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ESSAYS ON RISK-TAKING IN CORPORATE FINANCE

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# **ESSAYS ON RISK-TAKING IN CORPORATE FINANCE**

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Ph.D. thesis in Management as a collection of three independent essays titled:

1. Community-level social capital and investment decisions in equity crowdfunding
2. CFO pay convexity, risk-taking, and corporate hedging
3. CEOs' compensation incentives: a systematic review of the finance literature

## **General Abstract**

This thesis consists of three independent essays on risk-taking in corporate finance. The first essay explores how community-level social capital (CSC), framed as a cultural characteristic of individuals born in different provinces of Italy, affects investment behavior in equity crowdfunding. Results show that investors born in high-CSC provinces invest more money in ventures characterized by an enhanced risk profile. Observed risk-taking is theoretically linked to higher generalized trust endowed to people born in high-CSC areas. The second essay focuses on how convexity of Chief Financial Officers' stock options affects their hedging decisions in the oil and gas industry. Highly convex CFOs hedge less commodity price risk, even if the Chief Executive Officer's incentives are consistent with a more conservative hedging strategy. Finally, the third essay is a systematic literature review on how different sources of compensation-based risk-taking incentives of Chief Executive Officers affect decision-making in corporate finance.

# ABSTRACTS OF INDIVIDUAL ESSAYS

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## Abstract of Essay One

We investigate the role of community-level social capital in individuals' investment decisions in equity crowdfunding. We exploit a hand-collected dataset of individual investments pledged to successful campaigns in Italy between 2014 and 2018. Individuals born in provinces with high social capital invest more substantially in riskier campaigns. Contrary to inborn social capital, social capital in the province where investors live has no impact. This evidence survives several robustness checks and highlights the crucial role of an individual's cultural traits in fostering investment in equity crowdfunding.

## Abstract of Essay Two

We study how a CFO's risk-taking incentives affect corporate hedging. We utilize hand-collected data from 2009–2019 on corporate hedging and managerial compensation for a sample of US oil and gas firms. The relative convexity of CFO's equity compensation negatively affects hedging likelihood and extent. When CFO and CEO have diverging risk-taking incentives, the relative convexity of the CFO's equity payoff prevails over that of the CEO. This evidence underscores the primary role of the CFO in steering a firm's hedging strategy.

## Abstract of Essay Three

This paper provides a systematic literature review on CEOs' pay-related incentives to take risks. CEOs play a prominent role among all senior corporate executives as the key decision-makers in corporate strategy and performance, and an impressive amount of empirical evidence has assessed and confirmed the link between their characteristics and firm outcomes. Regardless of such a significant *corpus* of research, the debate on whether incentives allineate their interests to those of claim holders and alleviate principal-agent

conflicts is still open. To fill this gap, we review 129 scientific articles published in finance journals of recognized academic reputation between 1996 and 2022. Contributions in the literature mainly confirm the role of incentives in aligning the interests of CEOs and claim holders, but the risk of engaging in excessively aggressive corporate policies is significant and potentially value destroying. Moreover, new sources of incentives are emerging, thus broadening the debate to include debt-like compensation and CEOs' labour market phenomena in the discussion together with executive stock options.

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## ESSAY ONE

# Community-level social capital and investment decisions in equity crowdfunding\*

### Abstract

We investigate the role of community-level social capital in individuals' investment decisions in equity crowdfunding. We exploit a hand-collected dataset of individual investments pledged to successful campaigns in Italy between 2014 and 2018. Individuals born in provinces with high social capital invest more substantially in riskier campaigns. Contrary to inborn social capital, social capital in the province where investors live has no impact. This evidence survives several robustness checks and highlights the crucial role of an individual's cultural traits in fostering investment in equity crowdfunding.

**JEL classification:** G32; L26.

**Keywords:** Equity crowdfunding; Community-level social capital; Generalized trust; Culture.

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## 1. Introduction

Equity crowdfunding is a concrete and viable financing opportunity for businesses around the globe. Unlike other forms of crowdfunding, pledgers in equity crowdfunding become shareholders of a company and target a profit through dividends or successful exits (Ahlers et al., 2015). Investors in equity crowdfunding are residual claimants in early-stage companies, and the outcome of their investment is highly uncertain (Giudici, 2015; Vismara, 2021). In addition, equity crowdfunding attracts unsophisticated investors who cannot rely on due diligence and direct interactions with entrepreneurs before funding a new venture (Butticè et al., 2022). The greater information asymmetry makes equity crowdfunding riskier than traditional early-stage financing, such as business angels and venture capitalists (Signori and Vismara, 2018; Block et al., 2018). Consequently, equity crowdfunding has drawn the attention of policy-makers and is currently regulated in many countries across the globe (Hornuf and Schwienbacher, 2017).

Research on equity crowdfunding has grown substantially in recent years but remains fragmented (Mochkabadi and Volkmann, 2020). Nevertheless, as Vismara (2021) highlights, equity crowdfunding markets provide an interesting setting to test existing corporate finance and financial economics theories and develop new theoretical insights. However, most of the literature explores *demand-driven* determinants of campaign success (Ahlers et al., 2015; Vismara, 2016; Cumming et al., 2019b; Johan and Zhang, 2020; among others) and the follow-up performance and funding opportunities of investee firms (Signori and Vismara, 2018; Butticè et al., 2020). *Investor-driven* aspects, such as individual objectives and asset allocation, remain relatively unexplored. Data on single investments are difficult to obtain, and information is limited to a few platforms at most. In this paper, we study a whole equity crowdfunding market, and we contribute to explaining what drives individuals' investment decisions. Specifically, we explore how community-level social capital increases the amount pledged to riskier equity crowdfunding campaigns.

Social capital is a multidimensional concept subject to different interpretations (Hasan et al., 2020). At the community level, it is the set of norms, values, and beliefs that foster cooperation among individuals sharing the same geographical area (Guiso et al., 2004, 2012). In a high social capital environment, enhanced cooperative norms and civic-mindedness lead individuals to interact and create trust. Such individuals are, in other words, more likely to

anticipate cooperation rather than opportunism from the counterparty (Colquitt et al., 2007; Hasan et al., 2020). Trust rooted at the local level has an impact not only on within-community contracts but also, more importantly, on transactions involving agents outside the local community (Guiso et al., 2004).

Community-level social capital (hereafter CSC) is related to the broader concept of culture (Guiso et al., 2008b; Servaes and Tamayo, 2017). For individuals born in a given community, cooperation-enhancing values, beliefs, and social norms are cultural traits subject to temporal and geographical stickiness (Servaes and Tamayo, 2017) and an intergenerational transmission process (Guiso et al., 2008b; Tabellini, 2008). While culture can be defined as "*those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation*" (Guiso et al., 2006), CSC is the "*set of beliefs and values [...] that facilitate cooperation among the members of a community*" or "*good culture*" (Guiso et al., 2008b; Servaes and Tamayo, 2017). Overall, individuals born in communities where CSC is high are more trusting, as stronger cooperative values and beliefs are stowed in their cultural makeup (Guiso et al., 2008b; Guiso et al., 2015; Servaes and Tamayo, 2017). This "generalized trust," i.e., the propensity of individuals to rely on others, is a crucial element in financial transactions, especially those characterized by high information asymmetry (Hong et al., 2005; Hasan et al., 2021) and involving counterparties outside the community of reference (Guiso et al., 2004).

In this paper, we investigate the effect of CSC on investment behavior in equity crowdfunding. Pledging to an equity crowdfunding campaign is a trust-intensive activity due to the high risk and informational asymmetries that characterize the market (Giudici, 2015; Vismara, 2018; Block et al., 2021). Therefore, equity crowdfunding is an ideal setting to explore the relationship between CSC and financial decision-making, as trust reportedly encourages risky investments (Guiso et al., 2004, 2008a).

We proceed in three steps. First, we investigate whether CSC positively impacts the amount invested. Second, we identify high-risk campaigns and study how CSC enhances the amount directed to riskier ventures. Third, we disentangle the differential effects of inborn CSC from the CSC in the living place of an investor. We rely on a novel, hand-collected dataset including all investments pledged to successful Italian equity crowdfunding campaigns initiated between 2014 and 2018. This country-wide dataset offers a unique opportunity to

study how CSC shapes investors' decisions. Moreover, Italy fits this purpose, as there is substantial and acknowledged heterogeneity in CSC across provinces (Guiso et al., 2012).

We contribute to the literature by advancing the following significant findings. First, CSC does not alter the propensity to allocate more money to equity crowdfunding campaigns. However, people born in high-CSC areas invest more substantially in riskier campaigns. In other words, higher generalized trust significantly increases the amount pledged to ventures characterized by an enhanced risk profile. This evidence provides strong support for the role of CSC in encouraging individuals' investment decisions in trust-intensive activities. Second, while inborn CSC affects investment behavior, CSC in the area where the investor lives has no impact. This suggests that specific aspects of an investor's cultural makeup prevail over other environmental factors potentially affecting investment choices. Like other dimensions of cultural heritage, cooperative norms, beliefs, and trust related to the place of birth impact an individual's investment decisions regardless of where such decisions are made. This result contributes to the debate on social capital being driven by inherited or environmental variables (Guiso et al. 2004) and validates the first alternative.

Existing studies on social capital in equity crowdfunding build on entrepreneurs' social (network) capital and limit their analysis to a single platform (e.g., Vismara, 2016; Lukkarinen et al., 2016), base their results upon surveys and questionnaires (e.g., Polzin et al., 2018), or focus on where investors live (e.g., Hervé et al., 2019; Mohammadi and Shafi, 2020). In contrast, we take an *investor-side* perspective and elaborate on actual investments in a whole market. Our conclusions shed light on how generalized trust and cultural traits affect an individual's investment decisions. To this end, building on Vismara (2021), our research expands corporate finance studies to equity crowdfunding and improves our understanding of how investors make decisions in this context. This is very relevant, as equity crowdfunding has the potential to increase investors' inclusivity and democratization (Butticè et al., 2022). Our study might also provide interesting insights to platforms and entrepreneurs when planning their fundraising campaigns.

To alleviate endogeneity concerns, we rely on an epidemiological approach (Guiso et al., 2004; Fernández, 2011, for a review). We exploit movers in our sample to disentangle the effect of CSC from other environmental factors related to the place where an investor resides. This empirical strategy provides supportive evidence that unobservable characteristics of the investors' living place do not drive our results. Moreover, our results survive several other

robustness exercises. First, we assess their validity in the context of a narrower definition of risky campaigns. Second, we perform subsample analyses based on characteristics at the campaign level that could potentially impact the results. Third, we ensure that the evidence is not driven by the economic disparity between different Italian provinces. Fourth, we control for geographical proximity between investors and ventures and the geographical distribution of ventures. Fifth, we repeat our analysis and replace our CSC index with each of its constituents. All results are consistently robust.

We organize the remainder of the article as follows. Section 2 reviews the social capital and equity crowdfunding literature, focusing on community-level social capital. Section 3 develops the testable research hypotheses. Section 4 describes our data and variables and presents the sample descriptive statistics. Section 5 reports our empirical findings. Section 6 is devoted to robustness. Section 7 concludes.

## **2. Review of the literature**

### **2.1. Community-level social capital (CSC)**

Enclosing social capital in a unique definition is challenging. [Scrivens and Smith \(2013\)](#) and [Hasan et al. \(2020\)](#) identify four dimensions of social capital: (1) personal relationships, (2) social network support, (3) civic engagement, and (4) trust and cooperative norms. As [Lins et al. \(2017\)](#) clarify, the first two interpretations are frequently found in the sociology literature and stress the importance of networks in building social capital. The last two interpretations, viewing social capital as a resource that facilitates cooperation at the group, community, or societal level, are commonly used in finance and economics. In this paper, we follow this latter approach. We conceptualize community-level social capital (CSC) as the set of nonwritten norms, values, and beliefs that foster cooperation among individuals belonging to the same geographical area ([Guiso et al., 2004; 2008b](#)). Consequently, CSC is localized ([Laursen et al., 2012a](#)) and measured at the level of geographically linked administrative entities ([Laursen et al., 2012b](#)).

CSC operates as a societal monitoring system that incentivizes people to behave according to generalized norms of behavior ([Mistrulli and Vacca, 2015](#)). In this regard, CSC increases the cost of acting opportunistically and reduces agency costs ([Gupta et al., 2018; Hoi et al., 2019](#)).

CSC has a substantial impact on firms' and individuals' investing and financing decisions and improves financial development (Guiso et al., 2004; Javakhadze et al., 2016).

A critical facet of CSC is trust. In particular, social capital-facilitated "generalized trust" is the propensity of individuals to rely on others (Colquitt et al., 2007; Hasan et al., 2020). In a high social capital environment (e.g., province), individuals are more likely to cooperate, from both the economic (through local business relations) and the political (through civic engagement) perspectives. They are also more likely to anticipate cooperation rather than opportunistic behavior from the counterparty. In other words, individuals in high-CSC areas have higher generalized trust than their peers in low-CSC areas.

Unlike within-group trust, which acts as a substitute for financial contracts in the first place, generalized trust facilitates contractual relationships with agents outside the local community (Guiso et al., 2004). Therefore, generalized trust plays a crucial role in financial transactions characterized by high information asymmetry (Hasan et al., 2020). People in high-CSC areas hold more stocks and less cash than their peers in low-CSC areas, showing a preference for riskier investments (Guiso et al., 2004). Trust directly enhances individuals' and households' stock market participation and risk-taking (Guiso et al., 2008a). Hong et al. (2004, 2005) show that local social interactions also positively affect stock market participation. Bottazzi et al. (2016) examine the effect of trust in venture capital financing and show that trust positively predicts venture capital investment decisions and negatively correlates with successful exits. El-Attar and Porschke (2011) find that Spanish households with less trust invest more in housing and less in financial assets, particularly riskier assets.

Localized CSC is an environmental variable, i.e., a characteristic of a geographically bounded space that affects all actors sharing it. In this sense, cooperation-enhancing values, beliefs, and social norms embedded in social capital can be considered cultural traits (Guiso et al., 2008b; Tabellini, 2008; Guiso et al., 2015). According to Guiso et al. (2006), culture is defined as "*those customary beliefs and values that ethnic, religious, and social groups transmit fairly unchanged from generation to generation.*" In Guiso et al. (2008b), social capital is the "*set of beliefs and values [...] that facilitate cooperation among the members of a community.*" In other words, CSC is a "good culture" (Guiso et al., 2008b; Servaes and Tamayo, 2017). Consequently, people born in high-CSC areas are endowed with higher generalized trust, as stronger cooperative values and beliefs are stowed in their cultural makeup (Guiso et al., 2008b; Guiso et al., 2015; Servaes and Tamayo, 2017).

## 2.2. CSC and equity crowdfunding

Whether generalized trust, captured by inborn CSC, affects decision-making in equity crowdfunding is still unexplored. Unlike other forms of crowdfunding, equity crowdfunding is closer to traditional equity investing (Vismara, 2018, 2021). Nonfinancial motives are relatively unimportant, as backers primarily invest to achieve monetary returns (Cholakova and Clarysse, 2015). As in traditional equity investing, equity crowdfunding entails high risk and informational asymmetries (Giudici, 2015; Vismara, 2018; Block et al., 2021). In addition, the entrepreneur is usually a first-time one of low expertise and quality (Blaseg et al., 2021), the crowd is mainly composed of unsophisticated investors (Signori and Vismara, 2018), and due diligence is very heterogeneous across crowdfunding platforms (Cumming et al., 2019a). Overall, pledging to an equity crowdfunding campaign shows all the characteristics of a trust-intensive activity (Block et al., 2018). Consequently, trust-related cultural traits are likely to be relevant in supporting investment decisions.

The existing equity crowdfunding research has focused primarily on how *demand-driven* factors (i.e., factors related to the entrepreneur or the new venture) might attenuate asymmetric information (Ahlers et al., 2015; Vismara, 2016; Lukkarinen et al., 2016; Lin and Pursiainen, 2020; among others). Consequently, it has exploited different interpretations of social capital (see Cai et al., 2021, for a review). The *investor-side* perspective of equity crowdfunding is a more recent and less investigated stream of literature.

Among the existing studies, Hervé et al. (2019) show that population-based measures of social interaction where investors live influence their behavior, leading them to invest more. Income and education in an investor's place of residence explain the hypothetical bias, i.e., the discrepancy between investment intentions and actual investment behavior (Cumming et al., 2020). Hervé and Schwienbacher (2018) document a round-number bias in investors' contributions. Hervé et al. (2019) also report gender-based differential risk aversion, as women invest less in equity and more in fixed-income crowdfunding. Women are also less subject to hypothetical bias (Cumming et al., 2020). In addition, female investors contribute less to high-technology firms and firms in which the proponent retains a lower equity share (Mohammadi and Shafi, 2018). More recently, Giudici et al. (2020) show that investors are more likely to support ventures whose board members have a similar age and reside in neighboring cities. The effect is enhanced if a venture's board members live in areas with scarce civic responsibility and a low sense of citizenship. Finally, Shafi and Mohammadi

(2020) report that risk-taking is affected by weather-induced moods, as larger pledges are placed on sunnier days.

To our knowledge, there is no exploration of how backers' CSC influences their choices. Our paper aims to fill this gap. We provide the first empirical evidence that generalized trust induced by higher CSC related to the area of origin enhances investment in trust-intensive activities. Our work is related to the literature on crowdfunders' characteristics and their investing behavior and, more generally, to both the recent academic work on culture and financial decisions (Aggarwal et al., 2016; Vismara, 2021) and the debate on the changing landscape in entrepreneurial finance (Block et al., 2018).

### 3. Development of hypotheses

In high-CSC areas, shared norms of reciprocity and cooperation are enhanced, and the creation of trust is facilitated (Guiso et al., 2004, 2012; Hasan et al., 2021). In a high-CSC environment, individuals are more inclined to cooperate and anticipate cooperation from a counterparty, whether the counterparty belongs to the local community or not. Social capital-facilitated generalized trust affects transactions characterized by high information asymmetry (Guiso et al., 2004, 2008a; Hasan et al., 2020).

Since we are interested in investigating the role of social capital as a part of a community's culture (Guiso et al., 2008b; Servaes and Tamayo, 2017), our key variable is the CSC in the birthplace of an investor. People born in high-CSC areas are endowed with stronger cooperative values and beliefs stowed in their cultural makeup (Guiso et al., 2008b; Tabellini, 2008; Guiso et al., 2015).

Both cross-country and within-country cultural differences impact economic behavior. Ichino and Maggi (2000) find that shirking can be explained by where the employee was born, i.e., in northern or southern Italy. Uslaner (2008) shows that the cultural foundations of trust (proxied by an individual's ethnic background) play a major role in explaining trusting behavior. More related to our study, trust significantly impacts individuals' investment decisions. Trusting individuals are more likely to participate in the stock market, buy risky assets, and invest more in such assets (Guiso et al., 2008a). Following this reasoning, Guiso et al. (2004) show that people born in high-CSC areas invest larger amounts in stocks and use checks more intensively.

In equity crowdfunding, the risk of fraud is perceived as substantial (Ziegler et al., 2019). Investors endowed with high CSC are expected to trust the entrepreneur initiating a campaign more. Overall, CSC should have a positive impact on the amount invested in equity crowdfunding. Accordingly, we formulate the following hypothesis.

**H1.** Community-level social capital (CSC) positively impacts the amount pledged to an equity crowdfunding campaign.

The equity crowdfunding literature consistently shows that backers are unsophisticated investors subject to asymmetric information and opportunism, and entrepreneurs usually have low technical and managerial expertise (Giudici, 2015; Vismara, 2016; Ziegler et al., 2019; Blaseg et al., 2021). However, while participating in equity crowdfunding is a trust-intensive activity *per se*, firms initiating an equity crowdfunding campaign have very heterogeneous risk profiles. Mohammadi and Shafi (2018), among others, show that male and female investors discriminate between campaigns based on risk-related dimensions (i.e., the proponent firm's core business, opaqueness, and the entrepreneur's commitment). Hervé et al. (2019) find that the level of uncertainty embedded in different crowdfunding models (equity-like investment vs. bond-like investment) significantly impacts investors' willingness to pledge.

We argue that contributing to riskier equity crowdfunding campaigns requires, *ceteris paribus*, a higher stock of CSC, as it is a more trust-intensive investment. Therefore, we hypothesize an enhancing role of CSC on the amount that individual backers direct to riskier campaigns. Accordingly, we formulate the following hypothesis.

**H2.** The effect of community-level social capital (CSC) on the amount invested is stronger for riskier campaigns.

We focus on inborn CSC, as we aim to explore how investors' cultural makeup affects their choices. However, the characteristics of the living place also potentially affect investors' behavior. Hervé et al. (2019), Cumming et al. (2020), and Shafi and Mohammadi (2020) report that attributes of the place where the investor resides influence the amount pledged, the type of investment, and explain behavioral biases. More specifically, environmental-level social capital, i.e., CSC in the living place of an investor, might impact equity crowdfunding investment decisions similarly to traditional investment decisions (Guiso et al., 2004). Hence, we also investigate the role of environment-level CSC in investors' propensity to pledge.

Cultural traits have been shown to be dominant determinants of an individual's investment behavior (Fernández, 2011). Their persistent impact is consistently acknowledged throughout the literature, and it generally survives once the environmental characteristics of the place where the economic decision is made are factored in (Fernández, 2011; Guiso et al., 2004). Focusing on the interplay between cultural and environmental traits, Uslaner (2008) and Ichino and Maggi (2000) point toward a dominant role of cultural over environmental variables. Building on the documented strength and persistence of culturally related values and beliefs, we hypothesize a dominant role of cultural-level CSC over environmental-level CSC on crowdfunders' investment choices. Therefore, we formulate the following hypothesis.

**H3.** The effect of community-level social capital (CSC) bounded to an investor's place of birth on the amount pledged, especially in riskier ventures, prevails over that of CSC in their place of living.

## **4. Data, variables, and descriptive statistics**

### **4.1. Equity crowdfunding**

The equity crowdfunding industry in Italy started at the end of 2012 when an *ad hoc* law (the so-called *Decreto Sviluppo*) was passed (Giudici et al., 2013). The first campaign raised capital in 2014, and up to 2015, only "innovative startups" were allowed to operate through authorized equity crowdfunding platforms (Girauda et al., 2019). Afterward, the opportunity was also extended to "innovative SMEs."

We hand-collect data on all individual investments made in successful Italian equity crowdfunding campaigns initiated between 2014 and 2018. In this timespan, 223 successful campaigns were launched. We exclude 8 real estate projects because of their different characteristics in terms of duration and risk. We also exclude 23 campaigns funded through a mix of crowdfunding and other sources (such as right issues or private placements), as for these ventures, we cannot distinguish crowdinvestors from regular shareholders. Finally, we drop 4 campaigns due to a lack of data on the proponent firm. We are left with 188 usable campaigns, spanning 12,161 investments. Approximately 93% (11,354) of these investments are made by individuals, and a minority (7%, i.e., 807 investments) are made by firms. We exclude pledges made by firms, and for the remaining 11,354 investments, we search for crowdinvestors' information.

In Italy, the list of shareholders in limited liability companies is publicly available through the Business Register (*Registro delle Imprese*), a public register held by the local (mostly provincial) chambers of commerce. Hence, we unambiguously identify all shareholders through their tax codes and link each investment to the investor's personal characteristics. In particular, we gather the investor's gender, age, place of birth, and place of residence. The place of residence is present in the Business Register for a subsample of approximately three-quarters of all investments in our sample. We exclude investments made by individuals born outside Italy's borders (352 investments out of 11,354), as we focus on within-country variation in CSC. In this last step, we drop 3 campaigns. Our final sample is composed of 11,002 usable investments belonging to 185 successful campaigns on 13 equity crowdfunding platforms. We integrate this dataset with data on the issuer's profitability from Bureau Van Dijk AIDA.

To our knowledge, this dataset is one of the largest and most complete equity crowdfunding samples ever analyzed at a country level. Since we cover all equity crowdfunding platforms in Italy, our analysis should not be affected by potential biases from unobserved investors' preferences for using different platforms. Unfortunately, we do not possess information on investment bids submitted to unsuccessful campaigns, as the failed status implies that pledgers are not shareholders. However, the weight of such campaigns is minor in terms of the number of investments and the money committed (Giudici et al., 2020).<sup>1</sup>

*Please insert Table 1 here*

The temporal distribution of the campaigns and investments in our sample is reported in Table 1. Panel A shows that the majority of the campaigns raised money in 2018 (100 ventures out of 185), and the number increased over time. This pattern is consistent with the relatively recent emergence of the crowdfunding phenomenon and the positive annual growth rate

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<sup>1</sup> Unsuccessful campaigns attract a significantly smaller number of investors. There were 92 unsuccessful equity crowdfunding campaigns in Italy initiated between 2014 and 2018. We do not know who the pledgers were (or whether they were individual investors or firms), but these campaigns were supported by 11 pledges, on average, against 65 (= 12,161/188) for successful campaigns. Moreover, pledges to unsuccessful campaigns can be placed only to attract other investors and might be withdrawn strategically before the end of the campaign (Meoli and Vismara, 2021). Therefore, using pledges to unsuccessful campaigns leads to the risk of considering pledges that would never become real.

observed across different crowdfunding models and platforms (see [Ziegler et al., 2019](#), and [Rau, 2020](#), for an overview of the evolution of the European and worldwide crowdfunding markets, respectively). The total money raised was approximately €51 m (the mean value in a single campaign was €278k, and the median value was slightly less than €200k). In comparison, the mean pre-money valuation of the issuing company was €4.7 m (median value of approximately €2 m).

A total of 11,002 investments contributed to the success of the 185 campaigns (Table 1, Panel B), resulting in approximately 59 (= 11,002/185) investments per campaign, on average. Excluding the last year in our sample, we also observe an increasing trend in the average number of investments per campaign. We register, on average, 25 investments in 2014 (= 124/5), 30 in 2015 (= 269/9), 43 in 2016 (= 1,025/24), 74 in 2017 (= 3,496/47), and 61 in 2018 (= 6,088/100). The average amount pledged was approximately €3,170 (the median was €750).

#### **4.2. Community-level social capital**

We measure CSC at the provincial level (corresponding to the NUTS-3 regions in the Eurostat classification), as is common in the literature ([Guiso et al., 2004](#); [Guiso et al., 2008](#); [Giudici et al., 2018](#)). Provincial (rather than the much broader regional) borders are more likely to characterize communities sharing norms and values.

The measurement of social capital is a central issue. We adopt a broad measurement strategy to acknowledge the many dimensions of social capital at the local level ([Rupasingha et al., 2006](#)). More specifically, we follow previous work on localized social capital and crowdfunding in the Italian context ([Giudici et al., 2018](#)). We employ provincial-level (a) voter turnout (*Turnout*), (b) waste recycling (*Waste*), (c) number of nonprofit organizations (*Nonprofit*), (d) number of volunteers (*Volunteers*), and (e) people satisfied with their relationship with others (*Satisfaction*) as proxies for CSC.<sup>2</sup> All variables are drawn from the Italian National Statistics Bureau (ISTAT) and the Italian Ministry of the Interior.

We collect voter turnout in the 2013 National Parliamentary election, the most recent general election before the start of our sample period. We retrieve the waste recycling rate in 2003.

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<sup>2</sup> Table A1 in the appendix provides a detailed description of the proxies and how they are constructed, along with the data source.

We choose 2003, as the legal obligation to sort waste was implemented in Italy after 2003. Hence, waste sorting in 2003 was driven by unwritten norms and social pressures on leaving a better planet for future generations rather than a legal obligation (Galardo et al., 2017).<sup>3</sup> *Turnout* and *Waste* capture citizens' trust in institutions, as they involve norms and values responsible for civic engagement and cooperation with fellow citizens (Putnam, 1993; Giudici et al., 2018).

Then, we collect the number of nonprofit organizations and the number of volunteers. Nonprofit involvement and volunteering are correlated with civic-mindedness (Hasan et al., 2021). Such involvement provides multiple opportunities to interact with people outside one's social circle and facilitates the creation of generalized trust (Larsen et al., 2012a; Hasan et al., 2020) by encouraging solidarity, reciprocity, and cooperation with strangers (Putnam, 1993; Rupasingha et al., 2006). Finally, we include the share of people satisfied with friendship relationships. This variable captures trust creation through friendship and socialization outside the working environment (Larsen et al., 2012; Giudici et al., 2018). These three proxies (*Nonprofit*, *Volunteers*, and *Satisfaction*) capture voluntary participation in social associations and prosocial behavior, which are crucial to building trust and improving cooperation within geographically bounded communities (Rupasingha et al., 2006; Laursen et al., 2012a).

Except for *Turnout* (2013) and *Waste* (2003), the other three variables are measured in 2011, when the Italian Statistical Agency (ISTAT) conducted three large-scope censuses (the Agriculture Census, the Population Census, and the Industry and Services Census). This is unlikely to be a problem for our analysis, as social norms are characterized by temporal stickiness due to their lengthy accumulation through intergenerational transmission (Guiso et al., 2012; Jha, 2019). In our multivariate analysis, we control for a large set of provincial-level variables, also from the ISTAT.

We extract the principal components from *Turnout*, *Waste*, *No-profit*, *Volunteers*, and *Satisfaction*. The first component is the only one with an eigenvalue greater than 1 (= 1.85), explaining approximately 70% of the total variance. We use the first component as our provincial-level measure of social capital (*CSC*).<sup>4</sup> Table A1 in the Appendix provides factor

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<sup>3</sup> We weight 2003 waste recycling by the share of the population in each province that was actually covered by sorted waste collection services, as in Galardo et al. (2017).

<sup>4</sup> In the robustness section later in the paper, we also use each of these five variables in isolation. In spite of an expected lower statistical significance, this exercise shows that the main results of the paper continue to hold.

loadings for the five proxies and shows that they are all positively and highly correlated with CSC. The provincial distribution of CSC by quintiles is mapped in Figure 1.<sup>5</sup>

*Please insert Figure 1 here*

Higher CSC is concentrated in the northern part of the country, as is commonly found in Italy (Guiso et al., 2004). Red dots in Figure 1A (1B) highlight provinces above the median (in the upper decile) by CSC. We will turn to this visual inspection in the robustness section later in the paper, where we will repeat our investigations excluding high-CSC areas.

### **4.3. Descriptive statistics**

The descriptive statistics of the variables in our sample are reported in Table 2. Variables can be categorized according to three sets of information: characteristics of the investments, attributes of the campaign, and CSC and territorial controls at the province level.

*Please insert Table 2 here*

The descriptive statistics of the 11,002 investments are reported in the upper part of Table 2. Other than the amount invested, also reported in Table 1, we note that less than 10% of total pledges are submitted by female investors, and the average (median) age of investors across all investments is 43 (42). Sociodemographic characteristics of investors, such as gender and age, are known to affect their investment behavior (Hervé et al., 2019; Mohammadi and Shafi, 2018); hence, we later control for such attributes. We employ the region in which the investor was born to build three dummy variables, i.e., *North*, *Centre*, and *South and islands*. Since the geographical distribution of CSC is highly correlated with the Italian North-South divide (see Figure 1), we wish to control for differences between people born in the different macro-areas of the country. As expected, investments are unevenly distributed across the three macro-

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<sup>5</sup> Figure A1 in the Appendix shows the provincial distribution for each of the five proxies.

areas. Investors born in the Northern (and richer) part contribute to 64% of the bids within our sample, against 15% and 21% for *Centre* and *South and islands*, respectively.

We build the same three dummy variables as above, i.e., *North*, *Centre*, and *South and Islands*, but referring to where the investor resides. Later, in our multivariate analysis, we will disentangle the role of CSC where an investor lives from that of inborn CSC. We cannot retrieve information on the investor's residence from the Business Register for approximately one-fourth of the sample. Hence, variables requiring this information are limited to 8,459 investments (out of 11,002). Investors living in Northern Italy contribute to 71% of the bids in our sample (against 64% for individuals born in Northern Italy). This figure reflects a common internal migration pattern from the South to the Northern part of Italy due to acknowledged macroregional disparities between these two areas (Ichino and Maggi, 2000). We construct two dummy variables that take the value of 1 if the province of birth (or residence) of the investor coincides with the province where the funded firm is incorporated. *Local home bias (birth and residence)* should control for the propensity of crowdfunders to invest in geographically closer projects. These variables also control for the potential effect of within-community (within group) trust, rather than generalized (across groups) trust, on the amount invested. Only 14% (17%) of the investments are made by backers born (living) in the same province where the firm is located. *First investment* is an indicator variable identifying each investor's first (chronological) investment within our sample period. As in Hervé and Schwienbacher (2018), it captures potential investors' inexperience when pledging for the first time. Finally, *Mover* detects investors living in a province other than that in which they were born (34% of the investments in our sample are made by such investors).

The second group of variables characterizes equity crowdfunding campaigns. Backers in equity crowdfunding are generally nonprofessional and lack the expertise to assess a firm's performance and value (Wilson and Testoni, 2014; Signori and Vismara, 2018). An investment's riskiness is likely weighed through rule of thumb and high-level reading of intuitive and easy-to-gather information. Additionally, many firms in equity crowdfunding have no detailed records of financial information. Based on this evidence, we build two measures of a campaign's riskiness that are readily available and easily understandable by less-refined investors.

First, we identify campaigns belonging to Fintech, Biotech/Pharma/Lifescience, or Hi-Tech/IT/Communication categories. Technological firms are riskier than firms operating in

traditional sectors due to the uncertain nature of their operations (Mohammadi and Shafi, 2018). The dummy variable *Tech* detects such campaigns. *Tech* proxies for business risk, and it is easily understandable by relatively unsophisticated investors. Second, we identify investments in firms reporting a negative net income in the year before the campaign or in the year in which the campaign starts. The dummy *Unprofitable* exploits the evidence that investors exhibit a threshold mentality, perceiving continuous data in discrete form (Degeorge et al., 1999). Investors (especially naïve ones) base their investments on rules of thumb and display a "negativity bias," being more averse to losses (Degeorge et al., 1999). *Unprofitable* signals a negative past or current profitability and should detect financial risk.<sup>6</sup> As Table 2 shows, almost 37% of the campaigns in our sample are referred to as technological firms, and 7 firms out of 10 are unprofitable.

Equity crowdfunding is a financing channel for seed and innovative firms, and focusing on only one of the two variables at a time might not fully capture the campaign's riskiness. We also construct a *High risk* indicator, i.e., the intersection of the two variables above. In other words, *High risk* equals one when both business (industry) and financial (profitability) risk are high (i.e., *Tech* and *Unprofitable* are jointly equal to 1). Table 2 shows that approximately one-fourth of the campaigns in our sample are classified as high risk.

We control for firms launching multiple equity crowdfunding campaigns with a *Follow-on* variable taking the value of 1 if the campaign is a second-round (or above) equity issuance. Table 2 shows that 7% of the campaigns (13 out of 185) are follow-on rounds. We also construct two dummies (*Soft cap* and *Hard cap*) to detect campaign-specific clauses that may be important in explaining their funding. *Soft cap* identifies campaigns requiring a minimum amount to be successful and canceled if this threshold is not reached. *Hard cap* controls for highly successful campaigns ending before the scheduled end date, thus preventing additional investments from being made. Table 2 shows that almost all the campaigns have a soft cap, and approximately one-quarter of them have a hard cap.

For the third group of variables, we report the descriptive statistics of our CSC index, each of the CSC proxies, and provincial-level controls. Control variables account for characteristics of Italian provinces that may influence an individual's propensity to invest (Guiso et al.,

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<sup>6</sup> We recognize that for some firms (e.g., newly established ventures), information on profitability might not be accessible when the campaign is launched. We discuss this matter later in the paper, and we check the robustness of our results to a more restrictive definition of *Unprofitable*.

