 | 0.024 |
| | (-2.95) | (-2.69) | (-1.73) | (0.05) |
| _cons | -3.398*** | -6.319*** | -5.697*** | -2.578 |
| | (-4.00) | (-4.42) | (-5.48) | (-0.84) |
| N | 472 | 378 | 471 | 179 |
| Year Controls | Y | Y | Y | Y |
| Industry Controls | Y | Y | Y | Y |

Table 6 shows the results of the robustness check. The main estimation (equation 1) is repeated on different dependent variables by using risk index, capital expenditure, R&D expenditure and acquisition transaction as alternative proxies of risk-taking. For comparison, the baseline result is included in the first column of this table.

A first look at summary statistics in Table 7 indicates that later-born CEOs have a higher mean risk-taking index. A t-test performed in Table 7 confirms that the null hypothesis that the two subsamples have no difference is rejected. Moreover, there is sufficient evidence that the later-born group has a higher mean risk measure than the first-born group.

Table 7. Subsample Robustness Tests

*First-born CEOs*

| Variable | Obs | Mean | Std. | Min | Max |
|---|---|---|---|---|---|
| Birth order | 397 | 1 | 0 | 1 | 1 |
| Age | 397 | 48.10 | 7.17 | 33 | 62 |
| Family size | 397 | 0.42 | 0.77 | 0 | 3 |
| Firm size | 380 | 4.99 | 1.85 | -3.35 | 8.91 |
| Risk | 376 | 2.42 | 1.97 | -3.51 | 6.59 |

*Later-born CEOs*

| Variable | Obs | Mean | Std. | Min | Max |
|---|---|---|---|---|---|
| Birth order | 106 | 2.91 | 1.28 | 2 | 6 |
| Age | 106 | 52.03 | 5.25 | 41 | 72 |
| Family size | 106 | 2.33 | 1.34 | 0 | 5 |
| Firm size | 104 | 5.41 | 2.26 | -2.03 | 10.17 |
| Risk | 103 | 3.04 | 2.18 | -1.63 | 7.78 |

This table presents summary statistics of the two subsamples: one with all first-born CEOs and the other with all later-born CEOs. The mean, standard deviation, minimum and maximum values of selected variables are presented.

*T-test on subsamples*

| Group | Obs. | Mean of Aggregate Risk Index | Std. Error | Std. Dev | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| Non first Born | 103 | 3.047 | 0.215 | 2.185 | 2.620 | 3.474 |
| First Born | 376 | 2.420 | 0.101 | 1.971 | 2.220 | 2.620 |
| Combined | 479 | 2.555 | 0.092 | 2.033 | 2.372 | 2.737 |
| diff | | 0.626 | 0.224 | | 0.185 | 1.067 |

The table performs a t-test on two subsamples with first-born CEOs and later-born CEOs. It shows sufficient evidence suggests that the later-born group has a higher mean risk measure than the first-born group.

## 5. Conclusion

This paper supports the view that managers imprint their personalities on the firms they manage, the strategies they adopt and the decisions they make. More specifically, with a novel dataset, this study finds that birth order is significantly associated with riskier behaviour. The results also expand the general family science findings into the corporate world.

One insight of this study is on the CEO selection process. Firms could adjust their hiring process accordingly if later-born managers exert more aggressive and risk-seeking behaviours. Suppose firm owners seek revolutionary change in their firms; they would be better off appointing a later-born CEO to implement relatively risky strategies. On the other hand, if an owner is looking for some conservative "goalkeeper," a first-born CEO is more likely to nail this job. A potential development to make in the future is to relate this paper to moral hazard and the principal-agent problem. If agents take on too much risk, shareholders might have more concerns about the likelihood of the principal-agent problem. In a heterogeneous agent model, the contribution of this study would be to answer whether the appointment of a first-born conservative CEO could mitigate the principal-agent problem. This paper's main challenge is establishing an inference of birth order on manager behaviours. The matching story between firms and CEOs would be the main obstacle to the identification strategy.

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