2004). They also control for the effects of economic development, infrastructure, and labor market quality (Hoi et al., 2019). Table 2 shows that the average *Population density* is approximately 270 inhabitants per square kilometer, with sizeable cross-province variation (the minimum value is 36, and the maximum is 2,631). Since we cannot directly observe an investor's wealth, we use *Household income* as a proxy, as in Hervé et al. (2019). The average annual net income is approximately €30k. The average investment in our sample is located in a province with 545 bank branches and a GDP per capita of approximately €25k. Finally, approximately 10% of the population reached higher education. As for the previous variables, significant cross-province variation is present.

## 5. Empirical results

### 5.1. Univariate analysis

We now provide the first univariate evidence on the role played by CSC in investment choices. Table 3 partitions the whole sample of 11,002 investments into two subsamples, i.e., investments made by investors born in provinces with a CSC score above and below the median in our sample.<sup>7</sup> The average value of investment-related variables is shown, along with their difference and statistical significance.

*Please insert Table 3 here*

The first piece of evidence is that the average amount pledged by investors endowed with higher-than-median CSC is slightly larger (€3.4k v. €3.0k), but the €0.4k difference is insignificant (t-statistic = 1.34). Likewise, both *Tech* and *Unprofitable* are similar in the two subsamples, and the same holds for *High risk*. Overall, there is no statistically significant (univariate) evidence of CSC affecting the amount invested or the type of firm when the two dimensions are separately considered.

Next, we examine whether CSC discriminates between the amount invested in ventures characterized by higher riskiness; i.e., we jointly consider *Amount invested* and each risk

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<sup>7</sup> The number of observations is not exactly the same in each of the two subsamples, as CSC is defined at the provincial level, and all investments made by investors born in the same province share the same level of CSC.

dimension. The evidence is very different. Table 3 reports that the average investment pledged to *Tech* ventures by backers endowed with high CSC is much larger than the corresponding amount pledged by backers with low CSC (€4.0k v. €3.1k). The €0.9k difference is statistically and economically significant. When we look at the complementary subsample, i.e., the amount pledged to nontech ventures, we find that the €0.1k average difference is not distinguishable from zero. The evidence when considering *Unprofitable* is similar (the average pledge to unprofitable ventures is €3.5k when considering investors endowed with high CSC and €3.0k for the complementary subset). However, in this case, the €0.5k difference is not statistically significant (t-statistic = 1.21). Finally, when the two variables are jointly considered (*High risk*), investors with high CSC contribute on average €4.2k, against €2.9 for investors with low CSC. The €1.3k difference is significant at the 1% level and sizeable, representing approximately 40% of the €3.2k average pledge in our sample (from Table 2). This might signify that CSC has no wealth effect by itself, but investors with higher CSC pledge higher sums to riskier ventures. This evidence would be in line with H2, as a higher stock of CSC leads to greater contributions to riskier ventures.

For the other variables of Table 3, there is no difference between investors with high vs. low CSC in terms of gender (*Female*). *Age* is statistically but not economically significant (the average age of investors in the two subsamples is very close, i.e., 43.9 v. 42.4 years). When we look at the three geographic dummies (considering both the province of birth and the province of living), differences are significant. Such evidence is expected, as it aligns with what was already noted by Putnam (1993) and with previous works on CSC (Guiso et al., 2004; Guiso et al., 2012). The variable *Local home bias* (birth) shows a slight difference between the two subsamples, i.e., 11% of the investments made by high-CSC investors are directed to firms located within the same province of birth, compared to 16% for low-CSC investors. Finally, movers are more present in the low-CSC subsample, in line with the evidence on internal migration flows from Southern to Northern Italy.

Table 4 reports the pairwise correlation coefficients between our variables (figures in bold indicate statistical significance at the 1% level).

*Please insert Table 4 here*

It is worth mentioning the high and significant correlation between CSC and geographic dummies, i.e., 69% with *North, birth*, and -82% with *South and islands, birth*. Again, this is consistent with previous studies reporting similar correlations between CSC and geographical macroindicators (Guiso et al., 2004). For this reason, in the multivariate setting, we will augment all regressions with North-South indicators and territorial controls. The correlation between *Log amount invested* and *CSC* is low, and so is the correlation between *Tech*, *Unprofitable*, and *High risk* on the one side, and *CSC* on the other. Only the correlation between *CSC* and *Tech* is significant. This is in line with the evidence that *CSC* has a weak role or no role in explaining the amount invested and the type of venture when separately considered. In what follows, we formally test our hypotheses in a multivariate setting.

## 5.2. Multivariate analysis

To test our hypotheses, we proceed as follows. We run cross-sectional linear regressions, where our dependent variable is the logarithm of the amount invested for all investments in our sample. Our covariates include the same set of variables as in Table 2, i.e., *CSC*, investment-related variables, campaign-related variables, and territorial controls. We also control for unobservable factors affecting the amount invested through the platform and time fixed effects. We cluster the standard errors at the same level as the community-level *CSC*, i.e., at the provincial level.

### 5.2.1. Community-level social capital and amount invested

To test our first hypothesis, we regress the logarithm of the amount invested on the investor's *CSC* and controls. According to our theoretical discussion, a positive and significant coefficient of *CSC* indicates a positive impact of *CSC* on the amount invested. Model 1 in Table 5 reports the results of this analysis.

*Please insert Table 5 here*

The variable of interest is *CSC*. We control for *Female*, *Age*, North-South indicators at the level of an investor's place of birth, *Local home bias*, *First investment*, and the presence of *Soft cap* and *Hard cap*. We also include *Log population density*, *Log household income*, a

proxy for the quality of the local financial sector (*Log Number of bank branches*), *Log GDP per capita*, and *Education*.

Model 1 shows that the CSC index is insignificant in explaining the amount invested. In line with the univariate evidence, we do not find support for the role of CSC in increasing the amount pledged to equity crowdfunding campaigns. As for the control variables, *Age* positively affects the amount invested, likely capturing wealth effects at the investor level. People born in Northern Italy invest higher amounts than investors born in the Centre or South of the country. This is not surprising, as the North of Italy is richer and more economically developed, and investors born there are more likely wealthier. *Follow-on* is positive and statistically significant, meaning that campaigns in their second (or later) round attract larger investments.<sup>8</sup> *First investment* is also positive, meaning that first-time pledges are significantly higher than contributions made after some experience is accumulated.<sup>9</sup> Finally, *Hard cap* is also positive, as campaigns reaching a given threshold are the most successful. One may argue that such campaigns are somewhat different in terms of the investors' characteristics, as they no longer accept pledges once the cap is reached. For robustness, later in the paper, we rerun all our regressions excluding such campaigns.

### **5.2.2. Community-level social capital, amount invested, and campaign riskiness**

We now turn to analyze the role of CSC in the amount pledged to different campaigns depending on their riskiness. We regress the logarithm of the amount pledged on our measure of CSC, alone and interacted with the variables characterizing a campaign's riskiness, i.e., *Tech* and *Unprofitable*. We also jointly consider high-risk campaigns, i.e., ventures operating in the tech industry and not yet profitable (*High risk*). The results of this analysis are reported in Models 2 to 8 of Table 5.

Model 2 includes *CSC* and *Tech*, and Model 3 augments Model 2 with their interaction. Models 4 and 5 follow the same logic but explore the role of *Unprofitable*. Model 6 combines both risk variables (*Tech* and *Unprofitable*) and their interactions with *CSC*. Finally, Models 7 and 8 use *High risk* and show the effect of its interaction with *CSC*.

*CSC* alone is insignificant in all models. Additionally, riskier ventures attract more capital per single investment, on average. This is evident from the positive and significant coefficient of

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<sup>8</sup> All results hold unchanged excluding follow-on campaigns.

<sup>9</sup> We repeat our regressions in the subsample of first pledgers. All results continue to hold.

*Tech* in Model 2, *Unprofitable* in Model 4, and the combined effect of both variables in Model 7. In particular, individual pledges to high-tech firms are 12% larger ( $= \exp(.109) - 1$ ) in Model 2. The same figure is approximately 15% when considering *Unprofitable* ( $= \exp(.142) - 1$ ) in Model 4. The combined figure for *High risk* campaigns is 29% ( $= \exp(.255 + .227 - .227) - 1$ ), as in Model 7. Considering the sample mean of *Amount invested* (approximately €3,170, as in Table 2), this means a €920 higher pledge directed to high-risk campaigns, after controlling for other covariates.

We now turn to the interaction between risk attributes and CSC. This interaction is positive and strongly significant in Model 3 (considering *Tech*) and in Model 5 (considering *Unprofitable*). The two interacted effects combine with one another and survive in Model 6. Interestingly, when looking at the interaction between high-risk campaigns and CSC (Model 8), the coefficient is still positive and strongly significant. This means that CSC positively impacts the amount pledged to campaigns with a more uncertain outcome. A one standard deviation change in CSC ( $= 1.9$ , as in Table 2) yields a 13% increase ( $= \exp(1.9 \times .0623) - 1$ ) in the amount pledged to high-risk campaigns (Model 8). Relative to the average amount invested (€3,170, Table 2), this means approximately €400. The same figure increases to 20% (almost one-fifth of the average amount pledged, i.e., approximately €600) if we consider an interquartile range increase in CSC ( $= 2.7$ , Table 2). This evidence confirms that the economic impact of CSC is also relevant. This multivariate evidence follows our previous univariate results and is in line with our second hypothesis.

### **5.2.3. Community-level social capital in the province of birth and residence**

CSC and other institutions where an investor lives might impact investment decisions. We now aim to investigate this aspect and study the influence of CSC where the investor lives on the amount pledged. We proceed as follows and test H3 in two steps.

First, we repeat our previous analysis for H1 and H2 and replace the CSC measure (i.e., localized social capital where the investor was born) with CSC in an investor's residence (Table 6). Second, we regress the amount pledged to equity crowdfunding campaigns on both CSC variables, i.e., at the level of the province of birth and the province of residence (Table 7). In so doing, we disentangle the individual contributions of these two CSC variables. To carry out these empirical investigations, we will rely on a sample of approximately 8.5k investments (against 11k investments in our full sample), as for about one-fourth of the

investments, the Business Register does not report information on an investor's place of living.

*Please insert Table 6 here*

Table 6 is similar to Table 5 but includes *CSC* at the level of an investor's province of residence rather than in the province of birth. The same geographic localization is applied to all control variables, including provincial-level controls, which are now measured at the level of an investor's place of living. *CSC* is still insignificant *per se* and significant when interacted with the variables measuring a campaign's riskiness. However, and interestingly, the intensity of the statistical significance is weaker. *Tech x CSC* is positive and significant at only the 10% level, and *Unprofitable x CSC* is insignificant. Finally, the product between *CSC* and *High risk* is significant at the 5% level. As Table 2 shows, in approximately two-thirds of the investments, there is no difference between an investor's province of birth and province of living (the average of the dummy *Mover* is 34%). Therefore, while the results in Table 6 resemble those of Table 5, the weaker significance of the coefficients leads to a first support of H3, as inborn *CSC* seems to be a more important determinant than its environmental counterpart.

To shed more light on the individual contributions of these two *CSC* variables in explaining the amount invested, we now include both as regressors. We also include a *Mover* dummy and all provincial-level control variables, i.e., localized at the level of both birth and residence places. The results are reported in Table 7 (we suppress the visualization of all control variables for brevity and better readability).

*Please insert Table 7 here*

Compared to the previous tables, three comments are in order. First, *CSC* alone is insignificant, regardless of whether we localize it at the level of the province of birth or residence. Second, when interacting *CSC* with risk variables, only inborn *CSC* maintains its

significance, while CSC in the living place is never significant. This is evident in Model 3 for *Tech*, in Model 5 for *Unprofitable*, and in Model 8 for *High risk*. This result is noteworthy, as it confirms that the cultural dimension of CSC dominates the environmental dimension in explaining backers' behavior. Third, the dummy *Mover* is always insignificant. Movers are no different than individuals born and residing in the same province with regard to the amount invested in equity crowdfunding campaigns. Taken together, this evidence supports our third hypothesis, i.e., the notion that cooperative norms and beliefs linked to the place of birth remain ingrained in individuals' minds, similar to other dimensions of cultural heritage (Guiso et al., 2012), and affect their decisions regardless of the characteristics of the place in which such decisions are made.<sup>10</sup>

#### 5.2.4. Movers

The evidence hitherto discussed strongly points toward a relevant role of the investor's inborn CSC. However, possessing information on both the place of birth and the location of residence of an investor allows us to exploit movers in our sample and weaken endogeneity concerns. Movers also reinforce the conclusion on the prevalence of inborn over environmental CSC.

To confirm our baseline results for H1 and H2 in Table 5, we follow an "epidemiological approach" (Fernández, 2011), previously used in the literature on culture and economic outcomes by Ichino and Maggi (2000), Guiso et al. (2004), and Fernández and Fogli (2009), among others. Consideration of investors who no longer live where they were born allows us to control for the institutional environment shared by investors living in the same province (Guiso et al., 2015). In other words, movers permit the addition of province-of-residence fixed effects in all regressions.

Province-of-residence fixed effects control for all unobservables in an investor's area of residence that might affect the amount invested (e.g., the formal and informal institutional environment). This is a relevant exercise aimed at reducing endogeneity concerns, as unobservables at the provincial level with explanatory power for both the economic and industrial development of Italian provinces and their community-level social capital are subsumed in the province-of-residence fixed effects. We include these effects in Panel A of Table 8, where we repeat the analysis as in Table 5, and we add the dummy *Mover*. As before,

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<sup>10</sup> In untabulated results, we repeat the analysis in Table 7 only for a subsample of 2,246 investments made by movers. The results continue to hold and are available upon request.

we use heteroscedasticity-robust standard errors clustered at the level of the province of birth. All other variables are unchanged.

*Please insert Table 8 here*

Panel A of Table 8 shows that the results are robust and mostly unchanged. This evidence confirms that CSC plays an important role in explaining risky investment choices. This effect persists after controlling for province-of-residence fixed effects, i.e., the impact of formal and informal institutions in the place of residence and any indirect wealth effect associated with living in a richer and more economically developed province.

In Panel B of Table 8, we leverage on movers to further confirm the prevalence of cultural-level CSC over environmental-level CSC. We follow [Guiso et al. \(2004\)](#), and we replace the CSC variable with three distinct ones, i.e., (a) CSC of birth and (b) CSC of residence for investors who moved across provinces and (c) CSC of birth for nonmovers (identical to CSC of residence for these investors). The results in Panel B of Table 8 clearly show that CSC of birth prevails over CSC of residence in explaining the amount invested in riskier ventures. Focusing on movers, only the former is strongly significant, while the latter is insignificant in all specifications. This evidence consistently confirms the importance of the cultural inherited trait rather than the environmental dimension of CSC in explaining investors' behavior.

## **6. Robustness**

We now carry out a set of robustness exercises to validate our results. First, we ensure that our results are robust to a narrower definition of Unprofitable. Second, we exclude campaigns endowed with a hard cap provision and control for potential confounders due to highly successful campaigns. Third, we ensure that our results are not driven by economic disparities among Italian provinces. Fourth, we control for geographical proximity between investors and ventures and ventures' geographical distribution. Last, we replace the CSC index with each of its constituents.

### **6.1. Unprofitable as a risk measure**

Our sample is composed of successful campaigns launched by Italian limited liability companies. These firms are required by law to file several documents (including statutes, financial statements, and all shareholders) with the Business Register, a public register accessible to everyone. However, no profit and loss account is available in the short run if a firm is newly established. Unprofitable cannot be ex ante defined in such a case. We acknowledge this limitation of our Unprofitable dummy, and to support the validity of our results, we proceed as follows.

We check in our dataset whether the webpage of the crowdfunding campaign reports bottom-line profits (even preliminary and not yet filed) on the firm seeking funding. We flag campaigns for which there is no such information on the webpage and in the public Business Register. We exclude these campaigns from our sample and repeat the paper's main analyses. Panel A of Table 9 is the equivalent of Table 5 (CSC of birth), and Panel B of Table 9 replicates Table 7 (CSC of birth and residence). We report only the relevant covariates for better readability. Approximately 12% and 13% of the observations are dropped from the samples in Panel A and Panel B, respectively, but the results remain robust.

*Please insert Table 9 here*

## **6.2. Campaign-level checks**

A caveat in interpreting our results is that the presence of a hard cap provision might self-select the investments in our sample. Table 2 shows that approximately one-quarter of the campaigns have a hard cap. These campaigns end ahead of time, as soon as the target equity capital is reached. This provision may endogenously exclude potential investors who are willing to pledge but are precluded from investing due to the unexpected end of the collection period. While unlikely, we cannot rule out the possibility that our results are affected by such selection bias. To alleviate this concern, in Panel A of Table 10, we repeat our main analysis excluding campaigns with a hard cap. The results are robust despite the lower number of observations (7,896 versus 11,002, as in Table 5). All variables maintain their sign, significance, and magnitude. This also means that a potential selection bias is hardly an issue in our setting.

*Please insert Table 10 here*

We also acknowledge that CSC might be less important in explaining the amount pledged to very successful campaigns. Instead, the hype generated by such campaigns may be an important determinant of their success. Following this concern, we repeat our investigation excluding the first, fifth, and tenth upper percentiles of the cross-sectional distribution of the campaigns by amount raised. We present our results in Panel B of Table 10. Models 1 and 2 exclude the first percentile (2 campaigns), Models 3 and 4 exclude the first five percentiles (10 campaigns), and Models 5 and 6 exclude the first ten percentiles (18 campaigns). The results are mostly unchanged. Our results are also robust if we progressively exclude the first, fifth, and tenth lower percentiles of the cross-sectional distribution of the campaigns by their duration (in days), as campaigns that terminate rapidly can also be considered more successful. We do not tabulate these results for brevity.

### **6.3 Geographical subsamples**

Figure 1 shows a high concentration of CSC in some areas. No provinces in Southern Italy had a CSC score above the median (Figure 1A). Additionally, the first quartile of CSC is concentrated in the North, with many provinces in the Northeast. In our analysis, we use a rich set of provincial controls, but we cannot completely rule out the possibility that our results are driven by confounders, such as wealth, correlated with the regional distribution of CSC. We now repeat the main analysis progressively excluding investments made by pledgers born in provinces belonging to the highest decile, quartile, and 50th percentile of the cross-sectional distribution (by province) of CSC. The results reported in Panel A of Table 11 are qualitatively robust. It seems improbable that such confounders drive the evidence in Table 5.

*Please insert Table 11 here*

In Panel B of Table 11, we further analyze this issue with three additional checks. First, we exclude investments made by investors born in Lombardy, the first Italian region by per capita GDP and the most industrialized (by number of active firms, source: ISTAT). Investments made by pledgers born in Lombardy account for approximately 28% of our sample. We repeat the regressions in this subsample (Models 1 and 2 of Panel B, Table 11). The results confirm that our conclusions are unlikely to be driven by wealth and economic development.

In a second related and more drastic check (Models 3 and 4 of Panel B, Table 11), we exclude the top three Italian regions from the sample by per capita GDP. CSC and per capita GDP are positively but not perfectly correlated (in our sample, their correlation is approximately 50%, unreported). In addition to Lombardy, we drop investments made by pledgers born in Lazio (where the Italian capital, Rome, is located) and Veneto (in the northeast of the country). Lombardy, Lazio, and Veneto are also the first three regions by the number of active firms, as economic and industrial development are highly correlated. This is a drastic exercise, as all these investments account for approximately 43% of our sample. However, our previous conclusions hold.

Finally, we drop investments made by pledgers born in the three regions contributing more to equity crowdfunding (by the number of investments), i.e., Lombardy, Piedmont, and Emilia-Romagna. We are left with approximately half of the original sample. The results (Models 5 and 6 of Panel B, Table 11) are robust and confirm that our conclusions do not depend on the concentration of pledgers born in these regions.

#### **6.4. Venture location**

We previously controlled for the propensity of crowdfunders to invest in geographically closer projects through *Local home bias*, a dummy tracking investors born (residing) in the same province as the funded venture. This provincial-level variable is consistent with our geographical definition of CSC and allows us to control for within-community preferences potentially affecting our results. However, we now repeat our regressions replacing *Local home bias* with *Geographical proximity*, i.e., the inverse of the square root of the minimum linear distance between each investor's municipality of birth and the venture's exact address (Giudici et al., 2020). *Geographical proximity* is a continuous measure of geographical proximity between investors and ventures. Models 1 and 2 of Table

12 show that the evidence is robust. *Geographical proximity* (as it previously was for *Local home bias*) is statistically insignificant.

*Please insert Table 12 here*

The Italian North-South divide correlates not only with the distribution of CSC across provinces but also with the geographic distribution of ventures. Approximately two-thirds of our campaigns are initiated by firms located in Northern Italy, while the rest are equally split between Central and Southern Italy (including islands). It may be argued that campaigns launched by firms located in the South are different (for instance, riskier) than those launched by firms located in Northern and Central Italy. It may also be argued that our results are partially driven by the interaction between the CSC of the investor and the CSC of the venture. To control for this, in Table 12, we repeat our analysis replacing the variable *Local home bias* with macroregional fixed effects (Models 3 and 4) and fixed effects at the level of the province in which the firm is headquartered (Models 5 and 6). All results are unchanged. In particular, the last two specifications are very restrictive. They exclude the possibility that our results are driven by formal and informal institutions in the province where the entrepreneur is located, also comprising their CSC.

### **6.5. Community-level social capital constituents**

In a final robustness exercise, we replace the CSC index with its constituents, as described in Section 4.2. Each of the five models in Table 13 uses a single CSC variable, i.e., voter turnout (Model 1), waste recycling (Model 2), number of nonprofit organizations (Model 3), number of volunteers (Model 4), and satisfaction with relationships with others (Model 5). The magnitude of the coefficients in Table 12 is affected by the different units of measure of these variables. However, the results are qualitatively robust, and the economic interpretation is unchanged.

*Please insert Table 13 here*

## 7. Conclusion

Equity crowdfunding is a viable and widespread financing alternative for early-stage firms around the globe. It represents a means of democratization in entrepreneurial finance, as it is available to traditionally underrepresented and financially constrained categories of entrepreneurs (Cumming et al., 2021; Butticiè and Vismara, 2022). However, equity crowdfunding is risky. Backers are generally unsophisticated, largely exposed to asymmetric information, a low expertise and quality of entrepreneurs, and opportunism (Giudici, 2015; Vismara, 2016, Blaseg et al., 2021; Ziegler et al., 2019). Investing in equity crowdfunding is even riskier than traditional early-stage financing, such as business angels and venture capitalists, because of the low contractual power of pledgers (Block et al., 2018).

Equity crowdfunding is an ideal laboratory to explore the role of trust-related cultural traits linked to CSC as factors influencing investment choices. We rely on a novel, hand-collected sample of all investments pledged to successful Italian equity crowdfunding campaigns initiated between 2014 and 2018, and we investigate the role of CSC in shaping individual investment decisions in a highly uncertain context. Unlike previous studies, this dataset allows us to explore the investment strategies individuals implement within a whole market.

We report two main findings. First, individuals endowed with higher inborn CSC invest more substantially in riskier campaigns. CSC does not alter the propensity of allocating more money in general, but it is crucial to determine the investment in riskier ventures. The impact of inborn CSC is economically relevant, as a one standard deviation change in CSC yields a 13% increase in the amount pledged to high-risk campaigns. Second, the effect of cultural-level CSC on investment choices persists after accounting for the potential role of CSC in the place of living. This evidence underscores how specific aspects of an investor's cultural makeup prevail over other potentially relevant environmental factors affecting investment behavior.

We advance original contributions to two strands of literature. First, we add to the understanding of how individuals make decisions in equity crowdfunding by focusing on the impact of CSC on their investment choices. To our knowledge, this is the first study analyzing the cross-section of actual investments in equity crowdfunding in a whole market that shows how CSC impacts individuals' decision-making. Second, and more generally, we contribute to the literature on how generalized trust and cultural traits affect an individual's investment

decisions, showing that inherited variables prevail over environmental traits in driving the creation of social capital. Overall, our work adds to the debate on challenges and opportunities in entrepreneurial finance. Digitalization has opened the door to new players and financing channels and broadened the range of financing opportunities for young and innovative firms (Block et al., 2018). Our study uses a dataset of Italian ventures and investors, yet we believe that our evidence can be, to some extent, generalized to other trust-intensive activities typical of the entrepreneurial finance context (e.g., different crowdfunding models and initial coin offerings) (Block et al., 2021). This is especially true in geographical regions where legal enforcement is weak (Hasan et al., 2020).

We recognize that our study also has weaknesses, mainly due to data limitations. First, our dataset does not contain information on investments submitted to unsuccessful campaigns. Second, we do not possess information on the residence of some investors. Third, we cannot obtain data on individual wealth in the Italian setting. Fourth, we do not directly test causality, as our setting does not allow for a quasi-experimental research design. While we cannot overcome such issues, we argue that our conclusions are unlikely to be reversed. Pledges to unsuccessful campaigns are modest, in both size and number. Missing data on investors' residence affects only one-quarter of the 11,002 investments in our sample. Individual wealth effects are proxied by a rich set of correlated provincial controls, as in other studies (e.g., Hervé et al., 2019; Shafi and Mohammadi, 2020). Lastly, the evidence we draw from the subsample of movers and several further robustness exercises suggests that alternative explanations (such as regional economic disparities) are unlikely to cause our results.

Finally, we acknowledge that a promising research avenue is to further study the mechanism through which CSC affects equity crowdfunding investments. According to modern portfolio theory, we might argue that generalized trust decreases relative risk aversion and increases the budget money invested in risky assets. Moreover, it could be worth exploring potential mediators of the CSC-investment behavior nexus, as observed investment choices could indeed be the result of unobserved attributes of proponents playing a role in the valuation process of individuals (Colombo et al., 2022). However, future research is needed to investigate this effect, and we welcome studies that add new evidence through surveys and interviews with equity crowdfunding pledgers.

We believe our findings are relevant for entrepreneurs and policy-makers alike. Entrepreneurs seeking funds through an equity crowdfunding campaign should be aware of a clientele effect.

High risk ventures are more likely to be supported by investors coming from high-CSC areas. Further evidence on what leads individuals to make investment choices in equity crowdfunding is also relevant to regulators evaluating the potential of innovative financing for firm growth and the protection of occasional investors.

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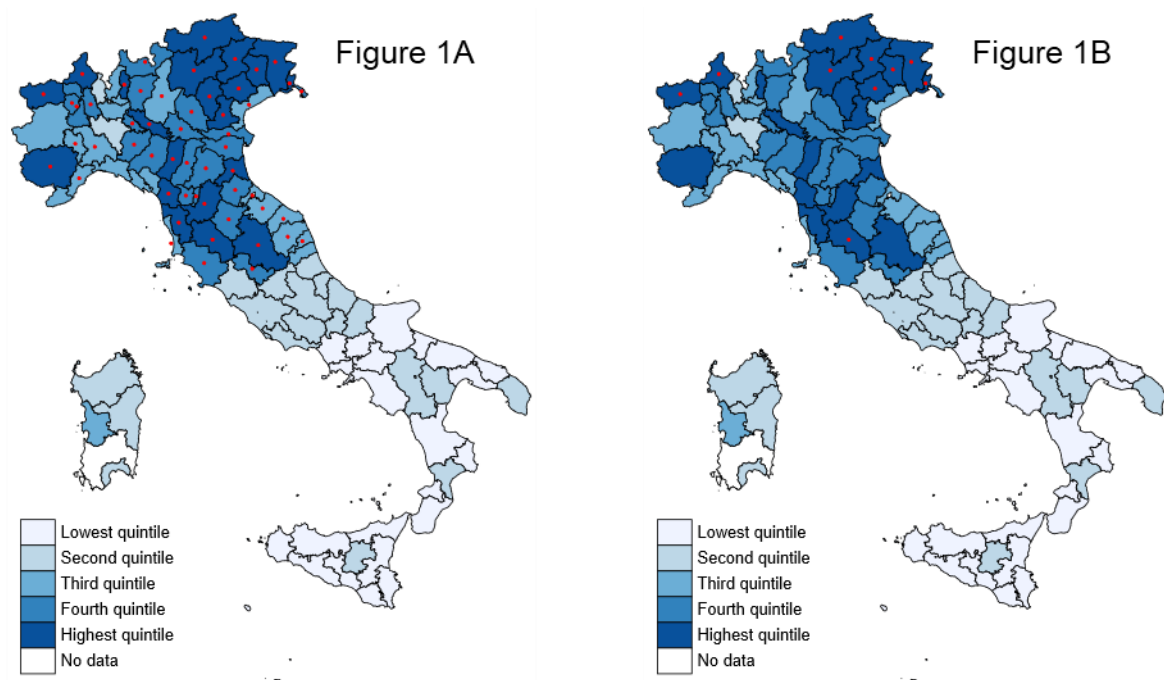
## Tables and Figures

<i>Panel A</i>	<b>Campaigns</b>		<b>Amount raised, €k</b>			<b>Pre-money value, €k</b>		
<b>Year</b>	<b>N</b>	<b>N, %</b>	<b>Total</b>	<b>Mean</b>	<b>Median</b>	<b>Total</b>	<b>Mean</b>	<b>Median</b>
2014	5	2.7	1,715.3	343.1	380.0	4,016	803.2	676.2
2015	9	4.9	3,008.7	334.3	240.0	15,200	1,684.9	1,215.0
2016	24	13.0	4,365.6	181.9	166.5	60,800	2,534.3	1,396.6
2017	47	25.4	14,600.0	310.8	193.3	271,000	5,767.4	2,077.8
2018	100	54.1	27,700.0	277.0	198.5	523,000	5,233.8	5,745.6
Total	185	100.0	51,389.6	277.8	199.0	874,016.0	4,724.4	2,077.8

<i>Panel B</i>	<b>Year</b>	<b>No. of investments</b>	<b>Mean contribution, €</b>	<b>Median contribution, €</b>
	2014	124	10,604.6	1,470.0
	2015	269	4,158.4	1,500.0
	2016	1,025	2,715.6	501.0
	2017	3,496	3,229.6	999.7
	2018	6,088	3,017.0	500.7
	Total	11,002	3,169.9	749.7

**Table 1** – *Campaigns and investments*. Panel A shows the number of funded crowdfunding campaigns launched between 2014 and 2018 in Italy. It also shows the total, average, and median amount raised (in € thousands) and the total, average, and median pre-money value of funded companies (in € thousands). Panel B shows the number of investments and the average and median contribution.



**Figure 1** – *Distribution of community-level social capital (CSC)*. Figure 1A shows the geographical distribution of the CSC index by quintiles across Italian provinces. Darker areas correspond to higher levels of CSC (larger quintiles). The red dots indicate provinces above the median of the CSC distribution. Figure 1B replicates the visual inspection of CSC by provinces, but highlights (red dots) provinces in the upper decile of CSC.

	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Q3</b>	<b>Max</b>
<b>Investments</b>								
<i>Amount invested, €</i>	11,002	3,169.9	15,814.4	90.0	495.0	749.7	1,999.4	1,083,951.0
<i>Female, %</i>	11,002	9.4	29.2	0	0	0	0	100
<i>Age, years</i>	11,002	43.1	11.5	18.0	35.0	42.0	50.0	97.0
<i>North, birth, %</i>	11,002	63.8	48.1	0	0	100	100	100
<i>Centre, birth, %</i>	11,002	14.8	35.5	0	0	0	0	100
<i>South and islands, birth, %</i>	11,002	21.4	41.0	0	0	0	0	100
<i>Local home bias, birth, %</i>	11,002	13.7	34.4	0	0	0	0	100
<i>First investment, %</i>	11,002	56.2	49.6	0	0	100	100	100
<i>North, residence, %</i>	8,459	71.2	45.3	0	0	100	100	100
<i>Centre, residence, %</i>	8,459	16.8	37.4	0	0	0	0	100
<i>South and islands, residence, %</i>	8,459	11.9	32.4	0	0	0	0	100
<i>Local home bias, residence, %</i>	8,459	16.5	37.1	0	0	0	0	100
<i>Mover, %</i>	8,459	33.7	47.3	0	0	0	100	100
<b>Campaigns</b>								
<i>Tech, %</i>	185	36.8	48.3	0	0	0	100	100
<i>Unprofitable, %</i>	185	71.9	45.1	0	0	100	100	100
<i>High risk (Tech x Unprofitable), %</i>	185	24.3	43.0	0	0	0	0	100
<i>Follow-on, %</i>	185	7.0	25.6	0	0	0	0	100
<i>Soft cap, %</i>	185	95.1	21.6	0	100	100	100	100
<i>Hard cap, %</i>	185	24.3	43.0	0	0	0	0	100
<b>Social capital and territorial controls</b>								
<i>Social capital</i>	106	0.0	1.9	-4.1	-1.3	0.6	1.4	5.8
<i>Turnout, %</i>	106	75.1	6.1	59.5	70.3	76.9	79.9	84.3
<i>Waste, %</i>	106	19.9	15.0	0.0	6.8	18.6	30.6	58.1
<i>Nonprofit, %</i>	106	1.1	0.3	0.4	0.9	1.2	1.3	2.1
<i>Volunteers, %</i>	106	17.8	8.0	3.9	11.6	18.1	22.1	60.2

<i>Satisfaction, %</i>	106	25.2	4.5	15.3	21.0	27.2	28.8	33.6
<i>Population density, inh/km<sup>2</sup></i>	106	271.4	383.2	35.6	106.8	177.9	277.6	2,630.5
<i>Household income, €</i>	106	30,300.2	4,534.7	22,054.0	26,242.0	31,477.0	34,253.0	39,217.0
<i>Number bank branches</i>	106	544.8	547.4	56.0	232.0	374.0	678.0	3,630.0
<i>GDP per capita, €</i>	106	25,609.0	7,098.2	14,699.7	18,694.3	25,641.6	30,535.2	52,409.7
<i>Education, %</i>	106	9.9	1.7	6.9	8.6	9.9	10.7	15.8

**Table 2 – Descriptive statistics.** The table reports the descriptive statistics of the variables. *Amount invested* is the amount pledged by each investment; *Female* is a dummy taking 1 if the investor's gender is female; *Age* is the age of the investor; *North, birth*, *Centre, birth*, and *South and islands, birth* are dummies taking the value of 1 if the investor is born in the North, Centre, or South (including islands) of Italy, respectively; *Local home bias, birth* is a dummy taking the value of 1 if the province of birth of the investor coincides with the province where the funded company is incorporated; *First investment* is a dummy variable taking the value of 1 for each investor's first (chronological) investment; *North, residence*, *Centre, residence*, and *South and islands, residence* are dummies taking the value of 1 if the investor lives in the North, Centre, or South (including islands) of Italy, respectively; *Local home bias, residence* is a dummy taking the value of 1 if the province of residence of the investor coincides with the province where the funded company is incorporated; *Mover* is a dummy taking the value of 1 if the investor lives in a province other than that in which they were born; *Tech* is a dummy taking the value of 1 if the funded project belongs to the categories of "Fintech," "Biotech/Pharma/Lifescience," or "Hi-Tech/IT/Communication" (proxying business risk); *Unprofitable* is a dummy taking the value of 1 if the funded company reports a negative net income in the year before the campaign or in the year in which the campaign has started (proxying financial risk); *High risk* is a dummy taking the value of 1 if the company is both *Tech* and *Unprofitable*; *Follow-on* is a dummy taking the value of 1 if the campaign is a second-round (or above) equity issuance; *Soft cap* is a dummy taking the value of 1 if the funded campaign requires a minimum amount to be raised for success; *Hard cap* is a dummy taking the value of 1 if the funded campaign has reached a maximum pre-established amount, and has closed before the planned end date; *CSC* is the community-level social capital index (for the 106 Italian provinces), and *Turnout*, *Waste*, *Nonprofit*, *Volunteers*, and *Satisfaction* are its five components (see Appendix A for their definition); *Population density* is the number of inhabitants per square kilometer in the province of birth of the investor (in 2016); *Household income* is the average household income in the province of birth of the investor (in 2016); *Number of bank branches* is the number of bank branches in the province of birth of the investor (in 2016); *GDP per capita* is the level of gross domestic product in the province of birth of the investor (in 2016); *Education* is the share of the population in the investor's province of birth reaching higher education (in 2011).

	Above median		Below median		Difference	t-statistic
	N	Mean	N	Mean		
<i>Amount invested, €</i>	5,375	3,378.5	5,627	2,970.6	407.9	1.34
<i>Tech, %</i>	5,375	38.0	5,627	37.2	0.8	0.86
<i>Amount invested, Tech = 1, €</i>	2,040	3,987.0	2,091	3,054.6	932.5	2.49 **
<i>Amount invested, Tech = 0, €</i>	3,335	3,006.3	3,536	2,920.9	85.4	0.20
<i>Unprofitable, %</i>	5,375	66.8	5,627	66.4	0.4	0.44
<i>Amount invested, Unprofitable = 1, €</i>	3,593	3,535.2	3,739	3,022.0	513.2	1.21
<i>Amount invested, Unprofitable = 0, €</i>	1,782	3,062.6	1,888	2,868.8	193.8	0.57
<i>High risk (Tech x Unprofitable), %</i>	5,375	26.5	5,627	25.9	0.6	0.67
<i>Amount invested, High risk = 1, €</i>	1,422	4,177.3	1,457	2,882.0	1,295.3	2.85 ***
<i>Amount invested, High risk = 0, €</i>	3,953	3,091.2	4,170	3,001.5	89.7	0.24
<i>Female, %</i>	5,375	9.6	5,627	9.2	0.4	0.81
<i>Age, years</i>	5,375	43.9	5,627	42.4	1.5	7.06 ***
<i>North, birth, %</i>	5,375	83.2	5,627	45.3	37.9	45.33 ***
<i>Centre, birth, %</i>	5,375	16.8	5,627	12.9	3.9	5.80 ***
<i>South and islands, birth, %</i>	5,375	0.0	5,627	41.9	-41.9	-63.66 ***
<i>Local home bias, birth, %</i>	5,375	11.4	5,627	15.9	-4.4	-6.79 ***
<i>First investment, %</i>	5,375	57.9	5,627	59.6	-1.7	-1.84 *
<i>North, residence, %</i>	4,162	82.8	4,297	60.0	22.8	24.06 ***
<i>Centre, residence, %</i>	4,162	16.4	4,297	17.2	-0.8	-0.94
<i>South and islands, residence, %</i>	4,162	0.7	4,297	22.8	-22.1	-33.77 ***
<i>Local home bias, residence, %</i>	4,162	13.0	4,297	19.8	-6.8	-8.46 ***
<i>Mover, %</i>	4,162	27.7	4,297	39.6	-11.9	-11.69 ***

**Table 3** – *Descriptive statistics of investments by CSC*. The table reports the descriptive statistics of the sample of investments by median of investor's CSC. All variables are defined in Table 2. Mean differences and their t-statistics are reported. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

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	#1	#2	#3	#4	#5	#6	#7	#8	#9
#1 CSC	1.00								
#2 <i>Log amount invested</i>	<b>0.032*</b>	1.00							
#3 <i>Female</i>	0.02	<b>0.041*</b>	1.00						
#4 <i>Age</i>	<b>0.072*</b>	<b>0.238*</b>	<b>0.085*</b>	1.00					
#5 <i>Local home bias, birth</i>	<b>0.083*</b>	<b>0.062*</b>	<b>0.076*</b>	<b>0.043*</b>	1.00				
#6 <i>North, birth</i>	<b>0.686*</b>	<b>0.055*</b>	0.00	<b>0.069*</b>	<b>0.130*</b>	1.00			
#7 <i>South and islands, birth</i>	<b>-0.824*</b>	<b>-0.056*</b>	<b>-0.016*</b>	<b>-0.080*</b>	<b>-0.105*</b>	<b>-0.693*</b>	1.00		
#8 <i>First investment</i>	0.00	<b>0.048*</b>	<b>0.128*</b>	<b>-0.051*</b>	<b>0.183*</b>	<b>-0.027*</b>	0.01	1.00	
#9 <i>Tech</i>	0.00	<b>0.070*</b>	0.01	<b>0.070*</b>	0.00	0.00	-0.02	<b>-0.071*</b>	1.00
#10 <i>Unprofitable</i>	<b>0.044*</b>	<b>0.016*</b>	0.01	<b>0.037*</b>	<b>0.059*</b>	<b>0.066*</b>	<b>-0.047*</b>	0.00	<b>0.050*</b>
#11 <i>High risk</i>	<b>0.020*</b>	<b>0.051*</b>	0.01	<b>0.045*</b>	-0.01	<b>0.032*</b>	<b>-0.038*</b>	<b>-0.050*</b>	<b>0.768*</b>
#12 <i>Follow-on</i>	<b>0.021*</b>	<b>0.078*</b>	-0.01	0.01	<b>0.020*</b>	<b>0.045*</b>	<b>-0.032*</b>	<b>-0.059*</b>	<b>0.119*</b>
#13 <i>Soft cap</i>	<b>-0.018*</b>	<b>-0.057*</b>	<b>0.017*</b>	-0.02	-0.01	<b>-0.028*</b>	<b>0.041*</b>	-0.01	<b>-0.217*</b>
#14 <i>Hard cap</i>	-0.01	<b>0.063*</b>	<b>-0.023*</b>	0.00	<b>-0.029*</b>	<b>0.019*</b>	-0.01	<b>-0.097*</b>	<b>0.034*</b>
#15 <i>Local home bias, residence</i>	0.00	<b>0.081*</b>	<b>0.089*</b>	<b>0.056*</b>	<b>0.722*</b>	<b>0.041*</b>	<b>-0.021*</b>	<b>0.213*</b>	0.01
#16 <i>North, residence</i>	<b>0.477*</b>	<b>0.055*</b>	-0.01	<b>0.069*</b>	<b>0.060*</b>	<b>0.781*</b>	<b>-0.462*</b>	<b>-0.054*</b>	<b>0.018*</b>
#17 <i>South and islands, residence</i>	<b>-0.521*</b>	<b>-0.043*</b>	-0.01	<b>-0.135*</b>	<b>-0.024*</b>	<b>-0.463*</b>	<b>0.673*</b>	<b>0.063*</b>	<b>-0.045*</b>
#18 <i>Mover</i>	<b>-0.171*</b>	<b>0.043*</b>	<b>-0.026*</b>	<b>0.111*</b>	<b>-0.144*</b>	<b>-0.140*</b>	<b>0.180*</b>	<b>-0.106*</b>	<b>0.018*</b>

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	#10	#11	#12	#13	#14	#15	#16	#17	#18
#10 <i>Unprofitable</i>	1.00								
#11 <i>High risk</i>	<b>0.421*</b>	1.00							
#12 <i>Follow-on</i>	<b>0.153*</b>	<b>0.163*</b>	1.00						
#13 <i>Soft cap</i>	<b>-0.122*</b>	<b>-0.278*</b>	<b>-0.569*</b>	1.00					
#14 <i>Hard cap</i>	0.01	<b>0.128*</b>	<b>0.329*</b>	<b>-0.200*</b>	1.00				
#15 <i>Local home bias, residence</i>	<b>0.081*</b>	<b>0.019*</b>	<b>0.054*</b>	<b>-0.030*</b>	<b>-0.021*</b>	1.00			
#16 <i>North, residence</i>	<b>0.064*</b>	<b>0.044*</b>	<b>0.057*</b>	<b>-0.028*</b>	<b>0.029*</b>	<b>0.089*</b>	1.00		
#17 <i>South and islands, residence</i>	<b>-0.055*</b>	<b>-0.061*</b>	<b>-0.033*</b>	<b>0.044*</b>	0.00	<b>-0.051*</b>	<b>0.089*</b>	1.00	
#18 <i>Mover</i>	<b>0.022*</b>	<b>0.025*</b>	<b>0.021*</b>	<b>-0.032*</b>	<b>0.053*</b>	-0.01	<b>-0.051*</b>	<b>-0.092*</b>	1.00

**Table 4** – *Correlation table*. The table shows the pairwise correlation of the variables. Statistically significant correlation coefficients (at the 1% level) are reported in bold. All variables are defined in Table 2.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
<i>CSC</i>	0.00651 (0.0284)	0.00548 (0.0285)	-0.00801 (0.0301)	0.00671 (0.0280)	-0.0184 (0.0325)	-0.0304 (0.0342)	0.00507 (0.0282)	-0.0115 (0.0300)
<i>Tech</i>		0.109*** (0.0247)	0.104*** (0.0242)			0.0994*** (0.0237)	0.255*** (0.0417)	0.254*** (0.0416)
<i>Tech x CSC</i>			0.0360*** (0.0137)			0.0336** (0.0134)		
<i>Unprofitable</i>				0.142*** (0.0300)	0.139*** (0.0287)	0.135*** (0.0291)	0.227*** (0.0353)	0.227*** (0.0353)
<i>Unprofitable x CSC</i>					0.0383** (0.0176)	0.0358** (0.0176)		
<i>High risk</i>							-0.227*** (0.0489)	-0.238*** (0.0469)
<i>High risk x CSC</i>								0.0623*** (0.0167)
<i>Female</i>	-0.00260 (0.0567)	-0.00519 (0.0564)	-0.00723 (0.0564)	-0.00572 (0.0565)	-0.00518 (0.0565)	-0.00949 (0.0561)	-0.00755 (0.0560)	-0.00960 (0.0560)
<i>Age</i>	0.0234*** (0.00170)	0.0231*** (0.00168)	0.0231*** (0.00168)	0.0233*** (0.00170)	0.0233*** (0.00169)	0.0230*** (0.00168)	0.0229*** (0.00168)	0.0229*** (0.00169)
<i>Local home bias, birth</i>	0.151 (0.107)	0.148 (0.102)	0.148 (0.102)	0.147 (0.107)	0.144 (0.108)	0.142 (0.102)	0.140 (0.0992)	0.137 (0.0976)
<i>North, birth</i>	0.148*** (0.0558)	0.151*** (0.0560)	0.152*** (0.0560)	0.140** (0.0558)	0.139** (0.0555)	0.144** (0.0557)	0.146** (0.0564)	0.146** (0.0561)
<i>South and islands, birth</i>	0.0433 (0.0777)	0.0447 (0.0781)	0.0476 (0.0784)	0.0499 (0.0778)	0.0483 (0.0773)	0.0522 (0.0781)	0.0409 (0.0776)	0.0368 (0.0771)
<i>First investment</i>	0.114*** (0.0414)	0.121*** (0.0411)	0.122*** (0.0411)	0.120*** (0.0410)	0.117*** (0.0404)	0.124*** (0.0401)	0.132*** (0.0408)	0.130*** (0.0407)
<i>Follow-on</i>	0.255*** (0.0606)	0.268*** (0.0609)	0.265*** (0.0606)	0.221*** (0.0619)	0.222*** (0.0615)	0.232*** (0.0615)	0.207*** (0.0625)	0.206*** (0.0621)
<i>Soft cap</i>	0.186** (0.0832)	0.244*** (0.0840)	0.245*** (0.0842)	0.209** (0.0828)	0.212** (0.0829)	0.267*** (0.0830)	0.231*** (0.0824)	0.236*** (0.0823)
<i>Hard cap</i>	0.155*** (0.0327)	0.161*** (0.0331)	0.161*** (0.0333)	0.156*** (0.0326)	0.154*** (0.0324)	0.160*** (0.0329)	0.179*** (0.0323)	0.179*** (0.0324)

<i>Log population density</i>	-0.0109 (0.0349)	-0.0123 (0.0344)	-0.0132 (0.0343)	-0.0105 (0.0342)	-0.0115 (0.0348)	-0.0135 (0.0343)	-0.0108 (0.0334)	-0.0120 (0.0336)
<i>Log household income</i>	-0.402 (0.254)	-0.388 (0.254)	-0.376 (0.254)	-0.390 (0.253)	-0.387 (0.254)	-0.363 (0.254)	-0.409 (0.249)	-0.407 (0.248)
<i>Log number bank branches</i>	0.0766** (0.0337)	0.0776** (0.0336)	0.0787** (0.0334)	0.0758** (0.0333)	0.0760** (0.0332)	0.0780** (0.0330)	0.0739** (0.0332)	0.0739** (0.0331)
<i>Log GDP per capita</i>	0.136 (0.235)	0.129 (0.236)	0.127 (0.235)	0.145 (0.233)	0.147 (0.233)	0.138 (0.232)	0.145 (0.232)	0.146 (0.231)
<i>Education</i>	-1.012 (1.508)	-0.923 (1.508)	-0.910 (1.500)	-1.123 (1.496)	-1.102 (1.491)	-1.004 (1.487)	-1.025 (1.496)	-0.999 (1.487)
<i>Constant</i>	8.356*** (3.147)	8.203** (3.130)	8.092** (3.122)	8.155** (3.112)	8.106** (3.129)	7.866** (3.106)	8.317*** (3.076)	8.286*** (3.058)
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	11,002	11,002	11,002	11,002	11,002	11,002	11,002	11,002
Adjusted R-squared	0.183	0.184	0.185	0.185	0.186	0.187	0.188	0.189

**Table 5** – *CSC and amount pledged to risky campaigns*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
<i>CSC, residence</i>	-0.00791 (0.0458)	-0.0107 (0.0460)	-0.0220 (0.0473)	-0.00806 (0.0455)	-0.0335 (0.0508)	-0.0460 (0.0523)	-0.0107 (0.0457)	-0.0266 (0.0476)
<i>Tech</i>		0.121*** (0.0347)	0.107*** (0.0324)			0.105*** (0.0335)	0.223*** (0.0517)	0.225*** (0.0518)
<i>Tech x CSC, residence</i>			0.0299* (0.0175)			0.0283 (0.0172)		
<i>Unprofitable</i>				0.0677 (0.0438)	0.0530 (0.0416)	0.0461 (0.0432)	0.120** (0.0461)	0.121*** (0.0459)
<i>Unprofitable x CSC, residence</i>					0.0377 (0.0255)	0.0365 (0.0254)		
<i>High risk</i>							-0.156** (0.0671)	-0.186*** (0.0663)
<i>High risk x CSC, residence</i>								0.0579** (0.0242)
<i>Female</i>	0.0203 (0.0771)	0.0189 (0.0765)	0.0172 (0.0766)	0.0204 (0.0769)	0.0199 (0.0771)	0.0169 (0.0766)	0.0195 (0.0765)	0.0178 (0.0767)
<i>Age</i>	0.0220*** (0.00348)	0.0217*** (0.00343)	0.0217*** (0.00344)	0.0220*** (0.00347)	0.0220*** (0.00347)	0.0217*** (0.00342)	0.0217*** (0.00344)	0.0216*** (0.00344)
<i>Local home bias, residence</i>	0.140 (0.127)	0.134 (0.123)	0.133 (0.122)	0.136 (0.129)	0.134 (0.129)	0.129 (0.124)	0.130 (0.122)	0.129 (0.121)
<i>North, residence</i>	0.147* (0.0762)	0.150* (0.0769)	0.152* (0.0771)	0.145* (0.0760)	0.145* (0.0762)	0.150* (0.0771)	0.150* (0.0767)	0.151* (0.0773)
<i>South and islands, residence</i>	0.129 (0.115)	0.131 (0.115)	0.130 (0.114)	0.132 (0.115)	0.128 (0.116)	0.129 (0.115)	0.127 (0.115)	0.120 (0.114)
<i>First investment</i>	0.158*** (0.0487)	0.168*** (0.0490)	0.168*** (0.0490)	0.159*** (0.0484)	0.158*** (0.0484)	0.167*** (0.0488)	0.172*** (0.0488)	0.170*** (0.0487)
<i>Follow-on</i>	0.281*** (0.0652)	0.296*** (0.0661)	0.295*** (0.0659)	0.262*** (0.0704)	0.264*** (0.0703)	0.280*** (0.0716)	0.258*** (0.0739)	0.258*** (0.0738)
<i>Soft cap</i>	0.252*** (0.0859)	0.310*** (0.0906)	0.310*** (0.0909)	0.260*** (0.0861)	0.264*** (0.0856)	0.319*** (0.0901)	0.292*** (0.0946)	0.294*** (0.0943)
<i>Hard cap</i>	0.142*** (0.0279)	0.150*** (0.0282)	0.149*** (0.0283)	0.143*** (0.0279)	0.141*** (0.0279)	0.148*** (0.0283)	0.165*** (0.0281)	0.166*** (0.0281)

<i>Log population density, residence</i>	0.0324 (0.0408)	0.0299 (0.0409)	0.0292 (0.0411)	0.0323 (0.0406)	0.0304 (0.0413)	0.0274 (0.0415)	0.0311 (0.0409)	0.0288 (0.0415)
<i>Log household income, residence</i>	-0.270 (0.358)	-0.249 (0.357)	-0.239 (0.358)	-0.269 (0.357)	-0.262 (0.358)	-0.232 (0.359)	-0.270 (0.352)	-0.259 (0.354)
<i>Log number bank branches, residence</i>	0.0591 (0.0454)	0.0611 (0.0452)	0.0621 (0.0450)	0.0591 (0.0452)	0.0585 (0.0453)	0.0615 (0.0449)	0.0598 (0.0449)	0.0595 (0.0448)
<i>Log GDP per capita, residence</i>	0.238 (0.334)	0.235 (0.333)	0.233 (0.332)	0.242 (0.333)	0.247 (0.334)	0.241 (0.331)	0.240 (0.331)	0.243 (0.330)
<i>Education</i>	-3.505* (2.049)	-3.444* (2.067)	-3.421 (2.067)	-3.547* (2.049)	-3.508* (2.061)	-3.424 (2.080)	-3.479* (2.064)	-3.434 (2.069)
<i>Constant</i>	5.968 (4.409)	5.710 (4.387)	5.623 (4.398)	5.926 (4.382)	5.823 (4.416)	5.498 (4.408)	5.908 (4.368)	5.775 (4.390)
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,459	8,459	8,459	8,459	8,459	8,459	8,459	8,459
Adjusted R-squared	0.173	0.175	0.175	0.173	0.174	0.175	0.175	0.176

**Table 6** – *CSC of residence and amount pledged to risky campaigns*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of residence of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>	<b>Model (5)</b>	<b>Model (6)</b>	<b>Model (7)</b>	<b>Model (8)</b>
<i>CSC, birth</i>	0.00395 (0.0472)	0.00550 (0.0471)	-0.0175 (0.0475)	0.00354 (0.0473)	-0.0356 (0.0511)	-0.0527 (0.0520)	0.00442 (0.0471)	-0.0204 (0.0476)
<i>CSC, residence</i>	-0.0183 (0.0507)	-0.0222 (0.0507)	-0.0121 (0.0505)	-0.0180 (0.0510)	-0.00823 (0.0517)	-0.00477 (0.0515)	-0.0214 (0.0508)	-0.0148 (0.0505)
<i>Tech</i>		0.121*** (0.0325)	0.121*** (0.0297)			0.118*** (0.0299)	0.223*** (0.0538)	0.223*** (0.0534)
<i>Tech x CSC, birth</i>			0.0617*** (0.0176)			0.0582*** (0.0178)		
<i>Tech x CSC, residence</i>			-0.0253 (0.0260)			-0.0235 (0.0260)		
<i>Unprofitable</i>				0.0657* (0.0388)	0.0635* (0.0356)	0.0559 (0.0370)	0.118*** (0.0413)	0.118*** (0.0413)
<i>Unprofitable x CSC, birth</i>					0.0576*** (0.0200)	0.0531** (0.0205)		
<i>Unprofitable x CSC, residence</i>					-0.0145 (0.0245)	-0.0114 (0.0241)		
<i>High risk</i>							-0.155*** (0.0528)	-0.164*** (0.0540)
<i>High risk x CSC, birth</i>								0.0895*** (0.0214)
<i>High risk x CSC, residence</i>								-0.0214 (0.0289)
<i>Mover</i>	0.0622 (0.0534)	0.0604 (0.0535)	0.0631 (0.0531)	0.0630 (0.0534)	0.0632 (0.0536)	0.0638 (0.0533)	0.0609 (0.0535)	0.0638 (0.0531)
<i>Constant</i>	6.872 (4.206)	6.578 (4.187)	6.505 (4.180)	6.810 (4.175)	6.689 (4.192)	6.345 (4.170)	6.753 (4.154)	6.639 (4.133)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Observations	8,459	8,459	8,459	8,459	8,459	8,459	8,459	8,459
Adjusted R-squared	0.177	0.178	0.179	0.177	0.178	0.180	0.179	0.181

**Table 7** – *CSC of birth, CSC of residence, and amount pledged to risky campaigns*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). All covariates are defined in Table 2, and all controls are included both at the level of the province of birth and residence. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

<b>Panel A</b>				
	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>
<i>CSC</i>	-0.0153 (0.0464)	-0.0386 (0.0525)	-0.0490 (0.0532)	-0.0214 (0.0468)
<i>Tech</i>	0.113*** (0.0318)		0.111*** (0.0321)	0.205*** (0.0569)
<i>Tech x CSC</i>	0.0408*** (0.0139)		0.0381*** (0.0138)	
<i>Unprofitable</i>		0.0441 (0.0364)	0.0372 (0.0380)	0.0935** (0.0433)
<i>Unprofitable x CSC</i>		0.0531** (0.0222)	0.0511** (0.0225)	
<i>High risk</i>				-0.144*** (0.0537)
<i>High risk x CSC</i>				0.0733*** (0.0179)
<i>Mover</i>	0.0601 (0.0429)	0.0606 (0.0433)	0.0603 (0.0433)	0.0602 (0.0431)
<i>Constant</i>	12.58** (5.135)	12.91** (5.159)	12.56** (5.157)	12.55** (5.136)
<i>Control variables</i>	Yes	Yes	Yes	Yes
<i>Residence FE</i>	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes
Observations	8,459	8,459	8,459	8,459
Adjusted R-squared	0.198	0.197	0.199	0.199

<b>Panel B</b>				
	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>
<i>CSC (non movers)</i>	-0.0479 (0.0401)	-0.0584 (0.0416)	-0.0733 (0.0439)	-0.0529 (0.0400)
<i>CSC, birth (movers)</i>	0.0177 (0.0534)	-0.00329 (0.0575)	-0.0180 (0.0581)	0.0130 (0.0538)
<i>CSC, residence (movers)</i>	0.0242 (0.0517)	0.0114 (0.0562)	0.0241 (0.0554)	0.0176 (0.0531)
<i>Tech</i>	0.124*** (0.0290)		0.121*** (0.0293)	0.223*** (0.0531)
<i>Tech x CSC (non-movers)</i>	0.0429* (0.0238)		0.0409* (0.0234)	
<i>Tech x CSC, birth (movers)</i>	0.0539*** (0.0175)		0.0507*** (0.0177)	
<i>Tech x CSC, residence (movers)</i>	-0.0525 (0.0377)		-0.0500 (0.0380)	
<i>Unprofitable</i>		0.0627* (0.0356)	0.0546 (0.0370)	0.116*** (0.0412)
<i>Unprofitable x CSC (non-movers)</i>		0.0405 (0.0276)	0.0383 (0.0277)	

<i>Unprofitable x CSC, birth (movers)</i>	0.0580**	0.0541**		
	(0.0221)	(0.0222)		
<i>Unprofitable x CSC, residence (movers)</i>	-0.00612	-0.000967		
	(0.0316)	(0.0316)		
<i>High risk</i>				-0.161***
				(0.0531)
<i>High risk x CSC (non-movers)</i>				0.0770***
				(0.0289)
<i>High risk x CSC, birth (movers)</i>				0.0808***
				(0.0214)
<i>High risk x CSC, residence (movers)</i>				-0.0490
				(0.0383)
<i>Constant</i>	6.598	6.780	6.452	6.736
	(4.136)	(4.159)	(4.134)	(4.100)
<i>Control variables</i>	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes
<i>Observations</i>	8,459	8,459	8,459	8,459
<i>Adjusted R-squared</i>	0.180	0.179	0.181	0.182

**Table 8** – *CSC and investment in high-risk campaigns, movers*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Panel A also includes province-of-residence fixed effects. Territorial controls in Panel A are measured at the level of the province of birth. Territorial controls in Panel B are measured both at the level of the province of birth and the province of residence of the investor. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

<b>Panel A</b>								
	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>	<b>Model (5)</b>	<b>Model (6)</b>	<b>Model (7)</b>	<b>Model (8)</b>
<i>CSC</i>	0.00185 (0.0297)	0.000425 (0.0300)	-0.0102 (0.0308)	0.00163 (0.0291)	-0.0262 (0.0337)	-0.0348 (0.0345)	2.57e-05 (0.0295)	-0.0155 (0.0307)
<i>Tech</i>		0.136*** (0.0227)	0.132*** (0.0221)			0.123*** (0.0225)	0.327*** (0.0445)	0.326*** (0.0444)
<i>Tech x CSC</i>			0.0293** (0.0124)			0.0250** (0.0122)		
<i>Unprofitable</i>				0.163*** (0.0319)	0.158*** (0.0297)	0.151*** (0.0304)	0.275*** (0.0382)	0.275*** (0.0382)
<i>Unprofitable x CSC</i>					0.0447** (0.0187)	0.0418** (0.0189)		
<i>High risk</i>							-0.311*** (0.0614)	-0.321*** (0.0582)
<i>High risk x CSC</i>								0.0613*** (0.0172)
<i>Constant</i>	7.916** (3.218)	7.845** (3.212)	7.769** (3.191)	7.582** (3.172)	7.558** (3.180)	7.444** (3.157)	7.930** (3.177)	7.955** (3.146)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,670	9,670	9,670	9,670	9,670	9,670	9,670	9,670
Adjusted R-squared	0.186	0.189	0.189	0.190	0.191	0.193	0.194	0.196
<b>Panel B</b>								
	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>	<b>Model (5)</b>	<b>Model (6)</b>	<b>Model (7)</b>	<b>Model (8)</b>
<i>CSC, birth</i>	-0.0105	-0.00913	-0.0281	-0.0110	-0.0460	-0.0589	-0.00995	-0.0293

	(0.0479)	(0.0480)	(0.0483)	(0.0479)	(0.0524)	(0.0533)	(0.0478)	(0.0487)
<i>CSC, residence</i>	-0.0155	-0.0195	-0.0111	-0.0155	-0.0178	-0.0145	-0.0188	-0.0200
	(0.0522)	(0.0521)	(0.0529)	(0.0524)	(0.0528)	(0.0535)	(0.0521)	(0.0526)
<i>Tech</i>		0.149***	0.150***			0.146***	0.311***	0.312***
		(0.0299)	(0.0280)			(0.0291)	(0.0547)	(0.0544)
<i>Tech x CSC, birth</i>			0.0549***			0.0505***		
			(0.0171)			(0.0170)		
<i>Tech x CSC, residence</i>			-0.0247			-0.0257		
			(0.0282)			(0.0282)		
<i>Unprofitable</i>				0.0797*	0.0698*	0.0577	0.164***	0.165***
				(0.0402)	(0.0368)	(0.0386)	(0.0430)	(0.0431)
<i>Unprofitable x CSC, birth</i>					0.0550***	0.0501**		
					(0.0202)	(0.0205)		
<i>Unprofitable x CSC, residence</i>					0.00329	0.00611		
					(0.0274)	(0.0271)		
<i>High risk</i>							-0.256***	-0.273***
							(0.0662)	(0.0673)
<i>High risk x CSC, birth</i>								0.0808***
								(0.0240)
<i>High risk x CSC, residence</i>								-0.00325
								(0.0347)
<i>Constant</i>	5.563	5.477	5.411	5.434	5.338	5.231	5.666	5.513
	(4.393)	(4.383)	(4.360)	(4.342)	(4.356)	(4.330)	(4.366)	(4.324)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,284	7,284	7,284	7,284	7,284	7,284	7,284	7,284
Adjusted R-squared	0.180	0.182	0.183	0.180	0.182	0.185	0.184	0.186

**Table 9** – *CSC and investment in high-risk campaigns, narrower definition of Unprofitable*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (Log Amount Invested). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Campaigns for which there is no information on bottom-line profits on the webpage or in the public Business Register are dropped. Panel A replicates Table 5, while Panel B replicates Table 7. Territorial controls in Panel A are measured at the level of the province of birth. Territorial controls in Panel B are measured both at the level of the province of birth and the province of residence of the investor. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

**Panel A**

	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>
<i>CSC</i>	0.00207 (0.0321)	-0.0148 (0.0331)	-0.0277 (0.0351)	-0.00402 (0.0312)
<i>Tech</i>	0.0935*** (0.0264)		0.110*** (0.0250)	0.392*** (0.0532)
<i>Tech x CSC</i>	0.0262* (0.0152)		0.0289* (0.0151)	
<i>Unprofitable</i>		0.182*** (0.0353)	0.193*** (0.0342)	0.382*** (0.0405)
<i>Unprofitable x CSC</i>		0.0411** (0.0187)	0.0426** (0.0188)	
<i>High risk</i>				-0.449*** (0.0654)
<i>High risk x CSC</i>				0.0622*** (0.0187)
<i>Constant</i>	7.632** (3.412)	7.346** (3.375)	7.254** (3.334)	7.584** (3.222)
Observations	7,896	7,896	7,896	7,896
Control variables	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Platform FE	Yes	Yes	Yes	Yes
Adjusted R-squared	0.193	0.197	0.199	0.205

**Panel B**

	<b>Model (1)</b> <b>&lt; 99 perc</b>	<b>Model (2)</b> <b>&lt; 99 perc</b>	<b>Model (3)</b> <b>&lt; 95 perc</b>	<b>Model (4)</b> <b>&lt; 95 perc</b>	<b>Model (5)</b> <b>&lt; 90 perc</b>	<b>Model (6)</b> <b>&lt; 90 perc</b>
<i>CSC</i>	-0.0300 (0.0343)	-0.0125 (0.0297)	-0.0402 (0.0385)	-0.0128 (0.0322)	-0.0326 (0.0414)	-0.00948 (0.0337)
<i>Tech</i>	0.0767*** (0.0238)	0.241*** (0.0426)	0.0203 (0.0258)	0.0139 (0.0481)	-0.0191 (0.0270)	-0.0367 (0.0534)
<i>Tech x CSC</i>	0.0261* (0.0135)		0.0397** (0.0161)		0.0298* (0.0161)	
<i>Unprofitable</i>	0.123*** (0.0296)	0.221*** (0.0351)	0.0443 (0.0375)	0.0404 (0.0422)	0.0667* (0.0351)	0.0575 (0.0447)
<i>Unprofitable x CSC</i>	0.0356* (0.0194)		0.0400* (0.0213)		0.0382 (0.0238)	
<i>High risk</i>		-0.253*** (0.0481)		0.00612 (0.0506)		0.0208 (0.0589)
<i>High risk x CSC</i>		0.0551*** (0.0173)		0.0613*** (0.0177)		0.0598*** (0.0186)

<i>Constant</i>	7.961** (3.127)	8.361*** (3.073)	8.785*** (3.333)	8.854*** (3.316)	8.369** (3.465)	8.373** (3.435)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Platform FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,448	10,448	9,091	9,091	8,501	8,501
Adjusted R-squared	0.179	0.181	0.179	0.179	0.175	0.175

**Table 10** – *CSC and investment in high-risk campaigns, campaign-level checks*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). Panel A excludes campaigns in which a hard cap was reached. Panel B excludes the first (Models 1 and 2), fifth (Models 3 and 4), and tenth (Models 5 and 6) upper percentile of the cross-sectional distribution of the campaigns by amount raised. All covariates are defined in Table 2. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

<b>Panel A</b>						
	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>	<b>Model (5)</b>	<b>Model (6)</b>
	<b>&lt;= 90 perc</b>	<b>&lt;= 90 perc</b>	<b>&lt;= 3rd quartile</b>	<b>&lt;= 3rd quartile</b>	<b>&lt;= median</b>	<b>&lt;= median</b>
<i>CSC</i>	-0.0433 (0.0358)	-0.0247 (0.0328)	-0.0459 (0.0488)	-0.0286 (0.0465)	-0.0865 (0.0517)	-0.0537 (0.0482)
<i>Tech</i>	0.101*** (0.0251)	0.248*** (0.0442)	0.132*** (0.0283)	0.290*** (0.0480)	0.105*** (0.0387)	0.255*** (0.0614)
<i>Tech x CSC</i>	0.0376** (0.0145)		0.0525*** (0.0171)		0.0388* (0.0200)	
<i>Unprofitable</i>	0.134*** (0.0305)	0.218*** (0.0370)	0.122*** (0.0333)	0.214*** (0.0422)	0.183*** (0.0431)	0.224*** (0.0530)
<i>Unprofitable x CSC</i>	0.0405* (0.0212)		0.0311 (0.0247)		0.0636** (0.0241)	
<i>High risk</i>		-0.224*** (0.0499)		-0.246*** (0.0598)		-0.217*** (0.0784)
<i>High risk x CSC</i>		0.0721*** (0.0180)		0.0738*** (0.0198)		0.0737*** (0.0207)
<i>Constant</i>	8.035** (3.079)	8.420*** (3.030)	8.774*** (3.174)	9.262*** (3.156)	6.782** (3.306)	7.524** (3.197)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
Observations	10,143	10,143	8,137	8,137	5,776	5,776
Adjusted R-squared	0.182	0.184	0.191	0.193	0.183	0.185

<b>Panel B</b>						
	<b>Model (1)</b>	<b>Model (2)</b>	<b>Model (3)</b>	<b>Model (4)</b>	<b>Model (5)</b>	<b>Model (6)</b>
	<b>w/o Lombardy</b>	<b>w/o Lombardy</b>	<b>w/o top3 (GDP)</b>	<b>w/o top3 (GDP)</b>	<b>w/o top3 (inv)</b>	<b>w/o top3 (inv)</b>
<i>CSC</i>	-0.0441 (0.0380)	-0.0198 (0.0341)	-0.0358 (0.0413)	-0.0116 (0.0369)	-0.0900** (0.0380)	-0.0630* (0.0336)
<i>Tech</i>	0.104*** (0.0247)	0.268*** (0.0475)	0.0927*** (0.0269)	0.242*** (0.0494)	0.102*** (0.0306)	0.230*** (0.0626)
<i>Tech x CSC</i>	0.0355** (0.0140)		0.0320** (0.0154)		0.0332** (0.0147)	
<i>Unprofitable</i>	0.159*** (0.0269)	0.252*** (0.0373)	0.124*** (0.0289)	0.207*** (0.0405)	0.196*** (0.0299)	0.254*** (0.0455)
<i>Unprofitable x CSC</i>	0.0433** (0.0171)		0.0384** (0.0172)		0.0510*** (0.0181)	
<i>High risk</i>		-0.253*** (0.0610)		-0.231*** (0.0672)		-0.191** (0.0735)
<i>High risk x CSC</i>		0.0657*** (0.0177)		0.0548*** (0.0195)		0.0697*** (0.0181)
<i>Constant</i>	7.544* (4.267)	8.098* (4.224)	10.35** (4.285)	10.96** (4.227)	4.172 (4.312)	4.744 (4.261)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	7,957	7,957	6,326	6,326	5,859	5,859
<i>Adjusted R-squared</i>	0.198	0.200	0.204	0.206	0.211	0.212

**Table 11** – *CSC and investment in high-risk campaigns, geographical subsamples*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). In Panel A, the analysis excludes investments by investors in the upper decile (Models 1 and 2), quartile (Models 3 and 4), and above the median (Models 5 and 6) of *CSC*. In Panel B, the analysis excludes investors born in Lombardy (Models 1 and 2), in the top-three regions by regional-level GDP (Lombardy, Lazio, and Veneto, Models 3 and 4), and in the top-three regions by number of investments (Lombardy, Piedmont, and Emilia-Romagna, Models 5 and 6). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)
<i>CSC</i>	-0.0309 (0.0347)	-0.0118 (0.0304)	-0.0330 (0.0345)	-0.0139 (0.0303)	-0.0334 (0.0336)	-0.0134 (0.0281)
<i>Tech</i>	0.0989*** (0.0226)	0.257*** (0.0408)	0.120*** (0.0232)	0.233*** (0.0424)	0.163*** (0.0317)	0.322*** (0.0577)
<i>Tech x CSC</i>	0.0341** (0.0134)		0.0303** (0.0135)		0.0229* (0.0124)	
<i>Unprofitable</i>	0.136*** (0.0290)	0.230*** (0.0360)	0.136*** (0.0290)	0.204*** (0.0349)	0.106*** (0.0314)	0.198*** (0.0428)
<i>Unprofitable x CSC</i>	0.0360** (0.0177)		0.0364** (0.0170)		0.0395** (0.0184)	
<i>High risk</i>		-0.243*** (0.0482)		-0.179*** (0.0517)		-0.233*** (0.0645)
<i>High risk x CSC</i>		0.0629*** (0.0167)		0.0597*** (0.0166)		0.0529*** (0.0162)
<i>Geographical proximity (birth)</i>	0.0887 (0.0684)	0.0864 (0.0668)				
<i>Constant</i>	7.663** (3.148)	8.102** (3.089)	7.235** (3.090)	7.612** (3.039)	7.350** (2.885)	7.564*** (2.847)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes	Yes
<i>Venture macro-region FE</i>	No	No	Yes	Yes	No	No
<i>Venture province FE</i>	No	No	No	No	Yes	Yes
Observations	11,002	11,002	11,002	11,002	11,002	11,002
Adjusted R-squared	0.187	0.188	0.190	0.191	0.213	0.214

**Table 12** – *CSC and investment in high-risk campaigns, venture location controls*. The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). The analysis controls for the geographical distance between investor's municipality of birth and venture location's address (Models 1 and 2), venture's macro-regional distribution (Models 3 and 4), and venture's provincial distribution (Models 5 and 6). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

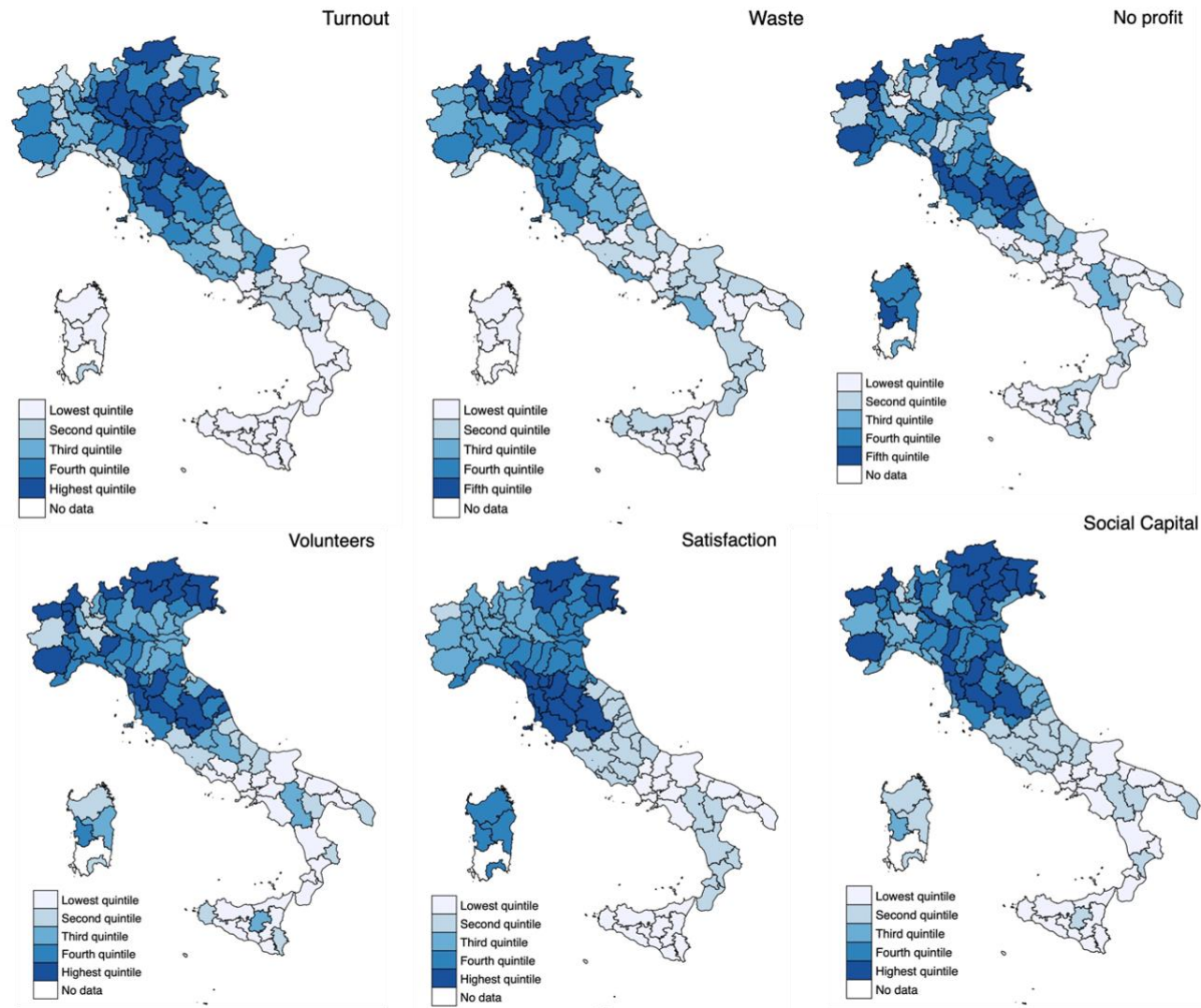
	<b>Model (1) Turnout</b>	<b>Model (2) Waste</b>	<b>Model (3) Nonprofit</b>	<b>Model (4) Volunteers</b>	<b>Model (5) Satisfaction</b>
<i>Turnout</i>	-1.428** (0.714)				
<i>Waste</i>		0.0883 (0.205)			
<i>Nonprofit</i>			-18.92 (15.28)		
<i>Volunteers</i>				-0.336 (0.553)	
<i>Satisfaction</i>					0.778 (0.949)
<i>Tech</i>	0.257*** (0.0412)	0.255*** (0.0417)	0.254*** (0.0417)	0.254*** (0.0416)	0.253*** (0.0419)
<i>Unprofitable</i>	0.228*** (0.0348)	0.228*** (0.0354)	0.226*** (0.0354)	0.226*** (0.0353)	0.227*** (0.0353)
<i>High risk</i>	-1.673*** (0.413)	-0.385*** (0.0722)	-0.497*** (0.117)	-0.412*** (0.106)	-0.860*** (0.180)
<i>Turnout x High risk</i>	1.870*** (0.531)				
<i>Waste x High risk</i>		0.609*** (0.184)			
<i>Nonprofit x High risk</i>			26.04** (9.984)		
<i>Volunteers x High risk</i>				1.087* (0.560)	
<i>Satisfaction x High risk</i>					2.471*** (0.675)
<i>Constant</i>	6.630*** (2.092)	9.559*** (2.584)	7.837*** (2.404)	7.939*** (2.587)	9.229*** (2.522)
<i>Control variables</i>	Yes	Yes	Yes	Yes	Yes
<i>Time FE</i>	Yes	Yes	Yes	Yes	Yes
<i>Platform FE</i>	Yes	Yes	Yes	Yes	Yes
<i>Observations</i>	11,002	11,002	11,002	11,002	11,002
<i>Adjusted R-squared</i>	0.189	0.189	0.189	0.188	0.189

**Table 13** – *CSC components and investment in high-risk campaigns.* The table reports the coefficients of a linear regression for the natural logarithm of the amount invested (*Log Amount Invested*). Each model uses a single CSC component, i.e., voter turnout (Model 1), waste recycling (Model 2), number of nonprofit organizations (Model 3), number of volunteers (Model 4), and satisfaction with relationships with others (Model 5). All covariates are defined in Table 2. All regressions include time and platform fixed effects. Heteroscedasticity-robust standard errors clustered at the level of the province of birth of the investor are in parentheses. \*\*\*, \*\*, \*, denote statistical significance at the 1, 5, and 10% level, respectively.

## Appendix. Community-level social capital (CSC) proxies and index

Variable	Variable name	Description	Source	Factor Loadings
Voter turnout	Turnout	Percentage of voters in 2013 National Parliament election in the province.	Italian Ministry of Internal Affairs	0.417
Recycling	Waste	Ratio of the amount of waste collected for recycling to the total amount of waste produced in the province in 2003, weighted by percentage of the population in the province covered by waste sorting services.	ISTAT	0.407
Number of nonprofit organizations	Nonprofit	Ratio of the number of nonprofit organizations to the province population in 2011.	ISTAT	0.450
Volunteers of nonprofit organizations	Volunteers	Ratio of the number of volunteers of nonprofit organizations to the province population in 2011.	ISTAT	0.483
Satisfaction with relationships with friends	Satisfaction	People aged 14 and older satisfied with their relationships with friends in 2011. This datapoint is at the regional level.	ISTAT	0.474

**Table A1** – *Variables included in the Principal Component Analysis and factor loadings.* This Table describes the five proxies of CSC included in the Principal Component Analysis, along with their source. It also reports the factor loadings for the first principal component (CSC). All factors are positively correlated with CSC and are roughly equally weighted in the index.



**Figure A1** – *Distribution of CSC constituents.* The Figure shows the geographical distribution of *Turnout*, *Waste*, *Nonprofit*, *Volunteers*, *Satisfaction*, along with *CSC*, by quintiles across Italian provinces. Darker areas correspond to higher levels of CSC (higher quintiles).

## ESSAY TWO

### CFO pay convexity, risk-taking, and corporate hedging\*

#### Abstract

We study how a CFO's risk-taking incentives affect corporate hedging. We utilize hand-collected data from 2009–2019 on corporate hedging and managerial compensation for a sample of US oil and gas firms. The relative convexity of CFO's equity compensation negatively affects hedging likelihood and extent. When CFO and CEO have diverging risk-taking incentives, the relative convexity of the CFO's equity payoff prevails over that of the CEO. This evidence underscores the primary role of the CFO in steering a firm's hedging strategy.

**JEL Classification:** G30; G32.

**Keywords:** CFO; Compensation; Hedging; Derivatives

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\*This paper is co-authored with Massimiliano Barbi (Department of Management, University of Bologna) and Irene Massimiliani (Accenture, Milan). CRediT author statement (in alphabetical order): Massimiliano Barbi: conceptualization, writing (original draft), writing (review and editing); Valentina Febo: conceptualization, data curation, formal analysis, writing (original draft), writing (review and editing); Irene Massimiliani: data curation, writing (original draft).

## 1. Introduction

The identity and attributes of top management are key determinants of a firm's strategy and organizational outcomes (Hambrick and Mason, 1984; Hambrick, 2007; Quigley and Hambrick, 2015). The chief executive officer (CEO) plays a prominent role among all senior executives, and extensive research has examined the CEO's role as the key decision-maker in corporate strategy and performance (e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Pérez-González, 2006; Bennedsen et al., 2007; Bloom et al., 2013; Custódio and Metzger, 2014; Bernile et al., 2017; Bennedsen et al., 2020). While the CEO is a firm's highest-ranking executive, the second most important senior manager is likely to be the chief financial officer (CFO) (Zorn, 2004; Uhde et al., 2017).

The responsibilities of the CFO have increased in recent decades, and they now extend beyond their original role of supervising financial reporting and planning (Hoitash et al., 2016). The CFO not only advises the CEO and oversees external financial communication but also plays a crucial role in capital budgeting, cash management, capital structure, and financial risk management (Schopohl et al., 2021). Therefore, the CFO has progressed, becoming the second-in-command, and they are directly involved in shaping and executing a firm's corporate strategy (Zorn, 2004; Indjejikian and Matejka, 2009; Huang and Kisgen, 2013; Datta and Datta, 2014; Uhde et al., 2017).

Despite the CFO's relevance, the literature has paid far less attention to the contributions of a CFO than to those of a CEO and has largely "*ignored [their] central role as a key decision maker*" (Uhde et al., 2017; Gupta et al., 2020). This is somewhat surprising, as it has been established that CFOs and CEOs have different managerial personalities. Kaplan and Sorensen (2021) study the behavioral features of CEOs and CFOs using a sample of candidates for these positions. Their results show that CFOs and CEOs are diametrically opposite. CFOs have a lower general ability score and are more interpersonal, detail-focused, and analytical. In contrast, CEOs score higher in general ability, are more focused on execution, have greater strategic focus, and are more charismatic (Kaplan and Sorensen, 2021). Graham et al. (2013) administer a psychometric test to senior executives and measure their behavioral traits. The responses of 1,180 CEOs (out of 10,700 surveyed) and 549 CFOs

(out of about 9,000 surveyed) provide strong evidence that CFOs have a less optimistic view and are more risk-averse than CEOs.

Due to their specialized expertise and technical competency, one of CFOs' most sophisticated areas of responsibility is risk management (Copeland, 2001; Hoitash et al., 2016). According to a 2010 global survey of more than 1,900 worldwide CFOs by the IBM Institute for Business Values, almost 80% of respondents classify managing and mitigating enterprise risk as "very" or "critically important" (IBM Institute for Business Values, 2010), nearly double the 40% who did so in the previous 2006 survey. McKinsey's 2016 Global Survey on the role of the CFO garnered responses from more than 500 CFOs globally.<sup>1</sup> On average, these indicate that risk management ranks first among the five nonfinancial accounting-related activities directly overseen by the CFO.

Hedging marketable risks is widespread. Recent academic surveys of CFOs (Giambona et al., 2018; Bodnar et al., 2019) show that nonfinancial firms extensively manage corporate exposures and that this evidence holds worldwide (see Bodnar et al., 1998, for the US; Bodnar and Gebhardt, 1999, for Germany; Mallin et al., 2001, for the UK; Bodnar et al., 2013, for Italy; among others). Almost 90% of the surveyed CFOs in Giambona et al. (2018) indicate that hedging increases a firm's cash flows, and nearly 80% conclude that it is ultimately value-increasing. The evidence that hedgers present higher performance and are worth more has also been established in several empirical studies (Carter et al., 2006; Allayannis et al., 2012; Pérez-González and Yun, 2013; Gilje and Taillard, 2017).

With few exceptions, most of the research on the relationship between managerial traits and hedging has evaluated the incentives of the CEO, who is viewed as the ultimate decision-maker (e.g., Kumar and Rabinovitch, 2013; Croci et al., 2017). However, risk management is primarily the result of the CFO's strategic choices. An example of the CFO's importance in steering a firm's hedging strategy is provided by Chesapeake Energy, an American oil and gas firm. On October 13, 2010, the firm announced that its CFO, Mark Rowland, would leave the company as of October 29, 2010. According to Reuters,<sup>2</sup> "Rowland [...] has been key in

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<sup>1</sup> Results are available at <https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/are-todays-cfos-ready-for-tomorrows-demands-on-finance>.

<sup>2</sup> The firm's press release can be found at <http://investors.chk.com/2010-10-13-chesapeake-energy-corporation-announces-marc-rowland-s-planned-departure-as-cfo-to-become-president-of-frac-tech>

*developing Chesapeake's financial structure, which includes a complex and extensive hedging program [...].*" After the announcement, which "*caught the market by surprise, [...] [s]hares of Chesapeake ended down 2.6 percent*" (on the contrary, the S&P 500 index experienced a daily return of +0.71% on October 13, 2010).

Motivated by this example and survey evidence, in this paper, we argue that financial risk management is an appropriate context for studying the role of CFO risk-taking incentives. This should be especially evident in industries, such as oil and gas, where marketable risks affect a firm's future cash flows materially. To our knowledge, this is the first study to provide evidence on the central role of the CFO in deciding whether and how to hedge marketable risks.

We exploit the well-established causal relationship between a manager's compensation convexity and risk aversion (Bakke et al., 2016) to investigate how CFO's risk-taking incentives affect hedging. For this purpose, we use a sample of US oil and gas producers from 2009 to 2019. We show that CFO compensation convexity, measured by the relative vega of their equity holdings in the firm, is negatively associated with the hedging likelihood. Moreover, a higher convexity is negatively related to the hedging extent. This result holds when the CFO is analyzed in isolation from the CEO, when the CFO is combined with the CEO, and when the different incentives of the CFO and the CEO are separately considered. Overall, this evidence supports the substantial role of a CFO's compensation-driven preferences on firm's hedging.

The remainder of the paper is organized as follows. The following section reviews the literature. Section 3 outlines our data sample and describes the variables. Section 4 contrasts hedgers with nonhedgers and discusses the multivariate results. Section 5 provides further robustness analyses. Section 6 illustrates the endogeneity checks. Finally, Section 7 concludes.

## 2. Literature review

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[services-llc-in-which-chesapeake-is-a-26-percent-shareholder-and-planned-promotion-of-nick-dell-osso-to-cfo](https://www.reuters.com/article/us-chesapeake-idUSTRE69C4DK20101013), while the Reuter's article was retrieved from <https://www.reuters.com/article/us-chesapeake-idUSTRE69C4DK20101013>.

This article contributes to two strands of literature. The first relevant set of studies analyzes how managerial risk aversion impacts hedging. The second strand is represented by the narrower literature on the incremental effect of a CFO's preferences on a firm's policies.

Managerial preferences affect hedging materially. Risk-averse managers have the incentive to hedge in full when their utility is concave in their firm's value, and such incentives reverse when their utility function is convex (Stulz, 1984; Smith and Stulz, 1985). Since executive stock options (ESOs) are convexity-increasing instruments, financial theory predicts a negative relation between ESOs and hedging (Smith and Stulz, 1985). Early empirical studies have confirmed this negative and significant association. Tufano (1996) studies hedging practices in the North American gold mining industry and finds that managers holding more (less) stock options manage less (more) gold price risk. Haushalter (2000) focuses on the oil and gas industry and confirms a negative relation between options holdings and the hedging likelihood and extent. Rogers (2002) finds a negative link between CEO risk-taking incentives (measured as the relative vega of the CEO's compensation) and the amount of derivative holdings. Croci et al. (2017) study whether managerial characteristics and preferences impact hedging in the oil and gas industry. Their focus, however, is on how firms hedge, through a more or less convex hedging instrument. For this choice, the convexity of managerial compensation appears nonsignificant.

The relationship between managerial incentives and firm hedging is intricate, as the outcome-based measures of managerial risk aversion (e.g., hedging) and option pay are endogenous. A neat causal relationship between compensation convexity and hedging is established by Bakke et al. (2016). They employ a quasi-natural experiment, i.e., a new accounting regulation mandating firms to expense ESOs at fair value (Financial Accounting Standard 123R). The passage of the new accounting principle has exogenously reduced management's option pay. Therefore, the observed significant increase in hedging of treated firms (i.e., firms that did not expense stock options before FAS 123R) relative to similar untreated firms (i.e., firms that did not utilize stock options or already expensed stock options voluntarily before FAS 123R) is consistent with a causal relationship.

Similar evidence, but directly from the field, is provided by Bodnar et al. (2019). They perform a psychometric test on 681 CFOs in nonfinancial firms, globally distributed, to assess their risk aversion directly. Their results confirm that firms with more risk-averse

managers hedge more and that the link between risk aversion and hedging propensity is stronger when executives are compensated with stocks and options. Notably, there is no significant association between risk aversion and hedging propensity in their subsample of firms whose CFOs are not compensated with stocks and options. In summary, while it is accepted that ESOs have an impact on decreasing managerial risk aversion, the relative importance of a CFO's incentives compared to those of the CEO remains uninvestigated.

This study also contributes to the literature on the importance of CFOs' preferences and characteristics, beyond those of CEOs, for corporate policies. Only a few articles consider the incremental role of the CFO, and this dearth of evidence is "*particularly troubling when it comes to corporate financial decisions, which is an area where the CFO wields substantial influence*" (Gupta et al., 2020).

In their seminal paper, Bertrand and Schoar (2003) study how individual managers affect a firm's decision-making and outcomes. CFO fixed effects are significant in explaining financial decisions (i.e., leverage, cash holding, and interest coverage). Similarly, Frank and Goyal (2007) find that CFOs are dominant in determining a firm's leverage. Chava and Purnanandam (2010) note that CEO and CFO risk-taking incentives affect corporate decisions in different stages of the decision-making process. CFOs are relevant but only for more technical financial choices, such as those related to capital structure, where their expertise matters more. Dittmar and Duchin (2016) analyze how the prior employment of CEOs and CFOs affects firms' investment and financing decisions. Firms operated by a CEO who has experienced financial distress are more conservative. For financing decisions (but not investing decisions), the joint impact of CEO and CFO experience is strongly significant, suggesting an incremental role of the CFO on capital structure variables. Florackis and Sainani (2018) investigate the effect of CFOs on cash decisions. They characterize "strong" and "weak" CFOs, based on an index of managerial ability. Firms with "strong" CFOs hold less cash than firms with "weak" CFOs, and this effect extends beyond that of CEOs. Similarly, Mobbs (2018) shows that firms in which the CFO is also a board member have fewer financial constraints and hold less cash. Recently, Ferris and Sainani (2021) have focused on M&As, finding that CFO influence is significant throughout the process. Unlike the existing studies, in this paper, we focus on hedging as a relevant financial decision to investigate the role of CFO's risk-taking incentives.

Finally, this paper is related to a few studies on the impact of CFO attributes and compensation policy on firm derivative usage. [Géczy et al. \(2007\)](#) characterize corporate speculators by surveying 1,928 publicly traded nonfinancial firms (the response rate is 19%). CFOs in firms speculating with interest rates and FX derivatives have a higher (and significant) wealth delta and a higher (but not significant) wealth vega, suggesting a link between CFOs' compensation and firms' trading with derivatives. [Géczy et al. \(2007\)](#) also argue that the CFO (and not the CEO) is ultimately responsible for forming the view reflected in a firm's derivatives position. [Chernenko and Faulkender \(2011\)](#) study firms' usage of interest rate swaps and find that firms with more performance-sensitive compensation metrics (especially for the CFO) use more interest rate swaps. However, the same metrics are generally insignificant in explaining the direction of swap activity. This evidence suggests a speculative component of firm derivative usage.

Our paper is tangential to these studies but focuses on hedging rather than speculation. As the cross-country study of [Bartram \(2019\)](#) suggests, there is little evidence that firms use derivatives for reasons other than hedging. We study firms' risk management practices in the oil and gas industry. This industry allows us to isolate a homogeneous common risk (i.e., commodity price risk) and minimize the omitted variable bias, likely present in studies employing firms in more than one industry. Additionally, oil and gas firms provide high-quality and granular information on hedging with derivatives, including volume (i.e., quantity), instruments, and maturity. We use this wealth of information to accurately measure hedging likelihood and extent and relate it to managerial (compensation-linked) risk-taking incentives.

### **3. Data, variables, and sample description**

#### **3.1. Data**

Our initial sample consists of US-listed firms belonging to SIC code 1311 (Crude Petroleum and Natural Gas) from 2009 to 2019. Limiting the analysis to only one industry is common when studying hedging determinants. For example, papers on risk management from a user perspective generally look at airline firms (e.g., [Carter et al., 2006](#); [Treanor et al., 2014](#); [Rampini et al., 2014](#)), while studies on commodity producers typically examine gold miners (e.g., [Tufano, 1996](#); [Tufano, 1998](#); [Adam and Fernando, 2006](#); [Adam, 2009](#); [Adam et](#)

al., 2017) or the oil and gas industry (e.g., Haushalter, 2000; Jin and Jorion, 2006; Bakke et al., 2016; Croci et al., 2017; Gilje and Taillard, 2017) (see Carter et al., 2017, for a review). Industry-specific analyses allow a focus on risk-homogeneous firms and attenuate endogeneity concerns from omitted firm-specific characteristics. Our study selects the oil and gas industry for three reasons.

First, not only do all firms face the same commodity price risk, but this risk is material. Oil and gas prices are volatile, as supply and demand are inelastic and price determinants are outside firm control. For example, the period covered by this study encompasses the 2014–2016 collapse in oil prices, one of the largest since World War II (World Bank Group, 2018). Between mid-2014 and early 2016, the price of WTI delivered in Cushing, Oklahoma, decreased from approximately \$106 (June 30, 2014) to \$26 (February 11, 2016), a 75% drop (data from St. Louis Fed). Second, the large volatility of oil and gas prices translates to a significant variation in revenue and high cash flow volatility among affected firms (Bakke et al., 2016). According to S&P, the energy sector showed the highest concentration of global bankruptcies in 2015 and 2016, accounting for more than 50% of defaults worldwide in both years (i.e., 142 energy firms) (S&P Global, 2016, 2017). In other words, oil price risk is economically material. The third reason for choosing this industry is data availability. Most firms disclose detailed information on hedging activity, including quantity (i.e., the notional of the contract), the instruments employed, and their maturity.

We manually collect most of our data from the Electronic Data Gathering, Analysis and Retrieval (EDGAR) system provided by the SEC. We require 10-Ks to be available on EDGAR for inclusion in the sample. The initial search provided a sample of 316 firms and 2,103 firm-year observations. As in Jin and Jorion (2006), we exclude firm-year observations where no oil or natural gas production is reported (425 observations). Moreover, we exclude firm-year observations for firms that choose not to disclose hedging data in tabular form (22 observations), as they do not allow us to quantify their hedging extent (Croci et al., 2017). The sample comprises 247 unique firms and 1,524 firm-year observations.

We merge this dataset with manually gathered CFO and CEO biographical information and compensation data from firms' annual proxy statements (DEF-14A). Therefore, we require DEF-14As to be available in EDGAR and CEO and CFO biographies to be informative enough to construct all our variables. This step reduces our sample to 1,152 firm-year

observations (182 unique firms). We identify the CFO and CEO in every firm during each fiscal year. In the case of a change during a fiscal year, we retain the manager in charge for most of that year. These short bios allow us to extract information on age and tenure. Then, we collect information on the total number of shares beneficially owned by each executive, executive stock option (exercisable and not) characteristics (maturity, exercise price, and number of underlying shares), and cash compensation (cash salary and bonuses). Finally, we collect stock prices from Compustat Security Daily, risk-free rates from the Federal Reserve data download program,<sup>3</sup> and firm-specific financial controls from Compustat. The final sample in our empirical investigation is an unbalanced panel of 154 firms and 867 firm-year observations.

Single-industry empirical studies on hedging are characterized by a small sample size.<sup>4</sup> This is also true in our case. Sample size is particularly constraining in studies combining hedging and managerial-level characteristics and compensation, as reliance on commercial databases for such variables (i.e., Execucomp and BoardEx) further decreases the number of usable observations. In our case, the hand-collected nature of our dataset—information drawn directly from proxy statements—allows us to overcome such data constraints. Our sample of 867 firm-year observations is comparatively larger than those in papers on the same topic, such as [Jin and Jorion \(2006\)](#) (330 firm-year observations for the 1998-2001 time period) or [Crocchi et al. \(2017\)](#) (approximately 500 observations for the 2000-2013 period).<sup>5</sup> While we acknowledge that sample size might impact the explanatory power of our analyses, the evidence we provide in this paper is based on the largest sample one can gather, given the nature of the variables concerned.

## 3.2. Variables

### 3.2.1. *Dependent variables*

Our dependent variables measure a firm's hedging activity. The first variable (*Hedger*) is a dummy equal to 1 if the firm hedges a portion of the next year's production and 0 otherwise.

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<sup>3</sup> The service is available at the following URL:

<https://www.federalreserve.gov/datadownload/Choose.aspx?rel=H15>.

<sup>4</sup> For example, [Adam and Fernando \(2006\)](#) and [Adam et al. \(2017\)](#) (gold mining industry) have approximately 200 observations in most of their models.

<sup>5</sup> Our sample is not directly comparable to those used in studies exploiting quasi-natural experiments. As an example, [Bakke et al. \(2016\)](#) base their analysis on 146 firm-year observations.

As we show later in the paper (Table 1), *Hedger* equals zero for 209 out of 867 firm-year observations (24% of the sample). We set *Hedger* to zero when the 10-K explicitly states that the firm does not hedge commodity price risk (172 firm-year observations, i.e., approximately 80% of the subsample for which *Hedger* = 0) or does not explicitly mention any hedging activity (37 firm-year observations, i.e., approximately 20% of the subsample for which *Hedger* = 0). In the latter case, hedging may be nonexistent or immaterial relative to the firm's size. *Hedger* captures hedging likelihood.

We exploit tabular information on derivatives to measure the extent of hedging. We calculate the delta of hedging positions, similar to [Jin and Jorion \(2006\)](#) and [Bakke et al. \(2016\)](#), and divide it by the next year's production. Unlike *Hedger*, which is a dummy variable, this hedge ratio allows for cross-sectional variation in the hedging magnitude. We focus on derivative contracts for oil, natural gas (NG), and natural gas liquids (NGLs) expiring in one year or less. We convert NG into barrel of oil equivalents and assimilate NGLs into oil ([Jin and Jorion, 2006](#); [Bajo et al., 2022](#)). We follow [Jin and Jorion \(2006\)](#) and [Bakke et al. \(2016\)](#) and retain only directional contracts (we discard basis spreads and other nondirectional contracts, as they do not hedge price risk). Instead, fixed-price delivery contracts are included, as they are operational hedges ([Jin and Jorion, 2006](#); [Bakke et al., 2016](#)).

As in [Tufano \(1996\)](#), for each type of commodity, we first aggregate all directional contracts (swaps, collars, etc.) hedging the expected production one year ahead. Then, we separately compute the volumetric delta for each class of contracts. Linear derivatives and fixed-price delivery contracts are assumed to have a unit (negative) delta. For nonlinear contracts, we estimate the delta according to [Black and Scholes' \(1973\)](#) formula. As this requires volatility estimation, we use historical daily volatility, annualized over the last 252 trading days. All volumetric deltas are cumulated to obtain the overall yearly volumetric delta. Finally, this figure is scaled by the next year's total production ([Jin and Jorion, 2006](#)). Assuming that the next year's production is an unbiased proxy for expected future production ([Bajo et al., 2022](#)), this hedge ratio (*HRI*) represents the expected payoff a firm receives in response to a \$1 change in the value of expected output. Appendix A offers more details on the calculation process.

We acknowledge that using actual future production in place of the current expectation of future output (not reported in 10-Ks) might lead to measurement error in the case of a

substantial distance between actual and expected production when the hedge is placed (Bakke et al., 2016). Following Jin and Jorion (2006) and Bakke et al. (2016), we alternatively use the actual reserves as a denominator for the yearly volumetric delta, and we compute a second hedge ratio (*HR2*). While the numerator of *HR1* and *HR2* is the same, *HR2* scales the volumetric delta of open derivative positions at the end of each fiscal year by current reserves. *HR2* is an alternative variable of hedging extent.

### 3.2.2. Independent variables

Theoretical models (Stulz, 1984; Smith and Stulz, 1985) suggest that the convexity of managers' compensation increases their sensitivity to stock return volatility. A more convex compensation makes the decision-maker less risk-averse (Guay, 1999; Chava and Purnanandam, 2010). As stock options increase payoff convexity, they reduce the managerial propensity to hedge (Bakke et al., 2016).

We capture compensation-linked risk-taking incentives with the relative vega of the manager's wealth invested in the firm (Guay, 1999; Core and Guay, 2002; Hayes et al., 2012; Bakke et al., 2016). Vega is the sensitivity of a manager's total equity investment in the firm (i.e., stocks and stock options) to the volatility of stock returns. We assume that the vega of current and outstanding prior grants of shares is zero, as in Rogers (2002) and Bakke et al. (2016).<sup>6</sup> We price stock options and compute their vega using the Black and Scholes' (1973) model, corrected for dividends (Merton, 1973), following Core and Guay (2002) and Bakke et al. (2016). To compare hedging incentives, we scale the vega of the manager by the market value of the total equity holdings. We compute this relative vega separately for the CFO (*CFO vega*) and the CEO (*CEO vega*).

*CFO vega* (*CEO vega*) is a relative measure of compensation-linked risk-taking incentives. It represents the incremental percentage change in the manager's equity in response to a 1% variation in stock volatility. In other words, if the stock volatility increases (decreases) by 1%, the manager's wealth invested in the firm increases (decreases) by a percentage equal to vega. Scaling a manager's portfolio vega by the market value of total equity holdings ensures that this measure is unaffected by the naturally higher compensation of the CEO relative to

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<sup>6</sup> In theory, since the value of the equity is a call option written on the firm's assets, its sensitivity to stock volatility is nonzero. However, as Guay (1999) points out, stock holdings provide a negligible risk-taking incentive.

the CFO and allows to directly compare CFO and CEO compensation-induced risk-taking incentives. Moreover, vega is a dynamic measure. The convexity of an option's payoff decreases as the option moves far from the moneyness, and vega accounts for the time-varying nature of managerial wealth's sensitivity to stock volatility.

Annual cash and stock compensation are relevant controls affecting managerial risk aversion. *Cash compensation* (i.e., yearly cash salary and bonus) measures wealth diversification, as cash allows managers to invest in assets outside their firm (Bakke et al., 2016). All else being equal, higher cash compensation renders hedging less important from managers' wealth perspective, leading them to hedge less. Similarly, we also control for the dollar value of annual stock grants (*Stock awards*). With the same rationale, managers with greater stock ownership are less diversified and prefer to hedge more (Smith and Stulz, 1985; Tufano, 1996)

We include *Age*, *Female*,<sup>7</sup> and *Tenure* as risk aversion-related controls at the managerial level.<sup>8</sup> We also include *CEO duality*, a dummy variable equal to one if the firm's CEO is also its board of directors' chair. *CEO duality* proxies managerial entrenchment and should be negatively correlated with risk aversion and hedging propensity (Crocchi et al., 2017). To control for CFO managerial power, we use *CFO director*. This dummy detects firms in which the CFO sits on the board of directors, as in Ferris and Sainani (2021). Finally, for both CFO and CEO, we detect whether they were internally promoted or hired from outside the firm (*CFO insider* and *CEO insider*) (Ferris and Sainani, 2021). We interpret this variable as another proxy of managerial entrenchment.

At the firm level, we control for hedging-related explanatory variables (Smith and Stulz, 1985; Froot et al., 1993). *Total assets* and *Tobin's Q* control for size and growth opportunities, *ROA* measures a firm's profitability, *Leverage* (long-term debt plus short-term debt over total assets) and *Quick ratio* (cash and cash equivalents plus accounts receivables over current liabilities) proxy financial constraints and liquidity, the ratio between CAPEX

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<sup>7</sup> We do not have a corresponding *CEO Female* dummy variable due to a lack of variability (only 2 observations in our sample).

<sup>8</sup> We acknowledge that education is a relevant control correlated with risk-taking (e.g., Bertrand and Schoar, 2003). We are unable to find this information in the proxy statement for approximately 14% of the observations (i.e., 118 out of 867). Given the size of our sample, we choose not to drop these observations from the main analysis. However, later in the paper we confirm our results in the subsample for which information on managerial-level education is present.

and total assets proxies *Investment intensity*, and *Dividend* is a dummy variable for dividend-paying firms. The definitions of all variables are provided in Appendix B.

### 3.3. Sample description

Table 1 presents the yearly distribution of hedgers and the proportion of hedgers by year. Except for 2014, where hedgers represent 68% of the sample, the fraction of hedgers floats between 73 and 87%, and the average over 11 years is 76%. The average hedging position has a (negative) delta of about 30% (Table 1, penultimate column). This means that hedging instruments provide firms with an average payoff of \$0.30 in response to a \$1 decline in the expected (next year's) production value. The evidence confirms that price risk is relevant among firms operating in the oil and gas industry and that hedging is strategic. Scaling the hedging position's delta by current reserves returns an average hedge ratio of about 2.7% (Table 1, last column).

*Please insert Table 1 here*

Table 2 presents the descriptive statistics of the variables in the following order. The first two sections comprise CFO and CEO compensation and attributes, respectively. The third section contains control variables at the firm level. The fourth section comprises variables we will use later in the paper for additional analyses and checks.

*Please insert Table 2 here*

The average CFO in our sample has a relative vega of their equity holdings (*CFO vega*) of 0.33%. Hence, in response to a 1% positive change in stock return volatility, the average CFO's total equity investment in the firm increases by 0.33%. Large volatility swings are not uncommon in the stock market. For example, the CBOE Volatility Index (VIX) reached 57% in January 2009 (the beginning of our sample period), was approximately 9% in November

2017 (toward the end of the sample period), and showed great variability across the 2009–2019 period. Accordingly, compensation’s convexity appears to be economically relevant.

The average market value of CFOs’ annual stock awards is approximately \$1.1 million, while the average cash compensation is \$0.5 million. These statistics confirm that equity-based compensation is also preponderant for CFOs (Indjejikian and Matějka, 2009; Chava and Purnanandam, 2010) and likely impacts their incentives and decisions (Ge et al., 2011; Feng et al., 2011; Kim et al., 2011; Hoitash et al., 2012), not only in the US (Caglio et al., 2018). A CEO’s compensation is higher than that of the CFO. The average CEO in our sample has a dollar value in annual stock awards of \$2.9 million and an annual cash compensation of approximately \$0.9 million. However, the average convexity of the CEO’s equity investment in the firm is lower than that of the CFO (*CEO vega* is 0.19% vs. 0.33% for the CFO). CEOs receive higher remuneration than CFOs, but the relative sensitivity of their equity investment to stock volatility is lower.

On average, CFOs are younger than CEOs (the mean is 51 years for the CFO and 57 for the CEO) and less tenured (6 years for the CFO, vs. 9 years for the CEO). Positions at firms’ apexes are male-dominated, as only 5 CFOs out of 100 are female (we do not report a CEO gender dummy, as it shows no variability). CEO characteristics are consistent with those in recent studies on the same industry (the average CEO age and tenure are 55 and 8.1 in Bakke et al., 2016 and 55.4 and 7.2 in Croci et al., 2017, respectively). Approximately 8% of the CFOs are also directors (*CFO director*), and almost half of the CEOs are also chairs of their board (*CEO duality*). These executives are expected to have stronger managerial power. Finally, 46% (resp., 60%) of the CFOs (resp., CEOs) were promoted from within their firm rather than hired externally.

For the firm-level variables, the average (resp., median) firm has \$6 billion in total assets and a *Tobins’s Q* of 1.5 times, while its ROA is –5.7%. Negative profitability is concentrated in 2009 (where two-thirds of the firms in our sample are unprofitable) and 2015–16 (virtually all US oil and gas firms have a negative operating performance in 2015 and 2016, following the 2014 oil price drop). These figures aligned with other studies (e.g., Bajo et al., 2022). The average quick ratio is approximately 119% and the leverage ratio is 35%. Firms in the oil and gas sector typically have a high investment intensity (the average CAPEX over total assets, i.e., *Investment intensity*, is 22%). Finally, almost half of the firms are dividend payers.

## 4. Results

We first compare hedgers to nonhedgers and provide univariate evidence on the different convexities of CFOs' (and CEOs') compensation in the two subsamples. Then, we investigate the likelihood and extent of hedging in a multivariate setting.

### 4.1. Hedgers vs. nonhedgers

We split our sample into hedgers and nonhedgers. As shown in Table 1, hedgers represent 76% of the sample (658 firm-year observations out of 867). Table 3 compares CFO and CEO compensation and attributes (and firm controls) in hedgers and nonhedgers.

*Please insert Table 3 here*

The average *CFO vega* is 0.25% for hedgers and 0.61% for nonhedgers, and the 0.36% negative difference is statistically significant at the 1% level. Therefore, a 1% stock return volatility increase in the average hedging (resp., nonhedging) firm converts into a 0.25% (resp., 0.61%) change in CFO equity investment. CFOs' compensation is less convex in hedging firms or, equivalently, CFOs with a more convex equity investment are less likely to hedge. When looking at the same variable for CEOs (*CEO vega*), the difference between hedgers and nonhedgers is smaller. Hedging firms have an average *CEO vega* of 0.18%, compared to 0.24% in nonhedgers. This difference is negative but modest (0.06%) and statistically significant at the 10% level.

Not only do CFOs in hedging firms have less convex equity holdings, they also have higher stock awards. A CFO's average annual stock award is \$1.3 million in hedgers and \$0.4 million in nonhedgers (this \$0.9 million difference is statistically significant). Stock-based compensation is a proxy for an executive's underdiversification, and underdiversified managers draw higher utility from hedging. The same significant effect holds for CEOs (\$3.5 million vs. \$0.9 million).

Finally, a different cash compensation characterizes CFOs (and CEOs) in hedgers and nonhedgers. CFOs (CEOs) in hedging firms receive higher annual cash compensation, and the \$0.2 million (\$0.5 million) difference is statistically significant. Theoretical predictions suggest the opposite, as higher cash compensation indicates that a manager is more diversified. However, as Table 2 shows, the average value of annual stock awards is more than twice the average annual cash compensation of CFOs (more than three times when considering CEOs). Consequently, hedging incentives are likely to be mainly driven by equity compensation.

Differences in tenure are only slightly significant for CFOs (5 years for hedgers vs. 6.5 years for nonhedgers) and insignificant for CEOs. The CFOs and CEOs in hedging firms are younger than those in nonhedging firms, but the average age difference is modest (2.4 years for CFOs and 2 years for CEOs). Previous research has shown that *Age* has a more complex effect on hedging, as it also impacts the hedging instrument (Crocchi et al., 2017). Hedgers are less likely to have a CFO sitting on their board and more likely to have a CEO serving as board chair. Internally promoted CFOs and CEOs are also present to a greater extent in hedging firms.

*Please insert Table 4 here*

Table 4 presents the pairwise correlations of hedging and compensation variables. *CFO vega* and *CEO vega* are negatively correlated with *Hedger*. However, the  $-27\%$  correlation coefficient of *CFO vega* (significant at the 1% level) is, in absolute value, larger than the  $-7\%$  correlation coefficient of *CEO vega* (significant at the 5% level). We also register a negative correlation between *CFO vega* and the extent of hedging, i.e., *HRI* and *HR2* (again, this is more sizeable than the negative correlation between *CEO vega* and the extent of hedging variables). These findings suggest that CFOs' incentives play a decisive role in firm hedging. We now explore this relationship in a multivariate setting.

## **4.2. Hedging likelihood**

We investigate the effect of CFOs' and CEOs' characteristics on hedging likelihood (Table 5). We run a linear probability model where the dependent variable is the dummy *Hedger*. Standard errors are clustered at the firm level, and all models include year fixed effects.

*Please insert Table 5 here*

In Model 1, we use only CFO-level covariates. We regress *Hedger* on *CFO vega*, CFO's (log-transformed) annual compensation variables (*Log CFO cash compensation*, *Log CFO stock awards*), other CFO attributes (*Age*, *Female*, *Tenure*, *Director*, *Insider*), and firm controls. Then, we augment Model 1 with the same type of variables for CEOs (Model 2) to investigate the combined effect of CFOs' and CEOs' traits on hedging likelihood.

Consistent with the previous evidence, *CFO vega* reduces the likelihood of hedging in both models. A one standard deviation change in *CFO vega* (0.58%, from Table 1) decreases hedging likelihood by about 7 percentage points (against a sample average of 76%) in Model 2. *CEO vega* has a smaller and insignificant impact (Model 2). Other CFO and CEO compensation variables are also insignificant. Firm-level control variables are aligned with predictions in the hedging literature. Hedging likelihood is positively related to size and profitability (as there are economies of scale in hedging), leverage (financial distress risk), and investment intensity (intangible capital and operational risk). Hedging is negatively associated with Tobin's Q and liquidity (more liquid and valued firms draw less utility from hedging). Dividend-paying firms' hedging likelihood is similar to that of their nondividend-paying counterparts.

In Models 3 and 4, we check whether *CFO vega* remains significant at different levels of *CEO vega*. Model 3 (resp., Model 4) considers only the subsample of firm-year observations in which the convexity of CEO equity compensation is high (resp., low), i.e., above (resp., below) the sample median. Hence, only half of the observations are employed in these two regressions. The significant effect of *CFO vega* is confirmed in both models. Model 4 assesses the impact of *CFO vega* on hedging, conditional on a relatively low convexity of CEO equity holdings. A one-standard-deviation increase in *CFO vega* in this subsample

decreases firm hedging probability by 6.6 percentage points. *CFO vega* remains impactful in hedging, despite CEOs' weaker risk-taking incentives.

### 4.3. Hedging extent

We run Tobit regressions where the dependent variable is the hedge ratio, i.e. the hedging position's delta scaled by next year's (expected) production (*HRI*, Table 6). The hedge ratio is left-censored at zero for approximately 24% of the sample (i.e., for nonhedgers). We include year fixed effects, and we cluster standard errors at the firm level. The structure of Table 6 replicates that of Table 5. The first two models investigate whether the negative effect of *CFO vega* persists on the hedge ratio. Models 3 and 4 explore the relative strength of CFOs' risk-taking incentives to those of CEOs on the hedge ratio.

*Please insert Table 6 here*

In Model 1 of Table 6, *CFO vega* is negative and significant. In Model 2, *CFO vega* retains its negative and significant effect (while *CEO vega* is not significant). Regarding the two complementary subsamples in Models 3 and 4, the CFO plays an incremental role in explaining the hedge ratio. In both subsamples, an increase in *CFO vega* results in less hedging. When CEO equity investment is less convex (Model 4), a one-standard-deviation increase in *CFO vega* (0.58%) generates a significant 6.6%-decrease in the hedge ratio. This figure represents about one-fourth of the sample average of *HRI* for hedgers (29.7% from Table 1).

Scaling the hedging position's delta by the next year's production is subject to a potential discrepancy between the next year's actual output and the (unobservable) firm's expectation when the hedge is placed. In other words, the "perfect foresight" assumption might be systematically biased. To avoid this issue, as in [Bakke et al. \(2016\)](#), we also scale the hedging position's delta by a firm's total reserves (*HR2*). Total reserves are contemporary to when the firm places the hedge and are less volatile. Table 7 is similar to Table 6 but uses *HR2* as the dependent variable.

*Please insert Table 7 here*

The results are qualitatively similar. The coefficient of *CFO vega* is negative and significant in Model 1 (CFO variables only), Model 2 (CFO and CEO variables), and Models 3 and 4 (subsamples with varying CEO equity investment convexity).

#### **4.4 CFO and CEO (mis)alignment**

In this section, we further explore the interaction between CFO and CEO compensation-induced risk-taking. We construct two dummies (*CFO high, CEO low (2q+)*, and *CFO low, CEO high (2q+)*) to represent significantly diverging risk-taking incentives. *CFO high, CEO low (2q+)* (resp., *CFO low, CEO high (2q+)*) is a dummy variable equal to 1 if the CFO has vega higher (resp., lower) than the CEO's by at least two quartiles of the respective distribution. These two variables imply extremely divergent CFO and CEO risk-taking incentives. Then, we construct two other additional dummies (*CFO high, CEO low (1q)*, and *CFO low, CEO high (1q)*) to capture milder cases of misalignment, i.e., those cases in which the distance between *CFO Vega* and *CEO Vega* is of just one quartile. Finally, we construct a variable (*Vega gap*) as the difference between *CFO Vega* and *CEO Vega*. This variable captures the divergence between managers' risk-taking incentives in a continuous manner and is more positive (negative) the higher *CFO Vega* with respect to *CEO Vega* (the lower *CFO Vega* with respect to *CEO Vega*).

Table 8 replicates Model 2 in previous analyses (including both CFO and CEO attributes. Models 1 to 3 substitutes *CFO Vega* and *CEO Vega* with *CFO high, CEO low* and *CFO low, CEO high*. In these first model, middle cases are captured in the constant, together with cases in which managers have aligned risk-taking incentives (i.e., *CFO Vega* and *CEO Vega* are in the same quartile of the respective distributions). Models 4 to 6 explicitly acknowledge middle cases by also including *CFO high, CEO low (1q)*, and *CFO low, CEO high (1q)*. Finally, Models 7 to 9 consider *Vega gap* as the main independent variable.

*Please insert Table 8 here*

*CFO high, CEO low* is steadily significant, while *CFO low, CEO high* is not, regardless of whether we explicitly account for middle cases (Models 4-6) or not (Models 1-3). This means that a significantly higher convexity of CFO equity investment (relative to that of the CEO) reduces hedging likelihood and hedging extent. In contrast, a significantly higher convexity of CEO equity investment (relative to that of the CFO) is insignificant. Models 4 to 6 of Table 8 show how middle cases of divergence do not seem to have an impact, as the coefficient of both *CFO high, CEO low (1q)* and *CFO low, CEO high (1q)* are not statistically significant. Coherently, results from Models 7 to 9 show that the bigger the gap in convexity in favor of the CFO (*Vega gap*), the lower the hedging probability and hedging extent. Overall, results from Table 8 support the prevalent role played by CFOs' risk-taking incentives on risk management strategies, with respect to those of the CEO, when such incentives diverge in a significant way.

#### **4.5. CFO and CEO similarity**

CFO risk-taking incentives seem decisive on hedging. However, when interpreting this evidence, a concern is that the systematic matching of CFO and CEO characteristics blurs the results. A CFO's attributes, correlated with their risk-taking attitude, might overlap with those of the CEO, acting as confounders on a firm's hedging and its extent. As in [Ferris and Sainani \(2021\)](#), we check whether pairing a CFO with a similar CEO drives the significance of our earlier results. To delineate similarities between these two executives, we consider their age, tenure, and appointment ([Ferris and Sainani, 2021](#); [Goergen et al., 2015](#)).<sup>9</sup>

We proceed as follows. First, we detect age similarity between the CFO and the CEO in each firm if their age difference is less than 5 years. Table 1 shows that the CEOs are, on average, 7 years older than the CFOs. Therefore, the subsample comprising CFOs and CEOs similar in age represents only 35% of the total sample. Second, we look at tenure similarity and code CFOs and CEOs as similar in tenure if they have spent 3 years or more together within the same firm. Approximately 42% of the sample comprises CFOs and CEOs with similar tenure. Finally, checking whether the CFO was appointed after the CEO is also relevant. A CEO has

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<sup>9</sup> Gender is another relevant attribute ([Goergen et al., 2015](#)), but we do not have sufficient gender variability in our sample of CEOs.

the authority to replace the CFO (Mian, 2001; Fee and Adlock, 2004), but the relative power of the CFO and CEO depends on who was appointed first. For example, in the context of hedging, a CEO might be willing to appoint a CFO with similar preferences and risk-taking appetites. We split the sample according to this criterion. The CFO was appointed before the CEO in 351 firm-year observations (41% of the sample).

*Please insert Table 9 here*

Table 9 replicates Model 2 in previous analyses (including both CFO and CEO attributes) separately by these subsamples (age in Panel A, tenure in Panel B, order of appointment of CFO and CEO in Panel C). The first two models in each panel estimate hedging likelihood, while the last four models estimate hedging extent (*HRI* and *HR2*). All controls are suppressed for brevity. Overall, these results confirm that a firm's hedging depends more on its CFO's than its CEO's risk-taking incentives. Unlike *CEO vega*, *CFO vega* generally retains significance across all three attributes.

## **5. Additional analyses**

This section describes additional analyses we perform to validate previous results. First, we replace our key independent variable and use two different proxies of compensation-linked risk-taking incentives. Second, we adapt our hedge ratios to account for longer-horizon (i.e., more than one year) hedging positions. Third, we complement our vector of controls with governance variables, such as the presence of a chief operating officer or risk management board committee. Fourth, we control for CFOs' and CEOs' education and qualifications within the subsample that provides this information.

### **5.1. Annual vega**

A concern with our measure of risk-taking incentive is that it is a cumulative variable, i.e. it measure the sensitivity of a manager's total equity investment in the firm to the volatility of stock returns. While we argue that the managerial incentive to hedge depends on the sensitivity of their overall equity invested (not just the stock and stock options they are

awarded in the current year), a cumulative variable might weigh more managers who have been in charge for longer.

To sidestep potential mismeasurements, we create two variants of our measure. The first variant is *Vega* ( $y/t$ ). While the denominator of this variable is the same as before (i.e., the market value of the total equity holdings), the numerator now accounts for the annual (not cumulative) stocks and stock options awarded. A second variant is *Vega* ( $y/y$ ). In this case, both the numerator and the denominator are annual figures. Both these two alternative proxies of managerial relative convexity are free of the abovementioned concern. However, if a manager is not awarded new stock options during a given year, both these proxies imply that their risk-taking incentive is zero, regardless of the actual equity (i.e., stocks and stock options) invested in the firm. As Table 2 shows, this occurs in more than half of the observations in our sample.

Table 10 repeats the previous analysis (i.e., hedging likelihood—Panel A, and hedging extent—Panel B and Panel C) using *Vega* ( $y/t$ ) and *Vega* ( $t/t$ ) to proxy for risk-taking incentive, respectively. All controls are suppressed for brevity.

*Please insert Table 10 here*

The evidence in Table 10 is comparable to that in Tables 5, 6, and 7. CFO vega is negatively related to the hedging likelihood and extent. We register a weaker statistical significance of vega in explaining the hedging extent, but this is likely due to the zero sample median of both the alternative proxies. This *de facto* more than halves our sample size.

## **5.2. Longer hedging horizon**

A further check relates to the hedging horizon. The measures of hedging extent are based on hedging contracts expiring in 1 year or less, as they hedge the firm's expected (next year) production. Derivative instruments expiring in more than one year are less common due to lower liquidity and firms' preference for rolling over stacked hedges (Adam and Fernando,

2006). However, we seek to rule out the concern that longer-maturity contracts might reverse our results.

Accordingly, we construct two supplementary hedge ratios, which cumulate the volumetric delta underlying derivative contracts up to 2 or 3 years in the future. All hedging positions resulting at the end of each fiscal year and maturing in 2 years or less, or 3 years or less, are weighed and scaled by current reserves. We do not standardize hedging volume by cumulated production up to 2 or 3 years in advance, as the assumption of perfect foresight is implausible.

The descriptive statistics of these two variables, i.e. *HR2 (1-2)* and *HR (1-3)*, are in Table 2. The sample average is 3.8% for *HR2 (1-2)* and 4.2% for *HR (1-3)* (it is 2.7% for *HR2*, Table 1). Table 11 is similar to Tables 7 and 8 but uses *HR2 (1-2)* (Panel A) and *HR2 (1-3)* (Panel B) as dependent variables. The results are steadily robust to this check.

*Please insert Table 11 here*

### **5.3. COO and internal controls**

We based our analysis on the interplay between CFOs and CEOs. However, following the study of [Hambrick and Cannella \(2004\)](#), management research has shown that having a COO on the executive team (i.e., a top functional manager) impacts corporate outcomes. In our context, the presence of a COO, whose mandate is generally more operational than that of the CEO, could reduce the significance of the CFO's risk-taking incentives. Accordingly, we construct a dummy variable for the presence of a COO within the firm's C-suite. As Table 2 shows, a COO is present in slightly more than half of the observations in our sample.

The presence of a risk-management committee is another potentially relevant firm-level control. A risk management committee assists the board of directors in identifying and mitigating risks. In firms with an *ad hoc* risk-management committee, the CFO's risk-taking incentives might be less important, as the committee ultimately approves the firm's hedging strategy. We construct a dummy variable (*RM committee*) detecting such firms.

Approximately 8% of the firm-year observations in our sample have a risk-management committee (Table 2).

We add *COO* and *RM committee* as regressors in Table 12 and re-estimate the first two models in Tables 5 to 7. These two dummies are generally insignificant, and all the results are qualitatively unchanged.

*Please insert Table 12 here*

#### **5.4. Education**

We use personal managerial traits, such as age and gender, as risk aversion control variables in our main analysis. However, we acknowledge that education and qualification are relevant traits that correlate with an executive's decisions. For example, top executives with advanced higher education or specialized postgraduate qualifications have an enhanced risk-taking profile (Bertrand and Schoar, 2003). We create two dummy variables indicating whether the CFO has a CPA license (*CFO CPA*) (e.g., Ferris and Sainani, 2021) and whether the CEO holds an MBA (*CEO MBA*) (e.g., Beber and Fabbri, 2012). However, based on the information in the CFOs' and CEOs' biographical sketches, we are unable to detect such information for the entirety of our sample (it is unavailable for 118 out of 867 firm-year observations). Given the hand-collected nature of our data, we do not use these controls in our main analysis to prevent dropping these observations, and we control for them in this section.

Table 13 replicates the first two models in Tables 5 to 7, adding *CFO CPA* and *CEO MBA* as controls. The former variable is insignificant, but it appears that a CEO with an MBA negatively influences hedging likelihood and extent. This finding is consistent with studies showing that such CEOs are willing to take more risks (e.g., Beber and Fabbri, 2012). The convexity of CFO equity holdings confirms its significance, while *CEO vega* remains insignificant.

*Please insert Table 13 here*

## 6. Endogeneity

The endogenous nature of executive compensation convexity is well recognized. [Bakke et al. \(2016\)](#) employ a quasi-natural experiment and show that a causal effect extends from compensation convexity to hedging decisions. Higher (resp., lower) compensation convexity reduces (resp., increases) hedging extent. Although we have not performed a quasi-natural experiment, the key association in our research (executive compensation convexity and firm hedging) is the same as that in [Bakke et al. \(2016\)](#). Therefore, it is plausible that the same causal effect applies to our context. Moreover, to alleviate endogeneity concerns, we have added a rich set of firm- and manager-level controls to our regressions. We have also carried out several additional exercises, discussed in the previous section, to assess the robustness of our results. In this section, we conduct further analyses to deal with endogeneity more directly.

### 6.1. Propensity-score matching

Observable confounders at the firm and CEO levels, associated with the convexity of CFO equity investment, might cause differences in firm hedging. Propensity-score matching allows contrasting the hedging decisions in treated and untreated firms, which are similar in their firm-, CEO-, and CFO-specific characteristics but differ regarding CFO compensation convexity.

We proceed as follows. First, we construct a dummy variable (*High CFO vega*) taking the value of 1 if *CFO vega* is higher than the sample median and zero otherwise. Observations are then assigned to a treatment (*High CFO vega* = 1) or control (*High CFO vega* = 0) group. Second, we estimate propensity scores as a logit function that regresses *High CFO vega* on firm controls, CEO-level controls (including *CEO vega*), CFO-level controls, and year fixed effects. We then match each firm in the treatment group (i.e., a firm with *High CFO vega* = 1) with a corresponding firm in the control group (i.e., a firm with *High CFO vega* = 0), using the nearest neighbor without replacement technique and retaining matches within a caliper distance of 0.01.<sup>10</sup> Using the complete set of controls for estimating propensity scores,

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<sup>10</sup> We tested different caliper magnitudes (i.e., no caliper, caliper equal to 0.1, 0.05, 0.01, and 0.001). All the results continue to hold, regardless of the caliper size.

we allow these two groups to differ only in *CFO vega*.<sup>11</sup> Finally, we re-estimate the first two models in Tables 5 to 7 on the propensity-score matched sample of 260 observations (130 treated-control pairs). The results in Table 14 show a negative and significant coefficient of *CFO vega* in all the models. This evidence is not driven by differences in observable firm, CEO, or CFO characteristics.

*Please insert Table 14 here*

## 6.2. Omitted variables

Endogeneity could stem from failing to account for unobservable firm-level characteristics with joint explanatory power for compensation and hedging. Although we use several controls, we assess the stability of our results to potentially omitted variable bias using [Oster's \(2019\)](#) sensitivity test.

We estimate a coefficient (Oster's delta,  $\delta$ ) that reflects how likely potential unobservables are to explain away the key covariate's significance. We focus on the fully specified models, i.e., Model 2 in Tables 5 to 7, re-estimating them with and without observable controls. Following [Oster \(2019\)](#), we set the hypothetical (maximum) R-squared of a regression augmented with potential unobservables to 1.3 times the R-squared of the model that includes all the controls. Finally, we compute  $\delta$ , which depends on the change in the coefficient of *CFO vega* in the two models (with and without observable controls), the change in R-squared (comparing the same two models), and the maximum R-squared defined above.

We find that  $\delta \approx 2$  in all models (the estimates are not shown for brevity). This value is well above the cutoff ( $\delta = 1$ ) suggested by [Oster \(2019\)](#). This means that the omitted unobservables must be at least twice as important as the observable controls to invalidate the effect of *CFO vega* on hedging likelihood and extent. We conclude that the effect of *CFO vega* is unlikely to be driven by omitted variables.

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<sup>11</sup> We check covariance balance using a t-test of mean differences for our variables in estimating propensity scores. This matching is highly successful in reducing the mean differences of these covariates between the two subsamples (i.e., treated and controls). None of the mean differences is statistically significant at the usual levels. We do not report the covariance balance tests for brevity.

### 6.3. Transitioning subsample

Finally, we focus on firms that jointly experience (a) a change in their CFO and (b) a change in their CFO's equity holdings convexity. In these firms, a new CFO takes office, and the convexity of their payoff is different from that of the outgoing CFO. Retaining only these firms allows us to avoid the overlap between firm attributes and compensation characteristics. Therefore, we control for the effect of unobserved firm characteristics on hedging choices.

We proceed as follows. First, we restrict our sample to firms that experience at least one CFO change. This filter reduces the number of firms to 71 and the number of firm-year observations to 517. Second, we only consider firms where we observe a significant change in *CFO vega* between the departing and arriving CFO, i.e., from a high (resp., low) to a low (resp., high) *CFO vega*. More precisely, we retain only firms whose new CFO has a vega above (resp., below) the sample median and where the vega of the old CFO is below (resp., above) the sample median. We use this restricted sample of firms undergoing CFO transition (71 firms, 517 observations) to compute medians. This approach is consistent with the incentive dummies used in multivariate analyses (Ferris and Sainani, 2021) and follows previous empirical research (Michaely et al., 2016; Boubaker et al., 2020; Bajo et al., 2022). The final sample in this analysis comprises 19 firms and 140 firm-year observations.

Table 15 estimates hedging likelihood (Panel A) and hedging extent (Panel B and Panel C) for this restricted subsample.

*Please insert Table 15 here*

*CFO vega* retains a negative and significant effect on hedging probability and hedging extent. Its coefficients show a weaker significance than in our main analyses, which we expected due to the much lower number of observations in this transitioning subsample. With this caveat concerning sample size, the combined results in Table 15 support a causal effect of CFOs' risk-taking incentives on firm hedging.

## 7. Conclusion

Risk management is one of the CFO's most sophisticated areas of responsibility due to the specialized expertise and technical competency it requires. Surveys of professionals suggest that risk management is the primary nonfinancial accounting-related activity that is directly overseen by CFOs. Despite this evidence, most of the research investigating the relationship between managerial preferences and firm hedging has focused on the risk-taking incentives of the CEO, which is usually viewed as the ultimate decision-maker in this area.

We show that CFOs' risk-taking incentives significantly impact firms' hedging. We use a sample of US oil and gas producers from 2009–2019 and find that compensation-induced risk-taking is negatively associated with hedging likelihood and extent. These findings hold when the CFO is analyzed in isolation from the CEO, when the CFO and CEO are jointly considered, and when their distinct incentives are studied separately. These results hold after controlling for CFO and CEO similarity and are robust to several additional analyses and endogeneity checks.

This study confirms that CFOs' risk-taking ultimately shapes firms' risk management. This evidence has significant managerial implications. As CFOs' option-based compensation increases the convexity of their equity holdings, this might have unintended consequences for firms' hedging. We suggest that CFOs' option-based compensation packages should therefore be carefully designed to constrain the risk-taking incentives they generate. The acknowledged and increasing importance of CFOs in a wide array of strategic decisions makes their risk preferences very relevant. Overall, this study contributes to the literature on managerial risk aversion and hedging; specifically, we shed light on the underinvestigated role of the CFO in a firm's decision-making.

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## Tables and Figures

Year	Firms	Hedger = 0	Hedger = 1	Hedgers, %	Hedge ratio ( <i>HRI</i> ), %	Hedge ratio ( <i>HR2</i> ), %
2009	91	25	66	72.5	33.8	2.9
2010	92	25	67	72.8	28.4	2.4
2011	89	23	66	74.2	24.5	2.0
2012	92	24	68	73.9	28.1	2.6
2013	88	19	69	78.4	35.9	3.2
2014	84	27	57	67.9	27.6	2.2
2015	76	19	57	75.0	23.9	2.3
2016	77	17	60	77.9	32.6	3.3
2017	67	9	58	86.6	33.9	3.2
2018	60	11	49	81.7	29.7	2.8
2019	51	10	41	80.4	28.8	2.6
<b>Total</b>	<b>867</b>	<b>209</b>	<b>658</b>	<b>75.9</b>	<b>29.7</b>	<b>2.7</b>

**Table 1** – *Distribution of hedgers and hedge ratios*. The second column reports the number of firms by year, distinguishing between hedgers (third column) and non-hedgers (fourth column). The last three columns report the yearly percentage of hedgers and the yearly average hedge ratios (*HRI* is the volumetric delta of the hedging position scaled by next year’s production, *HR2* is the volumetric delta of the hedging position scaled by current reserves). All variables are defined in Appendix B.

	<b>N</b>	<b>Mean</b>	<b>SD</b>	<b>Min</b>	<b>Q1</b>	<b>Median</b>	<b>Q3</b>	<b>Max</b>
<b><u>CFO variables</u></b>								
<i>CFO vega, %</i>	867	0.33	0.58	0.00	0.00	0.08	0.44	3.57
<i>CFO cash compensation, \$ mln</i>	867	0.50	0.29	0.00	0.31	0.44	0.60	1.64
<i>CFO stock awards, \$ mln</i>	867	1.09	1.18	0.00	0.09	0.76	1.66	5.49
<i>CFO age, years</i>	867	50.8	8.2	30.0	45.0	51.0	57.0	73.0
<i>CFO female, %</i>	867	4.8	21.5	0.0	0.0	0.0	0.0	100.0
<i>CFO tenure, years</i>	867	5.4	5.3	0.0	2.0	4.0	7.0	34.0
<i>CFO director, %</i>	867	8.1	27.3	0.0	0.0	0.0	0.0	100.0
<i>CFO insider, %</i>	867	46.4	49.9	0.0	0.0	0.0	100.0	100.0
<b><u>CEO variables</u></b>								
<i>CEO vega, %</i>	867	0.19	0.34	0.00	0.00	0.03	0.23	1.66
<i>CEO cash compensation, \$ mln</i>	867	0.94	0.72	0.00	0.48	0.80	1.10	3.85
<i>CEO stock awards, \$ mln</i>	867	2.86	3.31	0.00	0.12	1.73	4.27	15.20
<i>CEO age, years</i>	867	57.2	8.4	33.0	53.0	57.0	62.0	90.0
<i>CEO tenure, years</i>	867	8.2	9.2	0.0	2.0	5.0	11.0	52.0
<i>CEO duality, %</i>	867	53.6	49.9	0.0	0.0	100.0	100.0	100.0
<i>CEO insider, %</i>	867	59.9	49.0	0.0	0.0	100.0	100.0	100.0
<b><u>Firm-level variables</u></b>								
<i>Total assets, \$ bln</i>	867	6.0	10.4	0.0	0.4	1.8	6.3	52.1
<i>Tobin's Q</i>	867	1.5	0.8	0.5	1.0	1.3	1.7	5.7
<i>ROA, %</i>	867	-5.7	20.4	-67.7	-9.4	0.0	1.3	7.0
<i>Leverage, %</i>	867	34.7	27.4	0.0	18.1	31.1	45.0	154.5
<i>Quick ratio, %</i>	867	118.8	140.8	4.5	49.0	72.0	126.7	853.7
<i>Investment intensity, %</i>	867	22.2	13.5	0.3	12.3	20.0	30.4	63.1
<i>Dividend, %</i>	867	46.0	49.9	0.0	0.0	0.0	100.0	100.0
<b><u>Variables used in additional analyses</u></b>								
<i>CFO vega (y/t), %</i>	867	0.09	0.24	0.00	0.00	0.00	0.05	1.45
<i>CEO vega (y/t), %</i>	867	0.05	0.18	0.00	0.00	0.00	0.00	1.23
<i>CFO vega (y/y), %</i>	867	0.17	0.35	0.00	0.00	0.00	0.17	1.83
<i>CEO vega (y/y), %</i>	867	0.15	0.32	0.00	0.00	0.00	0.07	1.66
<i>HR2 (1-2), %</i>	867	3.8	4.0	0.0	0.0	2.8	5.8	16.3
<i>HR2 (1-3), %</i>	867	4.2	4.6	0.0	0.0	3.0	6.2	18.6
<i>COO, %</i>	867	46.4	49.9	0.0	0.0	0.0	100.0	100.0
<i>RM committee, %</i>	867	7.7	26.7	0.0	0.0	0.0	0.0	100.0
<i>CFO CPA, %</i>	749	41.1	49.2	0.0	0.0	0.0	100.0	100.0
<i>CEO MBA, %</i>	749	31.2	46.4	0.0	0.0	0.0	100.0	100.0

**Table 2 – Descriptive statistics.** The table reports the descriptive statistics of the sample (154 firms, 867 firm-year observations). The first set of variables comprises compensation and attributes of the CFO. The second set comprises compensation and attributes of the CEO. The third set comprises firm-level financial variables. The fourth set comprises variables used in additional analyses. All variables are defined in Appendix B. All continuous variables are winsorized at the 95% level.

	Hedger = 1	Mean	Hedger = 0	Mean	Difference	t-statistic
<i>CFO vega, %</i>	658	0.25	209	0.61	-0.36	-5.67 ***
<i>CFO cash compensation, \$ mln</i>	658	0.54	209	0.35	0.19	8.58 ***
<i>CFO stock awards, \$ mln</i>	658	1.30	209	0.40	0.90	11.63 ***
<i>CFO age, years</i>	658	50.18	209	52.57	-2.40	-3.62 ***
<i>CFO female, %</i>	658	4.26	209	6.70	-2.44	-1.28
<i>CFO tenure, years</i>	658	5.02	209	6.48	-1.46	-2.78 ***
<i>CFO director, %</i>	658	6.23	209	11.48	-5.25	-2.19 **
<i>CFO insider, %</i>	658	48.18	209	40.67	7.51	1.91 *
<i>CEO vega, %</i>	658	0.18	209	0.24	-0.06	-1.83 *
<i>CEO cash compensation, \$ mln</i>	658	1.05	209	0.58	0.46	8.97 ***
<i>CEO stock awards, \$ mln</i>	658	3.47	209	0.94	2.53	12.97 ***
<i>CEO age, years</i>	658	56.73	209	58.77	-2.04	-2.81 ***
<i>CEO tenure, years</i>	658	7.98	209	8.98	-1.00	-1.22
<i>CEO duality, %</i>	658	55.78	209	46.89	8.89	2.24 **
<i>CEO insider, %</i>	658	62.31	209	52.15	10.16	2.57 **
<i>Total assets, \$ bln</i>	658	6.98	209	2.86	4.12	5.84 ***
<i>Tobin's Q</i>	658	1.37	209	1.82	-0.45	-4.88 ***
<i>ROA, %</i>	658	-3.58	209	-12.42	8.83	4.85 ***
<i>Leverage, %</i>	658	38.34	209	23.43	14.91	6.09 ***
<i>Quick ratio, %</i>	658	89.98	209	209.71	-119.73	-7.45 ***
<i>Investment intensity, %</i>	658	23.65	209	17.74	5.91	5.11 ***
<i>Dividend, %</i>	658	50.30	209	32.54	17.77	4.69 ***

**Table 3** – *Descriptive statistics of hedgers vs. non-hedgers.* The table reports the descriptive statistics of hedgers (658 firm-year observations) and non-hedgers (209 firm-year observations), their mean difference and t-statistics (statistical significance at the 1, 5, and 10% levels is denoted as \*\*\*, \*\*, \*, respectively). All variables are defined in Appendix B.

	#1	#2	#3	#4	#5	#6	#7	#8	#9
#1 Hedger	1								
#2 HR1	<b>0.636***</b>	1							
#3 HR2	<b>0.582***</b>	<b>0.844***</b>	1						
#4 CFO vega	<b>-0.265***</b>	<b>-0.187***</b>	<b>-0.189***</b>	1					
#5 CFO cash compensation	<b>0.271***</b>	<b>0.111***</b>	<b>0.089***</b>	<b>-0.071**</b>	1				
#6 CFO stock awards	<b>0.324***</b>	<b>0.171***</b>	<b>0.160***</b>	<b>-0.147***</b>	<b>0.506***</b>	1			
#7 CEO vega	<b>-0.073**</b>	<b>-0.095***</b>	<b>-0.083**</b>	<b>0.496***</b>	<b>0.083**</b>	0.017	1		
#8 CEO cash compensation	<b>0.274***</b>	<b>0.090***</b>	<b>0.069**</b>	<b>-0.076**</b>	<b>0.779***</b>	<b>0.363***</b>	<b>0.064*</b>	1	
#9 CEO stock awards	<b>0.327***</b>	<b>0.150***</b>	<b>0.142***</b>	<b>-0.128***</b>	<b>0.470***</b>	<b>0.780***</b>	0.0300	<b>0.449***</b>	1

**Table 4 – Correlation table.** The table reports the pairwise correlations between hedging and compensation variables. Statistical significance at the 1, 5, and 10% levels is denoted as \*\*\*, \*\*, \*, respectively (for better readability, statistically significant correlation coefficients are also in bold). All variables are defined in Appendix B.

	(1)	(2)	(3)	(4)
	CFO	CFO and CEO	CEO vega upper median	CEO vega lower median
<i>CFO vega</i>	-0.140*** (0.0273)	-0.121*** (0.0298)	-0.130*** (0.0347)	-0.114*** (0.0432)
<i>CEO vega</i>		-0.0484 (0.0648)		
<i>Log CFO cash compensation</i>	0.0142 (0.0105)	0.0112 (0.0103)	0.0281** (0.0112)	0.00288 (0.0141)
<i>Log CFO stock awards</i>	0.00670 (0.00417)	0.00466 (0.00567)	0.00379 (0.00742)	0.00394 (0.00768)
<i>CFO age</i>	-0.00191 (0.00197)	-0.0249 (0.0176)	-0.0396* (0.0228)	0.00596 (0.0203)
<i>CFO age squared</i>	-0.00141 (0.00170)	0.0101 (0.0129)	0.0142 (0.0272)	0.0275* (0.0143)
<i>CFO female</i>	-0.0470 (0.0743)	0.0161 (0.0769)	-0.0883 (0.124)	0.147* (0.0769)
<i>CFO tenure</i>	-0.00444 (0.00301)	-0.00393 (0.00318)	0.00478 (0.00476)	-0.00461 (0.00297)
<i>CFO director</i>	-0.0530 (0.0552)	-0.0488 (0.0572)	0.0151 (0.0690)	-0.0633 (0.0601)
<i>CFO insider</i>	0.0228 (0.0377)	0.0206 (0.0379)	0.0349 (0.0485)	-0.0228 (0.0459)
<i>Log CEO cash compensation</i>		0.0132* (0.00790)	-0.00211 (0.0157)	0.0238*** (0.00813)
<i>Log CEO stock awards</i>		0.00320 (0.00513)	-0.000330 (0.00637)	0.00952 (0.00712)
<i>CEO age</i>		-0.0124 (0.0144)	-0.0175 (0.0307)	-0.0310** (0.0156)
<i>CEO age squared</i>		0.0228 (0.0172)	0.0349 (0.0223)	-0.00682 (0.0204)
<i>CEO tenure</i>		-0.00217 (0.00251)	0.00707** (0.00304)	-0.00590*** (0.00194)
<i>CEO duality</i>		0.0226 (0.0345)	0.0322 (0.0476)	-0.0123 (0.0419)
<i>CEO insider</i>		0.00215 (0.0346)	-0.0407 (0.0472)	0.0314 (0.0385)
<i>Log total assets</i>	0.0672*** (0.0135)	0.0650*** (0.0143)	0.0753*** (0.0171)	0.0575*** (0.0210)
<i>Tobin's Q</i>	-0.0506*** (0.0168)	-0.0499*** (0.0170)	-0.0796*** (0.0258)	-0.0221 (0.0235)
<i>ROA</i>	0.316*** (0.0921)	0.311*** (0.0957)	0.0824 (0.125)	0.510*** (0.124)
<i>Leverage</i>	0.284***	0.273***	0.367***	0.240***

	(0.0632)	(0.0634)	(0.0752)	(0.0855)
<i>Quick ratio</i>	-0.0490***	-0.0498***	-0.0545***	-0.0461***
	(0.0104)	(0.0104)	(0.0182)	(0.0128)
<i>Investment intensity</i>	0.604***	0.550***	0.488***	0.443***
	(0.111)	(0.104)	(0.145)	(0.124)
<i>Dividend</i>	0.0156	0.0142	-0.00576	-0.00470
	(0.0345)	(0.0344)	(0.0474)	(0.0407)
<i>Constant</i>	0.708***	1.472***	2.035**	1.068*
	(0.171)	(0.521)	(0.962)	(0.580)
Observations	867	867	433	434
Year fixed effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.49	0.50	0.50	0.55

**Table 5 – Hedging likelihood.** The table reports the coefficients of a pooled OLS model, where the dependent variable is *Hedger*, i.e. a dummy equal to 1 if the firm is a hedger and zero otherwise. Model 1 only comprises CFO-level variables. Model 2 adds CEO-level variables. Models 3 and 4 split the sample according to whether *CEO vega* is above (model 3) or below (model 4) the sample median. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include year fixed effects. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

	(1)	(2)	(3)	(4)
	CFO	CFO and CEO	CEO vega upper median	CEO vega lower median
<i>CFO vega</i>	-0.129*** (0.0301)	-0.101*** (0.0316)	-0.110*** (0.0380)	-0.114*** (0.0382)
<i>CEO vega</i>		-0.0824 (0.0617)		
<i>Log CFO cash compensation</i>	0.0130 (0.0105)	0.0163 (0.0103)	0.0418** (0.0188)	0.0101 (0.0121)
<i>Log CFO stock awards</i>	0.00350 (0.00353)	0.000953 (0.00466)	-0.00392 (0.00691)	0.00302 (0.00585)
<i>CFO age</i>	-0.00474** (0.00204)	-0.0105 (0.0179)	-0.0139 (0.0253)	0.0155 (0.0238)
<i>CFO age squared</i>	-0.00311 (0.00193)	0.0104 (0.0139)	-0.00254 (0.0245)	0.0281* (0.0146)
<i>CFO female</i>	-0.0512 (0.0768)	-0.0189 (0.0716)	-0.0268 (0.0936)	0.0176 (0.0719)
<i>CFO tenure</i>	-0.00335 (0.00329)	-0.000350 (0.00329)	0.00640 (0.00472)	-0.00206 (0.00321)
<i>CFO director</i>	-0.154*** (0.0587)	-0.148** (0.0594)	-0.123 (0.0778)	-0.157** (0.0640)
<i>CFO insider</i>	-0.0499 (0.0376)	-0.0417 (0.0371)	0.0107 (0.0529)	-0.119*** (0.0411)
<i>Log CEO cash compensation</i>		0.00841 (0.00949)	-0.0175 (0.0118)	0.0345*** (0.00854)
<i>Log CEO stock awards</i>		0.00267 (0.00440)	0.00639 (0.00647)	0.00248 (0.00521)
<i>CEO age</i>		-0.0137 (0.0154)	-0.000481 (0.0265)	-0.0321** (0.0162)
<i>CEO age squared</i>		0.00509 (0.0178)	0.00714 (0.0260)	-0.0205 (0.0237)
<i>CEO tenure</i>		-0.00549** (0.00236)	0.00122 (0.00320)	-0.00877*** (0.00201)
<i>CEO duality</i>		0.00138 (0.0313)	0.0207 (0.0463)	-0.0182 (0.0415)
<i>CEO insider</i>		-0.0367 (0.0353)	-0.0582 (0.0480)	-0.0154 (0.0409)
<i>Log total assets</i>	0.0297** (0.0130)	0.0305** (0.0137)	0.0301* (0.0169)	0.0308* (0.0178)
<i>Tobin's Q</i>	-0.0839*** (0.0231)	-0.0781*** (0.0232)	-0.105*** (0.0404)	-0.0567** (0.0259)
<i>ROA</i>	0.248***	0.254***	0.142	0.323***

	(0.0808)	(0.0785)	(0.110)	(0.103)
<i>Leverage</i>	0.324***	0.329***	0.426***	0.267***
	(0.0645)	(0.0620)	(0.0896)	(0.0755)
<i>Quick ratio</i>	-0.0510***	-0.0540***	-0.0524*	-0.0505***
	(0.0129)	(0.0136)	(0.0270)	(0.0125)
<i>Investment intensity</i>	0.385***	0.345***	0.351**	0.208
	(0.121)	(0.116)	(0.173)	(0.133)
<i>Dividend</i>	0.0213	0.0129	-0.00820	0.00117
	(0.0325)	(0.0318)	(0.0485)	(0.0381)
<i>Constant</i>	0.596***	0.998*	0.715	0.555
	(0.171)	(0.566)	(0.903)	(0.694)
Observations	867	433	434	867
Year fixed effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.41	0.43	0.40	0.54

**Table 6** – *Extent of hedging (HRI)*. The table reports the coefficients of a pooled Tobit model, where the dependent variable is *HRI*, i.e. the volumetric delta of the hedging position scaled by next year’s production. Model 1 only comprises CFO-level variables. Model 2 adds CEO-level variables. Models 3 and 4 split the sample according to whether *CEO vega* is above (model 3) or below (model 4) the sample median. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include year fixed effects. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

	(1)	(2)	(3)	(4)
	CFO	CFO and CEO	CEO vega upper median	CEO vega lower median
<i>CFO vega</i>	-0.0130*** (0.00294)	-0.0115*** (0.00292)	-0.0109*** (0.00337)	-0.0141*** (0.00423)
<i>CEO vega</i>		-0.00595 (0.00572)		
<i>Log CFO cash compensation</i>	0.00126 (0.00107)	0.00170* (0.00103)	0.00556* (0.00314)	0.000660 (0.00121)
<i>Log CFO stock awards</i>	0.000410 (0.000411)	0.000165 (0.000467)	-0.000596 (0.000686)	0.000551 (0.000546)
<i>CFO age</i>	-0.000408** (0.000202)	-0.000323 (0.00174)	-0.000941 (0.00250)	0.00306 (0.00237)
<i>CFO age squared</i>	-0.000191 (0.000200)	0.00104 (0.00132)	0.000518 (0.00213)	0.00287* (0.00157)
<i>CFO female</i>	-0.00432 (0.00785)	-0.00165 (0.00701)	0.00272 (0.0105)	-0.00376 (0.00512)
<i>CFO tenure</i>	-0.000443 (0.000346)	0.000028 (0.000352)	0.000835* (0.000503)	-0.000138 (0.000337)
<i>CFO director</i>	-0.00926 (0.00614)	-0.00942 (0.00606)	-0.00338 (0.00752)	-0.0129* (0.00706)
<i>CFO insider</i>	-0.000802 (0.00364)	0.000890 (0.00337)	0.00677 (0.00431)	-0.00699* (0.00396)
<i>Log CEO cash compensation</i>		0.000980 (0.000933)	-0.00129 (0.00109)	0.00356*** (0.000856)
<i>Log CEO stock awards</i>		0.000175 (0.000429)	0.000635 (0.000645)	0.000141 (0.000484)
<i>CEO age</i>		-0.00118 (0.00143)	-0.000864 (0.00230)	-0.00297* (0.00166)
<i>CEO age squared</i>		-0.000197 (0.00173)	0.000305 (0.00259)	-0.00353 (0.00236)
<i>CEO tenure</i>		-0.000750*** (0.000210)	-0.000179 (0.000283)	-0.00108*** (0.000245)
<i>CEO duality</i>		-0.000233 (0.00333)	0.00128 (0.00458)	-0.00145 (0.00426)
<i>CEO insider</i>		-0.00685* (0.00350)	-0.0103** (0.00459)	-0.00358 (0.00432)
<i>Log total assets</i>	0.00273** (0.00127)	0.00270** (0.00135)	0.00202 (0.00168)	0.00346* (0.00178)
<i>Tobin's Q</i>	-0.00597** (0.00280)	-0.00520* (0.00269)	-0.00970*** (0.00355)	-0.00142 (0.00342)
<i>ROA</i>	0.0222**	0.0240***	0.0104	0.0307***

	(0.00880)	(0.00847)	(0.0115)	(0.0109)
<i>Leverage</i>	0.0300***	0.0318***	0.0399***	0.0268***
	(0.00682)	(0.00650)	(0.00817)	(0.00810)
<i>Quick ratio</i>	-0.00350***	-0.00381***	-0.00413*	-0.00328**
	(0.00131)	(0.00132)	(0.00246)	(0.00133)
<i>Investment intensity</i>	0.0505***	0.0468***	0.0434**	0.0374**
	(0.0136)	(0.0129)	(0.0168)	(0.0166)
<i>Dividend</i>	0.00376	0.00246	-0.000270	0.00206
	(0.00340)	(0.00315)	(0.00448)	(0.00422)
<i>Constant</i>	0.0365**	0.0547	0.0503	-0.0106
	(0.0172)	(0.0540)	(0.0893)	(0.0708)
Observations	867	867	433	434
Year fixed effects	Yes	Yes	Yes	Yes
Pseudo R-squared	0.36	0.39	0.38	0.49

**Table 7 – Extent of hedging (*HR2*).** The table reports the coefficients of a pooled Tobit model, where the dependent variable is *HR2*, i.e. the volumetric delta of the hedging position scaled by current reserves. Model 1 only comprises CFO-level variables. Model 2 adds CEO-level variables. Models 3 and 4 split the sample according to whether *CEO vega* is above (model 3) or below (model 4) the sample median. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include year fixed effects. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

	(1) Quartiles	(2) Quartiles	(3) Quartiles	(4) Quartiles	(5) Quartiles	(6) Quartiles	(7) Vega gap	(8) Vega gap	(9) Vega gap
<i>CFO high, CEO low (2q+)</i>	-0.202** (0.0802)	-0.126** (0.0639)	-0.0174*** (0.00516)	-0.204** (0.0804)	-0.123* (0.0659)	-0.0172*** (0.00538)			
<i>CFO low, CEO high (2q+)</i>	-0.0424 (0.0484)	-0.0716 (0.0439)	-0.00655 (0.00446)	-0.0444 (0.0496)	-0.0692 (0.0441)	-0.00637 (0.00437)			
<i>CFO high, CEO low (1q)</i>				-0.0263 (0.0615)	0.0227 (0.0553)	0.00241 (0.00579)			
<i>CFO low, CEO high (1q)</i>				0.00616 (0.0379)	0.000587 (0.0359)	-0.000384 (0.00380)			
<i>Vega gap</i>							-0.113*** (0.0305)	-0.0890*** (0.0315)	-0.0103*** (0.00291)
<i>Constant</i>	1.570*** (0.579)	1.069* (0.604)	0.0627 (0.0566)	1.568*** (0.577)	1.073* (0.604)	0.0632 (0.0566)	1.403** (0.553)	0.922 (0.593)	0.0475 (0.0557)
Observations	867	867	867	867	867	867	867	867	867
CFO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
CEO controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted/Pseudo R-squared	.479	.404	.363	.478	.404	.363	.483	.408	.365

**Table 8 – Incentive misalignment.** The table reports the coefficients of a pooled OLS model for *Hedger* (Models 1, 4 and 7), and a pooled Tobit model for *HRI* (Models 2, 5 and 8) and *HR2* (Models 3, 6 and 9). Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include year fixed effects. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

Panel A - CFO-CEO joint age						
	<i>Hedger</i>		<i>HRI</i>		<i>HR2</i>	
	Similar	Different	Similar	Different	Similar	Different
<i>CFO vega</i>	-0.0732* (0.0405)	-0.150*** (0.0486)	-0.0735** (0.0329)	-0.126** (0.0513)	-0.00874*** (0.00288)	-0.0146*** (0.00467)
<i>CEO vega</i>	-0.183** (0.0881)	0.0273 (0.0792)	-0.247*** (0.0652)	-0.00618 (0.0818)	-0.0233*** (0.00545)	0.00134 (0.00766)
Observations	303	564	303	564	303	564
Adjusted/Pseudo R-squared	0.45	0.54	0.49	0.48	0.44	0.43
Panel B - CFO-CEO joint tenure						
	<i>Hedger</i>		<i>HRI</i>		<i>HR2</i>	
	Similar	Different	Similar	Different	Similar	Different
<i>CFO vega</i>	-0.190*** (0.0570)	-0.0926*** (0.0318)	-0.157** (0.0648)	-0.0907*** (0.0340)	-0.0193*** (0.00595)	-0.00975*** (0.00314)
<i>CEO vega</i>	0.0636 (0.105)	-0.108 (0.0725)	-0.0144 (0.0975)	-0.101 (0.0659)	0.00420 (0.00920)	-0.00945 (0.00644)
Observations	367	500	367	500	367	500
Adjusted/Pseudo R-squared	0.51	0.49	0.51	0.42	0.47	0.37
Panel C - CFO-CEO appointment						
	<i>Hedger</i>		<i>HRI</i>		<i>HR2</i>	
	CEO first	CFO first	CEO first	CFO first	CEO first	CFO first
<i>CFO vega</i>	-0.145*** (0.0371)	-0.0451 (0.0371)	-0.128*** (0.0424)	-0.0919** (0.0387)	-0.0147*** (0.00393)	-0.00934*** (0.00349)
<i>CEO vega</i>	0.0299 (0.0764)	-0.163 (0.106)	-0.0764 (0.0787)	-0.109 (0.0829)	-0.00346 (0.00723)	-0.0106 (0.00777)
Observations	516	351	516	351	516	351
Adjusted/Pseudo R-squared	0.49	0.54	0.43	0.49	0.40	0.45

**Table 9 – CFO-CEO effects.** The table reports the coefficients of a pooled OLS model for *Hedger* (first two models of each panel), and a pooled Tobit model for *HRI* and *HR2* (models from the third to the sixth of each panel). Panel A splits the sample according to whether the CFO and the CEO are similar in age (age gap of less than 5 years). Panel B splits the sample according to whether the CFO and the CEO are similar in tenure (tenure of 3 years or more for both executives). Panel C splits the sample according to whether the CFO was appointed after or before the CEO. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include CFO controls, CEO controls, firm controls, and year fixed effects. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

<b>Panel A - Dependent variable: <i>Hedger</i></b>								
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>	<b>(8)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega (y/t) upper median</b>	<b>CEO vega (y/t) lower median</b>	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega (y/y) upper median</b>	<b>CEO vega (y/y) lower median</b>
<i>CFO vega (y/t)</i>	-0.235*** (0.0769)	-0.209*** (0.0733)	-0.146* (0.0839)	-0.308*** (0.0948)				
<i>CEO vega (y/t)</i>		-0.0376 (0.122)						
<i>CFO vega (y/y)</i>					-0.180*** (0.0603)	-0.127* (0.0698)	-0.241*** (0.0729)	-0.215** (0.0875)
<i>CEO vega (y/y)</i>						-0.0708 (0.0719)		
Observations	867	867	222	645	867	867	222	645
Adjusted R-squared	0.48	0.48	0.42	0.54	0.48	0.49	0.45	0.54
<b>Panel B - Dependent variable: <i>HRI</i></b>								
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>	<b>(5)</b>	<b>(6)</b>	<b>(7)</b>	<b>(8)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega (y/t) upper median</b>	<b>CEO vega (y/t) lower median</b>	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega (y/y) upper median</b>	<b>CEO vega (y/y) lower median</b>
<i>CFO vega (y/t)</i>	-0.156** (0.0676)	-0.152** (0.0659)	0.0248 (0.0649)	-0.291*** (0.1000)				
<i>CEO vega (y/t)</i>		-0.0236 (0.0959)						
<i>CFO vega (y/y)</i>					-0.132** (0.0530)	-0.106 (0.0686)	-0.0437 (0.0632)	-0.245** (0.101)
<i>CEO vega (y/y)</i>						-0.0330 (0.0686)		
Observations	867	867	222	645	867	867	222	645
Pseudo R-squared	0.39	0.41	0.51	0.47	0.40	0.41	0.51	0.47

Panel C - Dependent variable: <i>HR2</i>								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CFO	CFO and CEO	CEO vega (y/t) upper median	CEO vega (y/t) lower median	CFO	CFO and CEO	CEO vega (y/y) upper median	CEO vega (y/y) lower median
<i>CFO vega (y/t)</i>	-0.0138* (0.00706)	-0.0143** (0.00694)	-0.00297 (0.00603)	-0.0292*** (0.00960)				
<i>CEO vega (y/t)</i>		-0.00288 (0.00946)						
<i>CFO vega (y/y)</i>					-0.0117** (0.00528)	-0.00853 (0.00728)	-0.00368 (0.00603)	-0.0225* (0.0116)
<i>CEO vega (y/y)</i>						-0.00431 (0.00733)		
Observations	867	867	222	645	867	867	222	645
Pseudo R-squared	0.33	0.36	0.54	0.41	0.34	0.36	0.54	0.41

**Table 10 – Hedging and annual vega.** The table reports the coefficients of a pooled OLS model for *Hedger* (Panel A), and a pooled Tobit model for *HRI* and *HR2* (Panel B and Panel C, respectively). CFO’s and CEO’s risk-taking incentives are measured by *Vega (y/t)* and *Vega (t/t)*. *Vega (y/t)* is the annual vega of a manager’s stocks and stock options divided by the market value of the total equity holdings. *Vega (y/y)* is the annual vega of a manager’s stocks and stock options divided by the market value of the annual stock and stock option awards. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include CFO controls, firm controls, and year fixed effects. CEO controls are included in all models but the first and the fifth of each panel. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

<b>Panel A - Dependent variable: <i>HR2 (1-2)</i></b>				
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega upper median</b>	<b>CEO vega lower median</b>
<i>CFO vega</i>	-0.0217*** (0.00454)	-0.0190*** (0.00467)	-0.0177*** (0.00525)	-0.0237*** (0.00741)
<i>CEO vega</i>		-0.00924 (0.00881)		
Observations	867	867	433	434
Pseudo R-squared	0.35	0.38	0.36	0.48
<b>Panel B - Dependent variable: <i>HR2 (1-3)</i></b>				
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega upper median</b>	<b>CEO vega lower median</b>
<i>CFO vega</i>	-0.0251*** (0.00515)	-0.0218*** (0.00530)	-0.0203*** (0.00600)	-0.0270*** (0.00887)
<i>CEO vega</i>		-0.0108 (0.00987)		
Observations	867	867	433	434
Pseudo R-squared	0.36	0.38	0.36	0.49

**Table 11** – Hedging longer maturities. The table reports the coefficients of a pooled Tobit model for *HR2 (1-2)* (Panel A) and *HR2 (1-3)* (Panel B). *HR2 (1-2)* (resp., *HR2 (1-3)*) is the volumetric delta of the hedging position with instruments expiring up to 2 years (resp., 3 years) scaled by current reserves. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include CFO controls, firm controls, and year fixed effects. CEO controls are included in all models but the first. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

	<i>Hedger</i>		<i>HR1</i>		<i>HR2</i>	
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CFO</b>	<b>CFO and CEO</b>	<b>CFO</b>	<b>CFO and CEO</b>
<i>CFO vega</i>	-0.140*** (0.0274)	-0.120*** (0.0294)	-0.133*** (0.0311)	-0.103*** (0.0319)	-0.0139*** (0.00312)	-0.0119*** (0.00304)
<i>CEO vega</i>		-0.0547 (0.0617)		-0.0881 (0.0610)		-0.00671 (0.00563)
<i>COO</i>	0.0234 (0.0367)	0.0166 (0.0371)	-0.0207 (0.0324)	-0.0192 (0.0323)	-0.00489 (0.00327)	-0.00415 (0.00318)
<i>RM committee</i>	-0.0691 (0.0643)	-0.0750 (0.0613)	-0.00481 (0.0598)	-0.0141 (0.0559)	0.00106 (0.00606)	0.000228 (0.00540)
<i>Constant</i>	0.696*** (0.181)	1.430*** (0.537)	0.618*** (0.175)	1.021* (0.567)	0.0415** (0.0175)	0.0606 (0.0533)
Observations	867	867	867	867	867	867
CFO controls	Yes	Yes	Yes	Yes	Yes	Yes
CEO controls	No	Yes	No	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted/Pseudo R-squared	0.49	0.50	0.42	0.43	0.36	0.39

**Table 12** – *COO and risk management committee*. The table reports the coefficients of a pooled OLS model for *Hedger* (first two models), and a pooled Tobit model for HR1 and HR2 (models from the third to the sixth). All models include a dummy for the presence of a COO (*COO*) and a risk management committee (*RM committee*). Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include CFO controls, firm controls, and year fixed effects (CEO controls are present in the second, fourth, and sixth model). \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

	<i>Hedger</i>		<i>HR1</i>		<i>HR2</i>	
	<i>CFO</i>	<i>CFO and CEO</i>	<i>CFO</i>	<i>CFO and CEO</i>	<i>CFO</i>	<i>CFO and CEO</i>
<i>CFO vega</i>	-0.119*** (0.0226)	-0.106*** (0.0250)	-0.125*** (0.0277)	-0.104*** (0.0275)	-0.0125*** (0.00286)	-0.0118*** (0.00289)
<i>CEO vega</i>		-0.0399 (0.0591)		-0.0766 (0.0563)		-0.00509 (0.00539)
<i>CFO CPA</i>	-0.0563* (0.0325)	-0.0545* (0.0312)	-0.0890*** (0.0338)	-0.0828** (0.0339)	-0.00990*** (0.00354)	-0.00888** (0.00350)
<i>CEO MBA</i>		-0.0246 (0.0422)		-0.0316 (0.0404)		-0.00189 (0.00435)
<i>Constant</i>	1.033*** (0.345)	1.436** (0.665)	1.015*** (0.364)	0.960 (0.750)	0.0615 (0.0374)	0.0334 (0.0721)
Observations	749	749	749	749	749	749
<i>CFO</i> controls	Yes	Yes	Yes	Yes	Yes	Yes
<i>CEO</i> controls	No	Yes	No	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted/Pseudo R-squared	0.50	0.50	0.45	0.45	0.38	0.40

**Table 13** – *CFO and CEO education*. The table reports the coefficients of a pooled OLS model for *Hedger* (first two models), and a pooled Tobit model for *HR1* and *HR2* (models from the third to the sixth). All models add *CFO CPA* and *CEO MBA* to the covariates. Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include *CFO* controls, firm controls, and year fixed effects (*CEO* controls are present in the second, fourth, and sixth model). \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

	<i>Hedger</i>		<i>HR1</i>		<i>HR2</i>	
	CFO	CFO and CEO	CFO	CFO and CEO	CFO	CFO and CEO
<i>CFO vega</i>	-0.154*** (0.0511)	-0.165*** (0.0498)	-0.112** (0.0483)	-0.119*** (0.0434)	-0.0155*** (0.00512)	-0.0158*** (0.00452)
<i>CEO vega</i>		-0.144 (0.104)		-0.293** (0.114)		-0.0241** (0.0102)
<i>Constant</i>	0.818*** (0.262)	2.475** (0.951)	0.320 (0.508)	2.124** (0.987)	-0.0155 (0.0583)	0.0486 (0.0999)
Observations	260	260	260	260	260	260
Treated	130	130	130	130	130	130
Untreated	130	130	130	130	130	130
CFO controls	Yes	Yes	Yes	Yes	Yes	Yes
CEO controls	No	Yes	No	Yes	No	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted/Pseudo R-squared	0.48	0.49	0.46	0.50	0.39	0.43

**Table 14** – *Propensity-score matching*. The table reports the coefficients of a pooled OLS model for *Hedger* (first two models), and a pooled Tobit model for *HR1* and *HR2* (models from the third to the sixth). Each model uses a sample composed of an equal number of treated and untreated observations, based on the nearest-neighbor propensity-score matching technique (without replacement) (Rosembaum and Rubin, 1983; Imbens, 2004). Variables used for matching are firm-level controls (*Log total assets*, *Tobin's Q*, *ROA*, *Leverage*, *Quick ratio*, *Investment intensity*, *Dividend*), CEO-level controls (*CEO vega*, *Log CEO cash compensation*, *Log CEO stock awards*, *CEO age*, *CEO tenure*, *CEO duality*, *CEO insider*), and CFO-level controls (*Log CFO cash compensation*, *Log CFO stock awards*, *CFO age*, *CFO female*, *CFO tenure*, *CFO director*, *CFO insider*). Heteroskedasticity-robust standard errors are clustered at the firm level and are reported in parentheses. All models include CFO controls, firm controls, and year fixed effects (CEO controls are present in the second, fourth, and sixth model). \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

<b>Panel A - Dependent variable: <i>Hedger</i></b>				
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega upper median</b>	<b>CEO vega lower median</b>
<i>CFO vega</i>	-0.0870*** (0.0242)	-0.0962** (0.0372)	-0.0693 (0.104)	-0.0992*** (0.0262)
<i>CEO vega</i>		0.0465 (0.103)		
Observations	140	140	70	70
Adjusted R-squared	0.56	0.56	0.34	0.78
<b>Panel B - Dependent variable: <i>HRI</i></b>				
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega upper median</b>	<b>CEO vega lower median</b>
<i>CFO vega</i>	-0.128*** (0.0432)	-0.123*** (0.0318)	0.0135 (0.0520)	-0.0837** (0.0391)
<i>CEO vega</i>		-0.00206 (0.161)		
Observations	140	140	70	70
Pseudo R-squared	0.62	0.67	0.83	0.82
<b>Panel C - Dependent variable: <i>HR2</i></b>				
	<b>(1)</b>	<b>(2)</b>	<b>(3)</b>	<b>(4)</b>
	<b>CFO</b>	<b>CFO and CEO</b>	<b>CEO vega upper median</b>	<b>CEO vega lower median</b>
<i>CFO vega</i>	-0.0115*** (0.00431)	-0.0104*** (0.00342)	0.00167 (0.00457)	-0.0113* (0.00587)
<i>CEO vega</i>		-0.00744 (0.0148)		
Observations	140	140	70	70
Pseudo R-squared	0.57	0.61	0.83	0.79

**Table 15 – Transitioning subsamples.** The table reports the coefficients of a pooled OLS model for *Hedger* (Panel A), and a pooled Tobit model for *HRI* and *HR2* (Panel B and Panel C, respectively). The table only considers a subsample of firms that experienced both a CFO change and a significant change in their vega. First, only firms that experienced at least a CFO change (70 firms) are retained. Second, the sample is further restricted to firms for which the vega of the new CFO is above (resp., below) the median of this variable (in the subsample of firms which experienced a CFO change) and the vega of the old CFO is below (resp., above) the same median (19 firms). Heteroskedasticity-robust standard errors are clustered at firm

level and are reported in parentheses. All models include CFO controls, firm controls, and year fixed effects. CEO controls are included in all models but the first. \*\*\*, \*\* and \* denote statistical significance at the 1, 5, and 10% level, respectively. All variables are defined in Appendix B.

## Appendix A. Hedging positions

We provide an example of how we construct hedging extent variables using Continental Resources Inc. (fiscal year 2009), a firm in our sample. Information provided in 10-K is reported below.

### A.1. Derivatives outstanding (December 31, 2009)

#### *Crude oil*

Period and type of contract	Volume (MBbls)	Swaps weighted average	Floors		Ceilings	
			Range	Weighted average	Range	Weighted average
<u>Jan 2010 – Jun 2010</u>						
Swaps	905	\$80.5				
Collars	453	—	\$70.0	\$70.0	\$95.0	\$95.0
<u>Jul 2010 – Dec 2010</u>						
Collars	644	—	\$75.0	\$75.0	\$96.75	\$96.75
<u>Jan 2011 – Dec 2011</u>						
Collars	1,278	—	\$75.0	\$75.0	\$89.0	\$89.0

#### *Natural gas*

Period and type of contract	Volume (MMMBtus)	Swaps weighted average
<u>Jan 2010 – Mar 2010</u>		
Swaps	2,700	\$6.18
<u>Apr 2010 – Jun 2010</u>		
Swaps	2,710	\$6.18
<u>Jul 2010 – Sep 2010</u>		
Swaps	2,720	\$6.18
<u>Oct 2010 – Dec 2010</u>		
Swaps	2,720	\$6.18

#### *Natural gas basis CenterPoint East*

Period and type of contract	Volume (MMMBtus)	Swaps weighted average
Jan 2010 – Dec 2010	7,200	\$(0.62)
Swaps		

We consider all directional derivative positions expiring within the next fiscal year (2010). Volumes are cumulated and converted into thousands of barrels of oil equivalent (MBOE). This firm hedges 905 thousand standard barrels (MBbls) of future oil production with swaps and 1,097

(= 453 + 644) MBbls with collars. The total volume for natural gas is 10,850 (= 2,700 + 2,710 + 2,720 + 2,720) million British thermal units (MMMBtus) (nondirectional contracts, such as basis swaps, are not included). MMMBtus are divided by 1.037 and converted into Mcf (thousand cubic feet), resulting in 10,462,874 Mcf.<sup>1</sup> Then, we convert this volume to MMcf (million cubic feet) and divide it by 6 to obtain the volume in MBOE (1,744 MBOE, i.e., 10,463 MMcf/6).<sup>2</sup>

To compute the delta of hedging positions (the numerator of *HR1* and *HR2*), we follow [Tufano \(1996\)](#). First, for each type of commodity, we aggregate all directional contracts (swaps, collars, etc.) covering the expected production one year ahead.<sup>3</sup> Then, we separately compute the delta for each class of contracts. Linear contracts are assigned a delta of  $-1$ , while we apply [Black and Scholes' \(1973\)](#) formula for nonlinear contracts.<sup>4</sup> Unit deltas are multiplied by the volume hedged by contract type. Finally, all volumetric deltas are summed (NG figures are converted in MBOE) to obtain each firm's overall yearly volumetric delta.

For Continental Resources, the volumetric delta of oil and natural gas swaps is  $-905$  MBbls (=  $-1 * 905$  MBbls) and  $-1,744$  MBOE (=  $-1 * 1,744$  MBOE), respectively. For collars, the unit delta is  $-0.7$ , computed through an annualized volatility of 35.56%, 1-year time horizon, risk-free rate of 0.55%, and 1-year future oil price of 84.44 \$/Bbls. The volumetric delta of collars is  $-769$  MBbls (=  $-0.7 * 1,097$  MBbls). The total volumetric delta of Continental Resources in 2009 is  $-3,418$  MBOE (=  $-905$  MBbls  $- 1,744$  MBOE  $- 769$  MBbls).

## A.2. Total production (December 31, 2010)

	<b>Net production volume</b>
<b>By commodity:</b>	
Crude oil (MBbls)	11,820
Natural gas (MMcf)	23,943
<b>Total company (MBOE)</b>	<b>15,811</b>
<b>By region:</b>	
North (MBOE)	12,431

<sup>1</sup> The conversion factor is provided by the United States Energy Information Administration (<https://www.eia.gov/tools/faqs/faq.php?id=45&t=8>).

<sup>2</sup> The standard assumption is that 6 Mcf of natural gas are equivalent to one barrel of oil for energy production ([Bajo et al., 2021](#)).

<sup>3</sup> If a firm reports different volumes and prices for the same type of contract, we compute the weighted average price per contract.

<sup>4</sup> We collect commodity spot and future prices from Refinitiv Datastream.

South (MBOE)	2,915
East (MBOE)	465
<b>Total company (MBOE)</b>	<b>15,811</b>

The total 2010 production is 15,811 MBOE. Since the 2009 hedging position volumetric delta is 3,418 MBOE, the hedge ratio (*HRI*) is 21.62% (= 3,418 MBOE/15,811 MBOE).

### A.3. Reserves (December 31, 2009)

	Crude oil (MBbls)	Natural gas (MMcf)	Total (MBOE)
Proved developed producing	83,745	169,556	112,004
Proved developed non-producing	1,525	226	1,563
Proved undeveloped	88,01	334,298	143,726
<b>Total proved reserves</b>	<b>173,280</b>	<b>504,080</b>	<b>257,293</b>

Total 2009 reserves amount to 257,293 MBOE. Since the 2009 hedging position volumetric delta is 3,418 MBOE, the hedge ratio (*HR2*) is 1.33% (= 3,418 MBOE/257,293 MBOE).

## Appendix B. Variable definitions

Variable name	Definition
<i>Hedger</i>	Dummy variable equal to 1 if the firm hedges with financial derivatives or fixed-rate contracts, and 0 otherwise
<i>HR 1</i>	Volumetric delta of hedging derivative contracts expiring in one year or less over next year's total production
<i>HR 2</i>	Volumetric delta of hedging derivative contracts expiring in one year or less over current reserves
<i>CFO (CEO) vega</i>	Vega of CFO's (CEO's) stock options (exercisable and non exercisable) over total market value of shares beneficially owned by the CFO (CEO) plus value of CFO's (CEO's) stock options (exercisable and non exercisable)
<i>CFO (CEO) cash compensation</i>	Annual cash salary plus bonus of the CFO (CEO)
<i>CFO (CEO) stock awards</i>	Annual stock awards of the CFO (CEO)
<i>CFO (CEO) age</i>	Age of the CFO (CEO)
<i>CFO (CEO) tenure</i>	Years in the CFO (CEO) position
<i>CFO female</i>	Dummy variable equal to one if the CFO's gender is female
<i>CFO director</i>	Dummy variable equal to one if the CFO is also a director
<i>CFO (CEO) insider</i>	Dummy variable equal to one if the CFO (CEO) position was the first position the individual held at the company
<i>CEO duality</i>	Dummy variable equal to one if the CEO is also the chair of the board of directors
<i>Total assets</i>	Total assets
<i>Tobin's Q</i>	Market value of equity plus total assets minus book value of equity, divided by total assets
<i>ROA</i>	EBIT over total assets
<i>Leverage</i>	Short term debt plus long term debt over total assets
<i>Quick ratio</i>	Cash and cash equivalents plus accounts receivables over current liabilities
<i>Investment intensity</i>	Capital expenditures over total assets
<i>Dividend</i>	Dummy variable equal to one if the firm is a dividend payer
<i>CFO high, CEO low (2q+)</i>	Dummy variable equal to 1 if the CFO has a vega higher than the CEO's by at least two quartiles of the respective distributions

<i>CFO low, CEO high (2q+)</i>	Dummy variable equal to 1 if the CFO has a vega lower than the CEO's by at least two quartiles of the respective distributions
<i>CFO high, CEO low (1q)</i>	Dummy variable equal to 1 if the CFO has a vega higher than the CEO's by one quartile of the respective distributions
<i>CFO low, CEO high (1q)</i>	Dummy variable equal to 1 if the CFO has a vega lower than the CEO's by one quartile of the respective distributions
<i>Vega gap</i>	Difference between <i>CFO Vega</i> and <i>CEO Vega</i>
<i>CFO (CEO) vega (y/t)</i>	Vega of CFO's (CEO's) annual stock options (exercisable and non exercisable) over total market value of shares beneficially owned by the CFO (CEO) plus value of CFO's (CEO's) stock options (exercisable and non exercisable)
<i>CFO (CEO) vega (y/y)</i>	Vega of CFO's (CEO's) annual stock options (exercisable and non exercisable) over annual market value of shares beneficially owned by the CFO (CEO) plus annual value of CFO's (CEO's) stock options (exercisable and non exercisable)
<i>HR2 (1-3)</i>	Volumetric delta of hedging derivative contracts expiring in three years or less over current reserves
<i>COO</i>	Dummy equal to one if the firm has a Chief Operational Officer (COO)
<i>RM committee</i>	Dummy equal to one if the firm has a an <i>ad hoc</i> risk-management committee
<i>CFO CPA</i>	Dummy equal to one if the CFO is a CPA (Certified Public Accountant)
<i>CEO MBA</i>	Dummy equal to one if the CEO holds an MBA

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## ESSAY THREE

# CEOs' compensation incentives: a systematic review of the finance literature

### Abstract

This paper provides a systematic literature review on CEOs' pay-related incentives to take risks. CEOs play a prominent role among all senior corporate executives as the key decision-makers in corporate strategy and performance, and an impressive amount of empirical evidence has assessed and confirmed the link between their characteristics and firm outcomes. Regardless of such a significant *corpus* of research, the debate on whether incentives allineate their interests to those of claim holders and alleviate principal-agent conflicts is still open. To fill this gap, we review 129 scientific articles published in finance journals of recognized academic reputation between 1996 and 2022. Contributions in the literature mainly confirm the role of incentives in aligning the interests of CEOs and claim holders, but the risk of engaging in excessively aggressive corporate policies is significant and potentially value destroying. Moreover, new sources of incentives are emerging, thus broadening the debate to include debt-like compensation and CEOs' labour market phenomena in the discussion together with executive stock options.

**JEL Classification:** G30; G32.

**Keywords:** CEO; Compensation;

## 1. Introduction

The characteristics of top management are critical determinants of corporate outcomes (Hambrick and Mason, 1984; Hambrick, 2007; Quigley and Hambrick, 2015). However, while theoretical contributions refer to “top management” in a general sense, the academic focus has been primarily on the Chief Executive Officer, and research around this key figure shows no sign of slowing down (Busenbark et al., 2016). On the one hand, such an intense focus on the CEO could be explained by empirical convenience in a general theory-testing setting (Busenbark et al., 2016). On the other hand, the most recent body of work seems instead to recognize the distinctiveness of CEOs as individuals in a unique position (Lange et al., 2015; Kaplan and Sorensen, 2021). Regardless of the research objective, an impressive amount of empirical evidence has assessed and confirmed the link between CEO characteristics and firm outcomes. Not surprisingly, many academic contributions focus on CEO compensation schemes (Busenbark et al., 2016), through the theoretical lenses of agency theory (Fama and Jensen, 1983).

The main mechanisms to alleviate principal-agent problems are incentives, which should be structured to align the interests of managers and claim holders (Jensen and Meckling, 1976) according to an optimal contracting view (Catuogno et al., 2016). According to Jensen and Meckling (1976), equity-based compensation should align the interests of risk-averse managers and stockholders and incentivize the formers to take risks for the latter's sake (Phan, 2014). A more recent body of literature shows how debt-based compensation has, instead, the objective of aligning the interests of managers and external debtholders (Wei and Yermack, 2011; Phan, 2014) by disincentivizing risk shifting. Finally, tournament participants competing for the apical position in the focus firm or a CEO position in another firm will select risk-increasing strategies to enhance their probability of winning, creating value for shareholders in the process (Coles et al., 2018).

Despite the steady interest around CEOs and the consequences of the design of their compensation schemes, finance research remains fragmented and fails to present a comprehensive picture on the topic. Our objective is to fill this gap by providing a systematization of empirical studies on CEOs' incentives (not) to take risks. In other words, this systematic literature review aims to assess how scientific articles within the finance discipline have advanced the academic knowledge on the role of compensation-linked incentives of CEOs in corporate financial decision-making.

Literature on CEO compensation is multidisciplinary, broad, and highly dynamic. These characteristics guarantee, on the one hand, the need to critically assess and summarize academic contributions to promote a correct cumulation of knowledge. On the other hand, a too-broad review exercise would result in fragmentation of knowledge across different theoretical frameworks, which is undoubtedly deleterious if the aim is to provide a picture as organic as possible (Busenbark et al., 2016). Accordingly, this systematic literature review is based on 129 scientific articles published in finance journals of recognized academic reputation between 1996 and 2022. After an accurate screening and categorizing process, the selected papers are grouped and discussed across six research clusters exploring the relationship between CEOs' incentives and: (1) corporate risk and risk-taking, (2) financing and (3) all other corporate policies, (4) information environment, (5) Initial Public Offerings (IPOs), Mergers and Acquisitions (M&As) and liquidation and, finally, (6) firm performance.

Overall, a generally agreeing picture emerges. Contributions in the literature mainly confirm the role of incentives in aligning the interests of CEOs and claim holders. More specifically, evidence from cluster 1 confirms the role of equity and tournament (debt) incentives as risk-taking increasing (decreasing) tools to satisfy shareholders (debtholders). Moreover, this mechanism is correctly recognized and priced by claim holders (cluster 2), pervasive across the firm's many functions (cluster 3) and corporate events (cluster 5), and impacts overall firm performance (cluster 6). However, the risk of engaging in excessively aggressive corporate policies is significant and could be detrimental not only to debtholders but also to shareholders if it encourages unethical corporate behavior (cluster 4). In other words, while a healthy amount of aggressiveness in corporate policies can be beneficial, excessive risk-taking could ultimately destroy shareholders' value. Therefore, compensation packages should be carefully designed to constrain the risk-taking incentives they generate.

Our contribution to the literature is twofold. First, up to our knowledge, we are the first to provide a unique focus on risk-increasing (risk-decreasing) incentives stemming from compensation packages, thus providing a comprehensive picture of how CEO pay can affect their willingness to take risks. Then, we not only update but also broaden the scope of previous literature reviews on the topic (i.e., Devers et al., 2007; Goergen and Renneboog, 2011; Catuogno et al., 2016) by including debt-like compensation and relative pay phenomena in our discussion. Therefore, our review provides a more complete understanding of the many compensation-related sources of risk-taking incentives.

The remainder of the paper is organized as follows. The next section introduces the figure of the CEO and discusses how different compensation-linked incentives can affect corporate behavior. Section 3 presents the scope of the review, together with the methodology adopted to select and classify articles and the research clusters identified. Section 4 summarizes and discusses findings in the literature. Finally, Section 5 concludes.

## **2. CEOs and compensation incentives**

Efforts to empirically validate early theoretical contributions in finance have always found fertile ground in the CEO figure. However, the intense focus on the CEO can be explained by empirical convenience in a general theory-testing setting rather than by a genuine interest in exploring the effects of their specific characteristics (Busenbark et al., 2016). Still, the most recent contributions seem to point to CEOs being unique individuals, either because of their position, personality, or the context in which they are studied (Lange et al., 2015; Busenbark et al., 2016; Kaplan and Sorensen, 2021). According to this last stance, CEOs undeniably play a prominent role among all senior corporate executives as the key decision-makers in corporate strategy and performance (e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Pérez-González, 2006; Bennedsen et al., 2007; Bloom et al., 2013; Custódio and Metzger, 2014; Bennedsen et al., 2020). Therefore, they are worthy of academic interest rather than just a convenient setting (Busenbark et al., 2016).

A well-established research stream, prominence of the CEO figure, and data availability have allowed scholars to study how the most disparate CEO-related factors affect corporate outcomes. This is especially true for the finance discipline, as corporate financial decision-making is among the primary responsibilities that can be traced back to the CEO. A non-exhaustive list of examples encompasses exposure to natural disasters in early life (Bernile et al., 2017), cultural heritage (Nguyen et al., 2018), gender of the prole (Cronqvist and Yu, 2017) and military experience (Malmendier et al., 2011). Moreover, characteristics of a CEO's social network (Ferris et al., 2017), gender (Faccio et al., 2016) and culturally determined preferences toward risk and uncertainty (Pan et al., 2017) are found to be associated with corporate outcomes.

The link between CEO characteristics and firm behavior is theoretically rooted in upper echelons theory (Hambrick and Mason, 1984) and agency theory (Fama and Jensen, 1983). The main mechanisms to alleviate principal-agent problems are incentives, which should be

structured to align the interests of managers and shareholders (bondholders) (Jensen and Meckling, 1976). Therefore, it is not surprising that many academic contributions focus on CEO compensation schemes (Busenbark et al., 2016), either in absolute or, much more recently, relative terms.

Undeniably, performance-sensitive pay in stock options has captured much academic attention, given the historically prevalent role of executive stock options (ESOs) in executive compensation packages (Shue and Townsend, 2017). However, over time the focus has broadened to include debt-based compensation and relative-pay phenomena (such as internal or industry-based tournaments) as aligning incentives. The following sections will summarize how these three compensation-linked incentives can alleviate conflicts between executives and shareholders (bondholders).

## 2.1. Equity incentives

While performance-sensitive pay (mainly in the form of stock options) was a much more prevalent component of executive compensation before 2005,<sup>1</sup> option-based or option-like pay remains an important share of CEO pay also nowadays (Shue and Townsend, 2017). Moreover, there is still a long-standing question (dating back to Jensen and Meckling (1976)) of whether options influence CEO risk-taking behavior (Shue and Townsend, 2017). According to Jensen and Meckling (1976), equity-based compensation should align the interests of risk-averse managers and stockholders and incentivizes the formers to take risks for the shareholders' interests (Phan, 2014). Therefore, how ESOs affect CEOs' financial decision-making has become a well-travelled path in academic research, generating an impressive body of work on the topic.

ESOs are convexity-increasing instruments. On the one hand, the option holder earns the difference between the price of the underlying and the strike price if the former rises above the latter. On the other hand, there is no symmetrical loss in the opposite scenario. Convexity of managers' compensation increases their sensitivity to stock return volatility and renders a decision-maker less risk-averse (Guay, 1999; Chava and Purnanandam, 2010), as also suggested by early theoretical models on risk management (Stulz, 1984; Smith and Stulz, 1985). Empirically, the methodology introduced by Core and Guay (2002), together with the

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<sup>1</sup> In 2005, the introduction of Financial Accounting Standard (FAS) 123R required firms to expense executive stock options at fair value, and it resulted in a significant decrease in option pay (Bakke et al., 2016)

advent of transparent reporting practices and commercial databases (i.e., Execucomp), has allowed researchers to directly apply [Black and Scholes' \(1973\)](#) model (corrected for dividends by [Merton \(1973\)](#)), to price stock options and compute risk-taking incentives. Compensation-linked risk-taking incentives are usually measured with the vega of the CEO's wealth invested in the firm ([Guay, 1999](#); [Core and Guay, 2002](#)), defined as the sensitivity of a manager's total equity investment in the firm (i.e., stocks and stock options) to the volatility of stock returns.

Many studies in the literature also control for or directly focus on the delta of a CEO's portfolio, where delta is the sensitivity of the value of the CEO's equity-based compensation to changes in the firm's stock price. While the effect of the CEO's vega on risk-taking is theoretically unambiguous, as vega is a direct measure of convexity ([Shue and Townsend, 2017](#)), delta captures pay-performance sensitivity instead. A higher delta should align managers' and shareholders' objectives by increasing the extent to which their gains and losses are shared ([Bakke et al., 2016](#)) and induce managers to operate accordingly to be rewarded with an increase in share price ([Armstrong et al., 2013](#)). However, a higher delta could also decrease risk-averse managers' willingness to bear risk ([Bakke et al., 2016](#)), thus also operating as a risk-taking disincentive. Therefore, the *a priori* effect of delta on managerial risk-taking is unclear ([Armstrong et al., 2013](#)).

## **2.2. Debt incentives**

A growing body of literature indicates that debt-like compensation makes up a significant, and in some cases even prevalent, portion of the total executive compensation packages ([Wei and Yermack, 2011](#); [Phan, 2014](#)). While equity-based compensation aims to alleviate agency costs of equity (i.e., conflicts between managers and shareholders), debt-based compensation has, instead, the objective of aligning the interests of managers and external debtholders. Consequently, it will promote more conservative investment policies rather than incentivizing risk-taking behavior.

The two primary components of debt-based compensation (also called “inside debt”<sup>2</sup>) are (a) defined benefit pensions and (a) deferred compensation. Pension benefits accrue under company-specific formulas and can be exchanged for either a lump sum or an annuity at

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<sup>2</sup> Pension benefits and deferred compensation represent fixed obligations by the company to pay corporate insiders/managers at a later time. Hence, these are usually referred to as “inside debt” ([Phan, 2014](#)).

retirement. Accrual of deferred compensation is at the manager's discretion if they decide to forego a part of their cash salary and instead lend it back to their company for a certain amount of time. Since inside debt is generally unsecured and unfunded,<sup>3</sup> managers have the same claims as other unsecured creditors in case of bankruptcy (Wei and Yermack, 2011). In other words, managers bear for a part of their compensation the same default risk faced by external bondholders (Wei and Yermack, 2011). Therefore, they also have the same incentives to preserve firm value in bankruptcy and adopt more conservative policies (Wei and Yermack, 2011).

The role of inside debt in alleviating agency costs between shareholders and external debtholders is already theoretically argued by Jensen and Meckling (1976). However, it will be only much later that Edmans and Liu (2011) will formally show how inside debt holdings are negatively associated with risk-taking behavior (Phan, 2014). Consequently, academic work on inside debt is much more recent with respect to research on equity-based incentives. For example, Wei and Yermack (2011) is considered a seminal work in the research stream, regardless of its relatively recent publication. This is not surprising, as in the case of the US (arguably, the most represented country in the literature), the SEC has mandated full disclosure of executive inside debt data only starting from 2007 (Wei and Yermack, 2011). Before that date, the computation of pension values required data and in-depth knowledge of actuarial mathematics, while deferred compensation plans were entirely opaque to the public (Wei and Yermack, 2011).

### 2.3. Tournament incentives

Tournament settings are characterized by many agents competing for a limited number of ranked slots (Coles et al., 2018). They are pervasive inside and outside the corporate world, and incentives stemming from them have been repeatedly proven to affect the risk-taking behavior of participants, as they will select risk-increasing strategies to enhance their probability of winning the tournament (Coles et al., 2018). While winning a sport-related tournament translates to winning a match or race and the associated prize, company tournaments are traditionally structured as races for promotion, in which the winning executive receives an award in the form of higher pay, perquisites, and improvement in social status (Naveen, 2006). Finance research has primarily focused on these internal tournaments,

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<sup>3</sup> In most companies, executive pension plans are only limitedly funded, secured, and insured by the federal Pension Benefit Guaranty Corporation (PBGC) (Wei and Yermack, 2011).

as the related incentives (usually proxied by the gap in compensation between the CEO and the next layer of senior managers) encourage risk-taking on the participants' part (Kale et al., 2009).<sup>4</sup>

As extreme results are more likely with greater risk-taking, all participants in an internal promotion tournament are encouraged to take more aggressive decisions to achieve more successful outcomes, regardless of their abilities (Goel and Thakor, 2008). The board of directors and the departing CEO will not be able to discern whether it was the executive's ability or the enhanced risk profile of the project that resulted in higher output, and they will choose the winner only according to the highest output achieved (Goel and Thakor, 2008). If we frame the promotion to CEO as "being in the money" and the prize as the resulting increase in compensation, internal tournaments exhibit option-like features that ultimately encourage risk-averse managers to engage in riskier policies on behalf of shareholders (Kini and Williams, 2012). These incentives are similar to performance-based and risk-taking ones (respectively, delta and vega of stand-alone compensation packages of executives) but are incremental to them (Kini and Williams, 2012).

Another recent stream on tournaments focuses on industry (or external) ones. These tournaments directly involve CEOs, and the winning prize is another, better paid, apical position in a different company in the same industry. Therefore, industry tournament incentives arise in the external labor market for executives rather than internally to the firm. However, similarly to rank-order tournament incentives, external incentives are also based on pay gaps<sup>5</sup> and sport the same option-like features, thus ultimately encouraging risk-taking. CEOs that take risks on behalf of shareholders are more likely to be strong candidates for the industry prize, i.e., a more desirable position leading another company (Coles et al., 2018).

### **3. Scope of the review and analytical approach**

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<sup>4</sup> CEOs are at the apex of the corporate hierarchy. Therefore, they are not subjected to promotion-based tournament incentives but only to performance-based ones (Kale et al., 2009). However, internal tournament incentives are intrinsically linked to the position of the CEO, as they directly stem from the differential between their pay and the pay of the next-in-line managers. Therefore, we argue that this systematic literature review should include internal tournaments, as they are placed on the nexus between literature on CEO compensation and on CEO selection, both directly related to the role and structure of the CEO position (Busenbark et al., 2016).

<sup>5</sup> In the case of industry tournaments, incentives are usually measured by the pay gap between a firm's CEO and the highest-paid CEOs within a group of peers in the same industry (Coles et al., 2018).

Literature on CEO compensation is multidisciplinary, broad, and highly dynamic. Consequently, any review article needs not only a rigorous and precise definition of its primary objective but also of its scope. Such a definitional exercise has the double objective of (a) delimiting the theoretical boundaries of the review and (b) avoiding overlapping with existing reviews on the topic, both in finance (i.e., [Goergen and Renneboog, 2011](#)) and adjacent fields (i.e., [Devers et al., 2007](#); [Catuogno et al., 2016](#)).

This systematic literature review aims to assess how scientific articles within the finance discipline have advanced the academic knowledge on the role of compensation-linked incentives of CEOs in corporate financial decision-making. Consequently, its exact scope can be defined across two dimensions. First, a focus on the (corporate) finance discipline will be exercised, thus excluding works in the adjacent fields of accounting, banking, and management. Then, the focus on compensation-linked incentives will be the first and most important criteria for including papers. This choice automatically excludes all works focusing on either cash compensation or only stock holdings (i.e., articles on stock ownership). As per the former, cash compensation measures wealth diversification rather than a risk-taking incentive, as cash allows managers to invest in assets outside their firm ([Bakke et al., 2016](#)). Similarly, managers with greater stock ownership are less diversified ([Smith and Stulz, 1985](#)). However, as [Guay \(1999\)](#) points out, also stock holdings provide a negligible risk-taking incentive *per se*. In the following sections, we describe our article selection procedure and detail the specific inclusion/exclusion decisions and coding criteria we adopted throughout the process.

### **3.1. Article selection procedure**

The selection of articles followed the most recently published standards in systematic literature reviews (e.g., [Bezemer et al., 2022](#)). Consequently, we focused on peer-reviewed journal articles and excluded other nonrefereed publications (e.g., book chapters and conference proceedings). As a starting point, we identified journals listed in the “Business Finance” category of the Web of Science database. We complemented it with journals belonging to the Chartered Association of Business Schools (CABS-2021) list and the Financial Times’ “FT50” one. Next, we conducted a multiple-keyword search for any published article featuring in the abstract, key words or title the expressions “CEO\* OR Chief Executive Officer \*” and, alternatively, (a) “incentive\*”, (b) “equity incentive\*”, (c) “inside

debt\*”, (d) “tournament\*”, (e) “compensation\*”, or (f) “pay\*”. The selection of these search terms resulted in an initial set of 1,497 research articles.

The broad nature of the selected keyword is fundamental to collect all possibly relevant articles. However, a downside is the possible inclusion of articles not directly relevant to the defined scope and objective of the review. To ensure relevance, we adopted a multi-stage screening process. First, we excluded all papers published in journals not belonging to the “Finance” field either by CABS-2021 of FT50 (673 articles). Then, we ensured a minimum quality standard by keeping only the articles published in journals ranked either 3 or more by CABS-2021 (Bezemer et al., 2022). Titles and abstracts of the remaining articles were read to remove (a) unrelated articles (242 articles)<sup>6</sup> and (b) articles focusing on the banking (70 articles) or fund/insurance sector (21 articles). Theoretical papers (39 articles) were also excluded. This initial screening process resulted in 259 potential articles of interest for the period 1996–2022.

Finally, we excluded articles focusing on antecedents of compensation-linked incentives rather than their effects (130 articles). After this last step, we arrived at a final sample of 129 articles published in the 21 journals identified in Table 1 (the complete list of articles in Table A1 in the Appendix). The journals with the highest contributions are the *Journal of Corporate Finance* (26 articles) and the *Journal of Financial Economics* (23 articles).

*Please insert Table 1 here*

### **3.2. Research clusters**

All 129 articles were coded across two dimensions to define research clusters. First, we grouped articles according to the type of incentive (equity-based, debt-based, or tournament-based) they focus on. Then, we categorized articles according to the nature of the outcome variable. Several rounds of coding were necessary to group similar papers along this last dimension. More specifically, outcome variables were grouped first according to the specific policy they address (e.g., debt, equity, firm risk, dividend policy), a corporate event (IPOs, M&As), or an overall theme (the information environment, firm value, firm performance). Then, smaller clusters (less than 10 papers) were aggregated together either across a main theme (e.g., risk, information) or in a residual category in case of very specific and less

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<sup>6</sup> Articles including incentives as control variables are considered non-relevant to the review, and excluded at this stage.

explored corporate policies. The outcome is a total of 6 research clusters and 32 subclusters. Table 2 shows the distribution of the 129 papers across the research clusters per type of incentive.

*Please insert Table 2 here*

The numbering and order of presentation of the clusters (from 1 to 6) is a function of the numerosity of the papers included (from the biggest to the smallest one). The biggest cluster (37 articles) groups papers directly centered around the risk-taking enhancing (decreasing) mechanism of incentives. These papers either directly test the role of incentives on corporate risk and risk-taking or take a risk management perspective. Clusters 2 to 6 exploit the risk-enhancing (decreasing) mechanism embedded in compensation packages to focus on more specific corporate outcomes. The second cluster (29 papers) focuses only on financing decisions, i.e., composition and riskiness of corporate debt and equity. The third cluster (22 papers) covers all other corporate policies (i.e., payout policy, investment policy) potentially affected by CEOs' incentives. Cluster number 4 (15 papers) groups articles showing how incentives can affect the quality and quantity of information that corporations disclose, either voluntarily or not. Articles in the fifth cluster (13 papers) deal with specific events in a corporation's life cycle, such as Initial Public Offerings (IPOs), Mergers and Acquisitions (M&As) and liquidation. Finally, cluster number 6 (13 papers) groups articles focusing on firm performance, either from an accounting or market point of view.

Table 2 highlights how most papers focus on equity-based incentives (89 articles, 69% of the sample). In contrast, the rest of the papers is almost equally divided between debt-based incentives (20 papers) and tournaments (20 papers). This is not surprising, as the research stream on equity incentives has historically been the first to be established due to data availability.

## **4. Review of the literature**

### **4.1. Cluster 1: Firm risk, risk management and innovation**

The first identified cluster in the literature groups all works that directly test the risk-taking enhancing mechanism captured by CEOs' compensation packages. Table 3 groups works according to subclusters and type of incentives.

*Please insert Table 3 here*

Half of the works focuses on the relationship between incentives and corporate risk-taking. In general terms, individual choices reveal willingness to bear risk, and risk-taking is linked to observable outcomes of risky choices. In an individual investment setting, investing in asset A rather than in asset B is risk-taking, depending on specific risk-related characteristics of both assets. In a corporate setting, the observable outcomes of CEOs' risk-taking are instead either firm-level risk or riskiness embedded in corporate policies.

While no unique measure captures corporate risk-taking, all studies in the subcluster consider a comprehensive set of corporate outcomes that, if taken together, can reflect company-wide risk-taking. Unsurprisingly, this subcluster generally confirms what was argued in section 2 on the role of incentives in aligning the interests of risk-averse managers and stakeholders. Stock option grants enhance equity risk (Shue and Townsend, 2017) and exchange rate risk (Francis et al., 2017). The role of managerial convexity in enhancing risk-taking is generally confirmed (Hayes et al., 2012; Low, 2009), as vega increases both idiosyncratic and systematic risk (Armstrong and Vashishtha, 2012). Results on the risk-taking enhancing mechanism operating through delta are more mixed, in line with theoretical ambiguity about whether pay-performance sensitivity encourages or discourages aggressive corporate policies. A positive and pro-cyclical relationship between portfolio delta and risk-taking is reported by Savaser and Sisli-Ciamarra (2017), while Alderson et al. (2014) show how incumbent CEOs with lower delta than their predecessors are more conservative. The role of inside debt as a risk-reducing incentive is instead unanimously supported in the literature, as it is associated with a low-risk corporate profile and lower corporate risk-taking (Lee et al., 2021; Cassell et al., 2012). However, higher volatility in CEOs' deferred compensation portfolios results in higher, rather than lower, firm risk (Cen and Doukas, 2017). Finally, rank-order (Kini and Williams, 2012), industry tournaments (Coles et al., 2018), and Relative Performance Evaluation (Wruck and Wu, 2022) match with a heightened firms' risk profile, confirming theoretical predictions described in section 2.3. Along the same lines, industry tournament incentives also affect stock price crash risk (Chowdhury et al., 2020; Kubick and Lockhart, 2021), while evidence on CEOs' equity incentives is more mixed (Kim et al., 2011).

Managerial preferences significantly affect hedging. Risk-averse managers have the incentive to hedge in full when their utility is concave in their firm's value, and such incentives reverse when their utility function is convex (Stulz, 1984; Smith and Stulz, 1985). Since executive

stock options (ESOs) are convexity-increasing instruments, financial theory predicts a negative relation between ESOs and hedging (Smith and Stulz, 1985). Following this theoretical prediction, both early empirical studies (Tufano, 1996; Rogers, 2002; Géczy et al., 2007) and more recent contributions (Bakke et al., 2016) have confirmed this negative and significant relationship. Moreover, risk-taking incentives affect both financial and operational hedging (Devos and Li, 2021). Keeping instead fixed the focus on financial hedging, Lonare et al. (2022) confirm how also industry incentives enable more aggressive risk management policies. Two exceptions in such a homogeneous (result-wise) subcluster are the work of Kolasinski and Yang (2018) and Doukas and Mandal (2018). While the former fails to find any connection between CEO vega and firm risk-taking, the latter reports insignificance of both debt and equity incentives on derivatives' usage.

One aspect of corporate risk-taking is innovative efforts and investment in Research and Development (R&D). While innovation is a key driver of firms' future competitiveness and productivity, it is also risky and sports a high probability of failure due to its long-term nature (Mao and Zhang, 2018). Industry (Kong et al., 2022) and rank-order (Shen and Zhang, 2018) tournament incentives follow expectations and enhance innovative activities. Unsurprisingly, innovation is also encouraged by convexity (Shen and Zhang, 2013; Chen et al., 2014; Mao and Zhang, 2018) and long-term incentives (Nguyen, 2018) embedded in CEOs' compensation contracts. More interestingly, O'Connor et al. (2013) do not confirm the positive relationship between convexity and innovation but instead show that short-terminism encapsulated in delta results in fewer R&D expenditures, especially in the presence of market frictions.

In sum, work in this cluster generally support the role of incentives in encouraging risk-taking for the sake of shareholders. However, as also highlighted by Devers et al. (2007), the underlying assumption in this stream is that there is a direct link between executives' risk-taking behavior and their organizations' risk profiles. Consequently, researchers employ organizational-level risk measures as proxies for managerial risk taking (Devers et al., 2007). While such an underlying assumption is theoretically supported by upper echelons theory, still more care should be exerted to confirm that organizational risk is an acceptable empirical manifestation of managerial risk, and not that the two construct are distinct as early research would suggest (Devers et al., 2007).

#### **4.2. Cluster 2: Financing policy**

The second cluster groups papers focusing on corporate financing policies. The distribution of the 29 works in the cluster is reported in Table 4.

*Please insert Table 4 here*

Unsurprisingly, more than 70% of the works focus on equity incentives. The relationship between managerial incentives and risk-taking can be detrimental to bondholders (Ortiz-Molina, 2006). Consequently, equity-based compensation can exacerbate agency costs of debt (Jensen and Meckling, 1976). As stockholders may have incentives to expropriate bondholder wealth by investing in risky projects (a phenomenon called risk-shifting or asset substitution), rational lenders will correctly anticipate such future risky choices and price them accordingly by adjusting required yields. Consequently, a higher alignment of managerial and shareholder interests is associated with higher at-issue yield spreads (Ortiz-Molina, 2006). This result also holds if we focus on bank rather than public debt: banks protect themselves *ex-ante* against risk-taking by charging a higher interest rate when lending to highly convex CEOs (Beladi and Quijano, 2013). Moreover, equity incentives also affect the characteristics of contracted debt: highly convex managers prefer more convex performance pricing schedules in performance-sensitive debt contracts (Tchisty et al., 2011), while higher pay-performance sensitivity (delta) is associated with a preference for bank rather than public debt (Meneghetti, 2012). Interestingly, the CFO's convexity affects the firm's debt structure rather than the CEOs' (Chava and Purnanandam, 2007).

Debt holders have tools at their disposal to prevent risk-shifting. The positive relationship between equity-based risk-taking incentives and the cost of debt can be alleviated by using short-term debt, as it constrains risk-shifting by subjugating managers to stricter monitoring (Brockman et al., 2010). Moreover, agency costs of debt arising from compensation structures can also be mitigated through higher debt concentration, as improved coordination enables creditors to better avoid expropriation by stockholders (Castro et al., 2020). Firm leverage can also be a moderator in the incentives-risk-taking relationship, as higher leverage increases the likelihood of financial distress (Kim et al., 2017). Financial distress directly diminishes the risk-taking capacity of the firm and impacts managerial risk-taking, as it affects both the likelihood of management turnover and future career prospects (Kim et al., 2017). Consequently, firm leverage weakens the positive relationship between equity-based compensation and risk-taking (Kim et al., 2017). Finally, bondholders anticipate greater risk-

taking by highly convex CEOs and require companies to retain more cash (Liu and Mauer, 2011).

As argued in section 2.2, debt-based compensation is a valuable tool to align the interests of managers and bondholders and prevent risk-shifting. Accordingly, higher inside debt is associated with lower bond yield spread (Kabir et al., 2013), incentivizes managers to use less costly and highly monitored shorter-term debt (Dang and Phan, 2016), and positively affects cash holdings (Liu et al., 2014). Moreover, higher inside debt is associated with less leverage than preferred by shareholders (Brisker et al., 2017), and its beneficial effects on debt terms encourage firms to raise debt rather than equity to meet their capital needs (Freund et al., 2018). Interestingly, debt incentives are not totally detrimental to shareholders, but their role as a deterrent to excessive managerial risk-taking also lowers the cost of equity capital (Shen and Zhang, 2020).

### **4.3. Cluster 3: Payout policy and other corporate policies**

Cluster 3 collects all other work exploring the role of incentives in corporate policies different from financing-related ones. The distribution of the 22 papers in the cluster according to their focus is reported in Table 5.

*Please insert Table 5 here*

The seminal works of Coles et al. (2006) and Chava and Purnanandam (2010) provide an overview of how CEOs' (and CFOs', in the case of Chava and Purnanandam (2010)) equity incentives affect company-wide policies. Given the central role of CEOs in corporate decision-making, it is not surprising that their compensation structure affects all aspects of corporate policy. Therefore, these two works are fundamental in showing how risk-taking, as enhanced by compensation, is pervasive across departments rather than compartmentalized.

Payout policy is the focus of the biggest subcluster (8 papers out of 22). Seminal works in dividend policy (i.e., DeAngelo et al., 2006; Grullon et al., 2002) support the conservative nature of corporate payouts as opposed to investing in value-increasing projects. Therefore, risk-taking and dividend payouts should be negatively correlated. Accordingly, Caliskan and Doukas (2015) show how CEOs with (a) high inside debt and (b) high portfolio delta pay excess cash out as dividends rather than invest in risky projects. On the contrary, highly

convex CEOs decrease payouts and are more likely to invest firm resources in value-increasing projects (Caliskan and Doukas, 2015). Similar evidence on the positive relationship between dividends and inside debt is reported by Borah et al. (2020) and Sheikh (2021), while Eisdorfer et al. (2015) interestingly supports a negative link between pension holdings and dividend policy. In this last case, the authors empirically confirm that CEOs with high pension holdings are reluctant to pay high dividends, as they will consequently commit their firm to a constant or growing level of dividends in the future. Such a pattern in expected dividends might leave fewer funds available for future pension payouts (Eisdorfer et al., 2015). Therefore, managers will prefer not to commit the firm to permanent future cash payouts by keeping funds in the firm or distributing cash to shareholders through stock repurchases (Eisdorfer et al., 2015). Finally, findings on equity incentives are also mixed, as the value of stock options declines when a stock goes ex-dividend (De Cesari and Ozkan, 2015), thus incentivizing repurchases or retaining earnings rather than dividend payouts in case of no dividend protection.<sup>7</sup> Accordingly, De Cesari and Ozkan (2015) show how delta, dividend payments and total payout are negatively correlated, while vega positively affects the total payout level. Along the same lines, both Burns et al. (2015) and Geiler and Renneboog (2016) confirm a negative impact of executive stock options on dividend payouts and a positive effect on share repurchases instead. Finally, the traditional positive link between ESOs and dividend payouts is re-established by Zhang (2018) in the case of dividend protection provisions.

Works in the investment policy subcluster (4 papers out of 22) are quite heterogeneous in their specific research focus and provide mixed evidence on the role of incentives in aligning CEOs' and stakeholders' interests. While equity incentives seem to reduce overinvestment (Broussard et al., 2004), equity vesting exacerbates myopia through a reduction in real investments, as CEOs exchange long-term projects for an increase in short-term earnings (Edmans et al., 2017). Internal capital allocation decisions benefit instead from debt incentives, as inside debt promotes conservative internal capital allocation choices that mitigate agency conflicts between executives and debtholders (Freund et al., 2021). However, the aligning purpose of equity incentives is not confirmed in the same context (Datta et al., 2009). CEO compensation also partially affects investment in Corporate Social Responsibility (CSR). Both internal tournament incentives and inside debt encourage a long-

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<sup>7</sup> A dividend protection provision ensures that, if the firm declares a cash dividend, the strike price of dividend-protected option is reduced on the ex-dividend date by the amount of the dividend paid, thus protecting executives' compensation from stock price drops due to dividend payments (Zhang, 2018).

term perspective and thus enhance CSR activities (Buchanan et al., 2021; Zhang et al., 2022), while ESOs enhance risk-taking only in non-socially responsible firms (Frye et al., 2006).

Residually, higher vega (lower delta) enhances risk-shifting through pension underfunding for CFOs rather than CEOs only for financially distressed firms (Anantharaman and Lee, 2014), while CEOs' total compensation is instead positively correlated to pension funding (Alderson et al., 2017). Internal tournament incentives affect incentive plans themselves (Mobbs and Raheja, 2012), while external ones encourage aggressive tax policies (Kubick and Lockhart, 2016). Finally, vega promotes more elastic cost structures, coherent with increased firm risk due to managerial operational decisions such as outsourcing (Li et al., 2021).

#### **4.4. Cluster 4: Information environment**

This cluster groups those works focusing on the relationship between compensation-linked incentives and the corporate information environment. Table 6 reports the papers' distribution according to subclusters and types of incentives.

*Please insert Table 6 here*

The cluster is quite heterogeneous in sub-topics that span from misreporting-related and earning management phenomena (8 papers in total), analysts-focused ones (2 papers), disclosure characteristics (3 papers) and finally, press releases (2 papers). However, the cluster is homogeneous regarding the incentives considered, as only 2 papers out of 15 focus on either inside debt or internal tournaments.

From the theoretical point of view, most papers focus on the possible distortive mechanism of risk-taking incentives (vega) and pay-performance sensitivity (delta) on the disclosure of information to external stakeholders. On the one hand, convexity could encourage excessively aggressive disclosure practices rather than just enough risk-taking to correctly align the interests of managers and shareholders. On the other hand, delta could either work as a risk-decreasing incentive or induce a "reward effect" by manipulating stock prices (Armstrong et al., 2013).

Following the argument of Armstrong et al., 2013, as misreporting and other aggressive accounting-related practices increase stock price and equity risk, both pay-performance

sensitivity and convexity will affect the manager's decision to misreport. While it is *a priori* unclear if delta will encourage caution or exacerbate misalignment, more convex managers will be more likely to misreport as their aversion to the resulting increase in equity risk will be lower (Armstrong et al. 2013). The more recent works in the first identified subcluster, such as Armstrong et al. (2013) and Hass et al. (2015), support this last argument. On the contrary, works by Burns and Kedia (2006) and Efendi et al. (2007) argue only for the role of delta as an incentive for misstatement, thus finding evidence of a reward mechanism stemming from the increase in equity value through misreporting. Such evidence is corroborated by findings by Peng and Roell (2008) on litigation. Results in the accruals and earnings management subclusters generally agree on this last view, as both Bergstresser and Philippon (2006) and Jiang et al. (2010) find a positive link between discretion and delta, even if in the latter case, the effect is significant for the CFO rather than for the CEO. More recent work by Feng and Jia (2021) confirms the relationship for CEOs and additionally reports vega's insignificant role.

Work on accounting quality seems to instead agree with evidence by Armstrong et al. (2013) and Hass et al. (2015) on the role of vega in exacerbating, rather than mellowing, misalignment. More specifically, Wruck and Wu (2021) show that companies led by highly convex CEOs sport a lower quality of future accounting disclosures. Chakrabarty et al. (2018) report a similar negative relationship with readability. On the contrary, Hu and Jiang (2019) focus on conservatism as one way to reduce the agency costs of debt and show how excessive risk-taking incentives raise the risk of expropriation of external debtholders' value and lead to more conservative financial reporting practices.

The last two subclusters deal with company information released to the public outside of financial statements, either in forecasts by analysts or by the company itself through press releases. According to the latter stream, pay-performance sensitivity encourages cheap talk (Gutierrez et al., 2020) and inflates the tone of narrative disclosure to influence stock prices (Arslan-Ayaydin et al., 2016). Works in the former subcluster show how pay-performance sensitivity encourages excessive risk-taking and enhances forecast errors in analysts, which become more optimistic (Mamatzakis and Bagntasarian, 2021), while inside debt promotes more conservative practices and is beneficial for forecast accuracy (Bhandari et al., 2018).

#### **4.5. Cluster 5: IPOs, M&As and liquidation**

Papers in the fifth cluster deal with the implications of CEO incentives for M&As, IPOs and liquidation. The distribution of the studies across these three corporate events is reported in Table 7.

*Please insert Table 7 here*

About 85% of the papers (11 out of 13) focus on M&As. The risk implications of M&As are multi-faceted. On the one hand, acquisition projects can increase firm risk, as they are investments with uncertain net present value (Crocì and Petmezas, 2015). On the other hand, diversifying or vertical M&As can potentially reduce risk (Lin et al., 2018). Regardless of the risk implications, M&As directly involve the CEO in the decision-making process and expose them to a certain degree of risk (Crocì and Petmezas, 2015). Consequently, if the sole motivation of an acquisition is to maximize a risk-averse manager's expected utility, agency conflicts between executives and claimholders are exacerbated in this setting (Smith and Stulz, 1985). Ultimately, acquisition decisions are likely driven by CEOs' risk-taking incentives (Lin et al., 2018). Accordingly, inside debt incentivizes conservatism by positively affecting risk-decreasing vertical M&A activity (Lin et al., 2018) that satisfies bondholders rather than shareholders (Phan, 2014). Internal tournament incentives, on the contrary, enhance acquisitiveness and equity market reaction (Boulton et al., 2014), and the same is true for equity-based risk-taking incentives (Crocì and Petmezas, 2015).

Corporate governance mechanisms in IPO firms sport unique characteristics (Colak et al., 2021). CEOs are much less diversified than their counterparts in seasoned firms, as stock options (also called IPO options) are granted to them during the process (Lowry and Murphy, 2007). As a result, IPO managers may take fewer risks than desired by shareholders, implying a misalignment of incentives (Colak et al., 2021). Accordingly, Colak et al. (2021) report how tournament incentives alleviate agency conflicts and promote risk-taking, consequently ensuring IPO firms better chances of survival post-IPO. Finally, voluntary liquidation can imply value creation for shareholders, but the final decision results from a cost-benefit analysis by the CEO<sup>8</sup> (Mehran et al., 1998). Consequently, if the incremental costs to CEOs from liquidation exceed the benefits, self-interested CEOs may forego such a decision even though it enhances shareholder value (Mehran et al., 1998), thus exacerbating agency costs of equity (Jensen and Meckling, 1976). Accordingly, Mehran et al. (1998)

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<sup>8</sup> In liquidation, CEOs exchange present value of future compensation and related perks in the firms for severance pay, gains in equity-based compensation and salary from future employment (Mehran et al., 1998)

report that the probability of a voluntary liquidation is positively related to pay-performance sensitivity, thus confirming its role as an incentives-aligning mechanism separate from convexity.

#### **4.6. Cluster 6: Firm performance**

The last identified research cluster addresses the relationship between CEOs' incentives and firm performance or value. The identified four subclusters are reported in Table 8.

*Please insert Table 8 here*

About half of the studies focus on the effect of incentives on equity and bond market performance (6 out of 13). These studies focus on stock and bond prices' reaction to managerial incentives and show how investors incorporate risk-increasing (risk-decreasing) incentives embedded in compensation contracts when pricing a firm's external claims (Wei and Yermack, 2011). More specifically, stock prices positively react to an increase in CEO vega and a decrease in CEO delta, while the opposite is true for bond prices (Billett et al., 2010). Moreover, bond prices rise, and equity prices fall at the time of disclosures on inside debt claims by firms whose CEOs hold large pensions and deferred compensation claims (Wei and Yermack, 2011). Finally, stockholders recognize potential learning effects and motivation stemming from peer evaluation based on industry and rank-order tournaments and positively react to it (Francis et al., 2016).

4 studies out of 13 confirm results from the previous subcluster but also focus on operating performance. Additionally, Kale et al. (2009) concentrate solely on the latter. Overall, these studies show how CEOs' risk-taking incentives (either related to equity compensation or tournament incentives) positively affect accounting-related performance measures such as ROA (Kale et al., 2009).

The cluster's last two studies explore the value implications of CEO incentives. Not surprisingly, the relationship between equity incentives and firm value is endogenous (Benson and Davidson, 2009). However, Benson and Davidson (2009) still find an inverted U-shaped relationship between equity incentives and Tobin's Q, which is consistent with incentive alignment at low levels and risk aversion at high levels of CEOs' pay-performance semi-elasticity. Finally, Benson et al. (2019) show how the value implication of a CEO's

equity incentives are heterogeneous across firms with different *ex-ante* risk profiles and sets of available investment opportunities.

In sum, studies in this last research cluster show performance and value implications of CEOs' incentives which are coherent with the alignment of managers' and claimholders' objectives. Equity holders and debtholders price risk-taking implications of CEOs' compensation structure (Wei and Yermack, 2011), and CEOs' operating results benefit from them (Kale et al., 2009). However, while performance implications have a linear directional effect, value implications are much less clear-cut (Benson and Davidson, 2009).

## 5. Discussion and conclusions

CEOs have been widely recognized as individuals with specific characteristics and in the unique position of key corporate decision-makers (Lange et al., 2015; Busenbark et al., 2016; Kaplan and Sorensen, 2021). Consequently, an impressive amount of empirical evidence has validated the link between CEO characteristics and firm outcomes, with a particular attention on how CEO compensation schemes affect behavior (Busenbark et al., 2016). Through the lenses of agency theory (Jensen and Meckling, 1976), scholars are still nowadays trying to understand whether incentives allineate the interests of managers and shareholders (bondholders), thus alleviating principal-agent conflicts.

Despite the steady interest around CEOs and the consequences of the design of their compensation schemes, finance research remains fragmented and fails to present a comprehensive picture on the topic. Our review fills this gap by providing a systematization of empirical studies on CEOs' incentives to take risks. We review 129 scientific articles published in finance journals of recognized academic reputation between 1996 and 2022. Contributions in the literature mainly confirm the role of incentives in aligning the interests of CEOs and claim holders, but the risk of engaging in excessively aggressive corporate policies is significant and potentially value destroying.

Our contribution to the literature is twofold. We are the first, up to our knowledge, to provide a unique focus on risk-increasing (risk-decreasing) incentives stemming from compensation packages, thus providing a comprehensive picture of how CEO pay can affect their willingness to take risks. Then, we not only update but also broaden the scope of previous literature reviews on the topic (i.e., Devers et al., 2007; Goergen and Renneboog, 2011;

Catuogno et al., 2016) by including debt-like compensation and relative pay phenomena in our discussion. Therefore, our review provides a more complete understanding of the many compensation-related sources of risk-taking (risk-decreasing) incentives.

Our systematic review suggests at least two different roads for future research. First, the vast majority (e.g., 69%) of the articles included in this review focus on equity-based incentives (e.g., stock options). However, the rising importance of debt and tournament incentives provides new avenues for future research. Regulatory changes in reporting requirements for US corporations and the consequent availability of new data are enabling both inside debt and relative pay phenomena to arise as competing and complementary incentives for the risk-taking behavior of CEOs. However, scholars should expand beyond simply substituting equity incentives with debt or tournament-like ones in standard input-output studies, as different sources will align (or misalign) the objectives of CEOs and different stakeholders. More importantly, the focus should be on the overall design of compensation packages of CEOs (stock options and inside debt) and their possible interaction with external and internal labor market mechanisms arising from said compensation.

Moreover, more attention on the interplay between CEOs and the rest of the C-suite is in order, as the specific focus on the CEO as a stand-alone figure is being challenged by literature. Several studies have highlighted how CEO-level effects can be either dampened or reinforced by CFO-related (Bertrand and Schoar, 2003; Chava and Purnanandam, 2010; Dittmar and Duchin, 2016; among others), COO-related (Hambrick and Cannella, 2004), and more in general board-related factors. Literature on internal tournaments points to this direction by studying risk-taking behavior in the context of top employees competing for the apical position of CEO (Coles et al., 2018). However, more attention on the direct interplay between compensation-based incentives at different levels of the corporate hierarchy is in order, as it can unveil possible distortive mechanisms inducing excessive risk-taking arising from surprising sources.

Overall, future research will need to expand our knowledge about how different pay-related phenomena affect managerial risk-taking behavior by assessing and exploring the interplay between different levels of analysis, similar to what was advocated by Bezemer et al. (2022) for the board-strategy literature. A multitude of actors affects financial decision-making, similarly to any other strategic decision (Bezemer et al., 2022). Moreover, all these actors are affected in their behavior by different, and sometimes conflicting, incentives. There is a need,

therefore, for more research about how CEOs fit in such a constellation of other decision-makers, and how their incentives to take risks could either exacerbate or dampen any conflict arising from such complex dynamics.

Our research has important implication for practitioners and policymakers, as it highlights how pervasive are the effects of incentives across all major corporate decisions and events. Moreover, it shows how there are multiple sources of incentives, and that focus should not only be put on possible distortive mechanisms originating from ESOs packages. Therefore, compensation committees should exert great effort in designing compensation packages and strike a delicate balance between optimal contracting and constraining the excessive (or less than optimal) risk-taking incentives they generate. Moreover, compensation committees should also look outside of the firm of focus, as external labor market mechanisms can influence CEOs behavior in ways which are difficult to predict and control for.

We recognize that our study also has weaknesses. First, our paper mainly refers to the agency theory framework, as incentives are the primary mechanism to correct principal-agent problems (Jensen and Meckling, 1976; Busenbark et al., 2016). While the finance literature generally exhibits a uniform theoretical approach, other theoretical lenses could be applied (Catuogno et al., 2016). Then, our paper focuses only on scientific articles published in journals of recognized academic reputation. While selection of articles followed the most recently published standards in systematic literature reviews (e.g., Bezemer et al., 2022), the exclusion of other nonrefereed publications (e.g., book chapters, conference proceedings, practitioner contributions) can undeniably introduce a bias in our finding, as these different sources could have provided complementary perspectives to the academic one we adopted in this paper.

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## Tables and Figures

Journal	Number of articles
Journal of Corporate Finance	26
Journal of Financial Economics	23
Journal of Banking & Finance	10
Financial Management	9
Journal of Financial And Quantitative Analysis	9
International Review of Financial Analysis	7
Journal of Finance	7
Review of Quantitative Finance And Accounting	7
Corporate Governance-An International Review	6
European Financial Management	4
Journal of Empirical Finance	4
Review of Financial Studies	4
Financial Review	3
Review of Finance	3
International Journal of Finance & Economics	2
Journal of Financial Research	1
European Journal of Finance	1
Journal of Financial Intermediation	1
Journal of Financial Markets	1
Journal of International Money And Finance	1
Review of Corporate Finance Studies	1
<b>Total</b>	<b>129</b>

**Table 1** – *Distribution of selected articles by journal.* The table reports the number of articles included the sample per scientific journal.

#	Research cluster	Equity incentives	Debt incentives	Tournament incentives	Total
1	Firm risk, risk management and innovation	25	4	8	37
2	Financing policy	21	6	2	29
3	Payout policy and other corporate policies	13	6	3	22
4	Information environment	13	1	1	15
5	IPOs, M&As and liquidation	8	2	3	13
6	Firm performance	9	1	3	13
	<b>Total</b>	<b>89</b>	<b>20</b>	<b>20</b>	<b>129</b>

**Table 2** – *Distribution of selected articles by research cluster and type of incentives.* The table reports the distribution of the 129 papers across the research clusters per type of incentive.

Subcluster	Reference	Equity incentives	Debt incentives	Tournament incentives	Total
<b>Total cluster</b>		<b>25</b>	<b>4</b>	<b>8</b>	<b>37</b>
<b>Corporate risk-taking</b>					
	Alderson et al., 2014	x			
	Armstrong and Vashishtha, 2012	x			
	Brisley et al., 2021	x			
	Cadman et al., 2016	x			
	Cassell et al., 2012		x		
	Cen and Doukas, 2017		x		
	Chakraborty et al., 2019	x			
	Chesney et al., 2020	x			
	Coles et al., 2018			x	
	Francis et al., 2017	x			
	Hayes et al., 2012	x			
	Jin, 2002	x			
	Kini and Williams, 2012			x	
	Lee et al., 2021		x		
	Low, 2009	x			
	Milidonis and Stathopoulos, 2014	x			
	Savaser and Sisli-Ciamarra, 2017	x			
	Shue and Townsend, 2017	x			
	Wruck and Wu, 2022			x	
<b>Total</b>		<b>13</b>	<b>3</b>	<b>3</b>	<b>19</b>

<b>Innovation, R&amp;D</b>				
	Chen et al., 2014	x		
	Kong et al., 2022			x
	Mao and Zhang et al., 2018	x		
	Nguyen, 2018	x		
	O'Connor et al., 2013	x		
	Shen and Zhang, 2013	x		
	Shen and Zhang, 2018			x
<b>Total</b>		<b>5</b>	<b>0</b>	<b>2</b>
<b>Risk management</b>				
	Bakke et al., 2016	x		
	Devos and Li et al., 2021	x		
	Doukas and Mandal, 2018		x	
	Géczy et al., 2007	x		
	Kolasinski and Yang et al., 2018	x		
	Lonare et al., 2022			x
	Rogers, 2002	x		
	Tufano, 1996	x		
<b>Total</b>		<b>6</b>	<b>1</b>	<b>1</b>
<b>Stock price crash risk</b>				
	Chowdhury et al., 2020			x
	Kim et al., 2011	x		

Kubick and Lockhart, 2021

x

---

**Total**

**1**

**0**

**2**

**3**

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**Table 3** – *Cluster 1: Firm risk, risk management and innovation.* The table reports the distribution of articles in the first cluster according to subcluster and type of incentive.

<b>Subcluster</b>	<b>Reference</b>	<b>Equity incentives</b>	<b>Debt incentives</b>	<b>Tournament incentives</b>	<b>Total</b>
<b>Total</b>		<b>21</b>	<b>6</b>	<b>2</b>	<b>29</b>
<b>Cost of debt</b>					
	Beladi and Quijano, 2013	x			
	Dezso and Ross, 2012	x			
	Imes and Anderson, 2021	x			
	Kabir et al., 2013		x		
	Lewellen, 2006	x			
	Mansi et al., 2016	x			
	Ortiz-Molina, 2006	x			
<b>Total</b>		<b>6</b>	<b>1</b>	<b>0</b>	<b>7</b>
<b>Debt structure</b>					
	Albring et al., 2011	x			
	Castro et al., 2020	x			
	Chava and Purnanandam et al., 2007	x			
	Meneghetti, 2012	x			
	Tchisty et al., 2011	x			
<b>Total</b>		<b>5</b>	<b>0</b>	<b>0</b>	<b>5</b>
<b>Leverage</b>					

	Brisker et al., 2017		x		
	Hung et al., 2012	x			
	Kim et al., 2017	x			
	Tosun et al., 2016	x			
<b>Total</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>
<hr/>					
<b>Cash holdings</b>					
	Feng and Rao, 2018	x			
	Huang et al., 2019			x	
	Liu and Mauer, 2011	x			
	Liu et al., 2014		x		
<b>Total</b>		<b>2</b>	<b>1</b>	<b>1</b>	<b>4</b>
<hr/>					
<b>Debt maturity</b>					
	Brockman et al., 2010	x			
	Dang and Phan, 2016		x		
	Hong, 2019	x			
<b>Total</b>		<b>2</b>	<b>1</b>	<b>0</b>	<b>3</b>
<hr/>					
<b>Capital structure</b>					
	Dong et al., 2010	x			
	Freund et al., 2018		x		
	Miao et al., 2022			x	
<hr/>					

<b>Total</b>		<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>
<b>Equity</b>					
	Carpenter et al., 2010	x			
	Devos et al., 2018	x			
<b>Total</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<b>Cost of equity</b>					
	Shen and Zhang, 2020		x		
<b>Total</b>		<b>0</b>	<b>1</b>	<b>0</b>	<b>1</b>

**Table 4** – *Cluster 2: Financing policy*. The table reports the distribution of articles in the second cluster according to subcluster and type of incentive.

Subcluster	Reference	Equity incentives	Debt incentives	Tournament incentives	Total
<b>Total</b>		<b>13</b>	<b>6</b>	<b>3</b>	<b>22</b>
<b>Payout policy</b>					
	Borah et al., 2020		x		
	Burns et al., 2015	x			
	Caliskan and Doukas, 2015		x		
	De Cesari and Ozkan, 2015	x			
	Eisdorfer et al., 2015		x		
	Geiler and Renneboog, 2016	x			
	Sheikh, 2021		x		
	Zhang, 2018	x			
<b>Total</b>		<b>4</b>	<b>4</b>	<b>0</b>	<b>8</b>
<b>CSR</b>					
	Buchanan et al., 2021		x		
	Frye et al., 2006	x			
	Zhang et al., 2022			x	
<b>Total</b>		<b>1</b>	<b>1</b>	<b>1</b>	<b>3</b>
<b>General</b>					

	Chava and Purnanandam, 2010	x			
	Coles et al., 2006	x			
<b>Total</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<hr/>					
<b>Investment policy</b>					
	Broussard et al., 2004	x			
	Datta et al., 2009	x			
	Edmans et al., 2017	x			
	Freund et al., 2021		x		
<b>Total</b>		<b>3</b>	<b>1</b>	<b>0</b>	<b>4</b>
<hr/>					
<b>Pension plans</b>					
	Alderson et al., 2017	x			
	Anantharaman and Lee, 2014	x			
<b>Total</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<hr/>					
<b>Cost structure</b>					
	Li et al., 2021	x			
<b>Total</b>		<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>
<hr/>					
<b>Incentives</b>					
	Mobbs and Raheja, 2012			x	

<b>Total</b>		<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>
<hr/>					
<b>Tax policy</b>					
	Kubick and Lockhart, 2016			x	
<b>Total</b>		<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>

**Table 5** – *Cluster 3: Payout policy and other corporate policies.* The table reports the distribution of articles in the third cluster according to subcluster and type of incentive.

Subcluster	Reference	Equity incentives	Debt incentives	Tournament incentives	Total
<b>Total</b>		<b>13</b>	<b>1</b>	<b>1</b>	<b>15</b>
<b>Misreporting, fraud and litigation</b>					
	Armstrong et al., 2013	x			
	Burns and Kedia, 2006	x			
	Efendi et al., 2007	x			
	Hass et al., 2015			x	
	Peng and Roell, 2008	x			
<b>Total</b>		<b>4</b>	<b>0</b>	<b>1</b>	<b>5</b>
<b>Analyst coverage and forecasts</b>					
	Bhandari et al., 2018		x		
	Mamatzakis and Bagntasarian, 2021	x			
<b>Total</b>		<b>1</b>	<b>1</b>	<b>0</b>	<b>2</b>
<b>Accounting disclosure characteristics</b>					
	Chakrabarty et al., 2018	x			
	Hu and Jiang, 2019	x			
	Wruck and Wu, 2021	x			
<b>Total</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>

<b>Accruals and earning management</b>					
	Bergstresser and Philippon, 2006	x			
	Feng and Jia, 2021	x			
	Jiang et al., 2010	x			
<b>Total</b>		<b>3</b>	<b>0</b>	<b>0</b>	<b>3</b>
<b>Press releases</b>					
	Gutierrez et al., 2020	x			
	Arslan-Ayaydin et al., 2016	x			
<b>Total</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>

**Table 6** – *Cluster 4: Information environment.* The table reports the distribution of articles in the fourth cluster according to subcluster and type of incentive.

Sub-cluster	Reference	Equity incentives	Debt incentives	Tournament incentives	Total
<b>Total</b>		<b>8</b>	<b>2</b>	<b>3</b>	<b>13</b>
<b>M&amp;A</b>					
	Agha and Hossain, 2022	x			
	Borokhovich et al., 1997	x			
	Boulton et al., 2014	x			
	Cai and Vijh et al., 2007	x			
	Croci and Petmezas, 2015	x			
	Hasan et al., 2020			x	
	Hillier et al., 2022	x			
	Lin et al., 2018		x		
	Nguyen et al., 2020			x	
	Panayi et al., 2021	x			
	Phan, 2014		x		
<b>Total</b>		<b>7</b>	<b>2</b>	<b>2</b>	<b>11</b>
<b>IPO</b>					
	Colak et al., 2021			x	
<b>Total</b>		<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>
<b>Liquidation</b>					

Mehran et al., 1998

	x			
<b>Total</b>	<b>1</b>	<b>0</b>	<b>0</b>	<b>1</b>

**Table 7** – *Cluster 5: IPOs, M&As and liquidation.* The table reports the distribution of articles in the fifth cluster according to subcluster and type of incentive.

Subcluster	Reference	Equity incentives	Debt incentives	Tournament incentives	Total
<b>Total</b>		<b>9</b>	<b>1</b>	<b>3</b>	<b>13</b>
<b>Market performance</b>					
	Balafas and Florackis, 2014	x			
	Billett et al., 2010	x			
	Feng and Jia, 2019	x			
	Feng and Yan, 2019	x			
	Francis et al., 2016			x	
	Wei and Yermack, 2011		x		
<b>Total</b>		<b>4</b>	<b>1</b>	<b>1</b>	<b>6</b>
<b>Market and accounting performance</b>					
	Bettis et al., 2010	x			
	Conyon and He, 2012	x			
	Elsila et al., 2013	x			
	Talavera et al., 2021			x	
<b>Total</b>		<b>3</b>	<b>0</b>	<b>1</b>	<b>4</b>
<b>Firm value</b>					
	Benson and Davidson, 2009	x			

	Benson et al., 2019	x			
<b>Total</b>		<b>2</b>	<b>0</b>	<b>0</b>	<b>2</b>
<hr/>					
<b>Accounting performance</b>					
	Kale et al., 2009			x	
<b>Total</b>		<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>

**Table 8** – *Cluster 6: Firm performance*. The table reports the distribution of articles in the sixth cluster according to subcluster and type of incentive.

## Appendix A. Full list of articles

Author(s)	Title	Year	Journal
Agha, M, Hossain, MM	Are board monitoring and CEO incentives substitutes for each other? Evidence from Australian market reaction to acquisition announcements	2022	<i>International Review of Financial Analysis</i>
Albring, SM, Khurana, IK, Nejadmalayeri, A, Pereira, R	Managerial compensation and the debt placement decision	2011	<i>Journal of Corporate Finance</i>
Alderson, MJ, Bansal, N, Betker, BL	CEO turnover and the reduction of price sensitivity	2014	<i>Journal of Corporate Finance</i>
Alderson, MJ, Betker, BL, Halford, JT	Are managers paid for better levels of pension funding?	2017	<i>Journal of Corporate Finance</i>
Anantharaman, D, Lee, YG	Managerial risk taking incentives and corporate pension policy	2014	<i>Journal of Financial Economics</i>
Armstrong, CS, Vashishtha, R	Executive stock options, differential risk-taking incentives, and firm value	2012	<i>Journal of Financial Economics</i>
Armstrong, CS, Larcker, DF, Ormazabal, G, Taylor, DJ	The relation between equity incentives and misreporting: The role of risk-taking incentives	2013	<i>Journal of Financial Economics</i>
Arslan-Ayaydin, O, Boudt, K, Thewissen, J	Managers set the tone: Equity incentives and the tone of earnings press releases	2016	<i>Journal of Banking &amp; Finance</i>
Bakke, TE, Mahmudi, H, Fernando, CS, Salas, JM	The causal effect of option pay on corporate risk management	2016	<i>Journal of Financial Economics</i>

Balafas, N, Florackis, C	CEO compensation and future shareholder returns: Evidence from the London Stock Exchange	2014	<i>Journal of Empirical Finance</i>
Beladi, H, Quijano, M	CEO incentives for risk shifting and its effect on corporate bank loan cost	2013	<i>International Review of Financial Analysis</i>
Benson, BW, Davidson, WN	Reexamining the managerial ownership effect on firm value	2009	<i>Journal of Corporate Finance</i>
Benson, BW, James, HL, Park, JC	Heterogeneity in the Effect of Managerial Equity Incentives on Firm Value	2019	<i>Financial Review</i>
Bergstresser, D, Philippon, T	CEO incentives and earnings management	2006	<i>Journal of Financial Economics</i>
Bettis, C, Bizjak, J, Coles, J, Kalpathy, S	Stock and Option Grants with Performance-based Vesting Provisions	2010	<i>Review of Financial Studies</i>
Bhandari, A, Mammadov, B, Thevenot, M	The impact of executive inside debt on sell-side financial analyst forecast characteristics	2018	<i>Review of Quantitative Finance And Accounting</i>
Billett, MT, Mauer, DC, Zhang, YL	Stockholder and Bondholder Wealth Effects of CEO Incentive Grants	2010	<i>Financial Management</i>
Borah, N, James, HL, Park, JC	Does CEO inside debt compensation benefit both shareholders and debtholders?	2020	<i>Review of Quantitative Finance And Accounting</i>
Borokhovich, KA, Brunarski, KR, Parrino, R	CEO contracting and antitakeover amendments	1997	<i>Journal of Finance</i>
Boulton, TJ, Braga-Alves, MV, Schlingemann, FP	DOES EQUITY-BASED COMPENSATION MAKE CEOS MORE ACQUISITIVE?	2014	<i>Journal of Financial Research</i>

Brisker, ER, Wang, W	CEO's Inside Debt and Dynamics of Capital Structure	2017	<i>Financial Management</i>
Brisley, N, Cai, J, Nguyen, T	Required CEO stock ownership: Consequences for risk-taking and compensation	2021	<i>Journal of Corporate Finance</i>
Brockman, P, Martin, X, Unlu, E	Executive Compensation and the Maturity Structure of Corporate Debt	2010	<i>Journal of Finance</i>
Broussard, JP, Buchenroth, SA, Pilotte, EA	CEO incentives, cash flow, and investment	2004	<i>Financial Management</i>
Buchanan, BG, Cao, CX, Wang, SH	Corporate social responsibility and inside debt: The long game	2021	<i>International Review of Financial Analysis</i>
Burns, N, Kedia, S	The impact of performance-based compensation on misreporting	2006	<i>Journal of Financial Economics</i>
Burns, N, McTier, B.C., Minnick, K.	Equity-incentive compensation and payout policy in Europe	2015	<i>Journal of Corporate Finance</i>
Cadman, BD, Campbell, JL, Klasa, S	Are Ex Ante CEO Severance Pay Contracts Consistent with Efficient Contracting?	2016	<i>Journal of Financial And Quantitative Analysis</i>
Cai, J, Vijh, AM	Incentive effects of stock and option holdings of target and acquirer CEOs	2007	<i>Journal of Finance</i>
Caliskan, D, Doukas, JA	CEO risk preferences and dividend policy decisions	2015	<i>Journal of Corporate Finance</i>
Carpenter, MA, Indro, DC, Miller, SR, Richards, M	CEO Stock-Based Pay, Home-Country Risk, and Foreign Firms' Capital Acquisition in the US Market	2010	<i>Corporate Governance-An International Review</i>

Cassell, CA, Huang, SX, Sanchez, JM, Stuart, MD	Seeking safety: The relation between CEO inside debt holdings and the riskiness of firm investment and financial policies	2012	<i>Journal of Financial Economics</i>
Castro, P, Keasey, K, Amor-Tapia, B, Tascon, MT, Vallascas, F	Does debt concentration depend on the risk-taking incentives in CEO compensation?	2020	<i>Journal of Corporate Finance</i>
Cen, W, Doukas, JA	CEO personal investment decisions and firm risk	2017	<i>European Financial Management</i>
Chakrabarty, B, Seetharaman, A, Swanson, Z, Wang, X	Management Risk Incentives and the Readability of Corporate Disclosures	2018	<i>Financial Management</i>
Chakraborty, A, Gao, LS, Sheikh, S	Does size affect the relation between option compensation and managerial risk taking? Evidence from Canadian listed companies	2019	<i>International Journal of Finance &amp; Economics</i>
Chava, S, Purnanandam, A	Determinants of the floating-to-fixed rate debt structure of firms	2007	<i>Journal of Financial Economics</i>
Chava, S, Purnanandam, A	CEOs versus CFOs: Incentives and corporate policies	2010	<i>Journal of Financial Economics</i>
Chen, YR, Chen, CR, Chu, CK	The Effect of Executive Stock Options on Corporate Innovative Activities	2014	<i>Financial Management</i>
Chesney, M, Stromberg, J, Wagner, AF, Wolff, V	Managerial incentives to take asset risk	2020	<i>Journal of Corporate Finance</i>
Chowdhury, H, Hodgson, A, Pathan, S	Do external labour market incentives constrain bad news hoarding? The CEO's industry tournament and crash risk reduction	2020	<i>Journal of Corporate Finance</i>
Colak, G, Gounopoulos, D, Loukopoulos, P, Loukopoulos, G	Tournament incentives and IPO failure risk *	2021	<i>Journal of Banking &amp; Finance</i>

Coles, JL, Daniel, ND, Naveen, L	Managerial incentives and risk-taking	2006	<i>Journal of Financial Economics</i>
Coles, JL, Li, ZC, Wang, AY	Industry Tournament Incentives	2018	<i>Review of Financial Studies</i>
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