UNIVERSITÄT PASSAU

Wirtschaftswissenschaftliche Fakultät

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Diskussionsbeitrag Nr. B-32-18

Betriebswirtschaftliche Reihe ISSN 1435-3539

PASSAUER DISKUSSIONSPAPIERE

Herausgeber:
Die Gruppe der betriebswirtschaftlichen Professoren
der Wirtschaftswissenschaftlichen Fakultät
der Universität Passau
94030 Passau

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Managers' Research Education, the Use of FX Derivatives and Corporate Speculation[*]

Oliver Entrop[†], Matthias F. Merkel[‡]

Abstract

In contrast to the U.S., many executive managers of continental European firms have a PhD. In this paper we analyze if a research-oriented background in the form of a PhD is linked to the corporate decision-making of CFOs in the use of foreign exchange (FX) derivatives in Germany. After controlling for fundamental firm characteristics, compensation schemes and personal characteristics of managers, we find some evidence that CFOs with a PhD in a business-related area tend to use FX derivatives less, while CFOs with a general business education do so more. Analyzing their behavior with regard to speculation, we find strong evidence that CFOs with a PhD speculate less on the FX market compared to CFOs with another (business) education. A possible reason may be that a research-oriented education is more associated with critical awareness and long-term orientation in corporate decision-making.

Keywords: FX Derivatives, Risk Management, Speculation, Behavioral Corporate Finance, PhD, Doctorate

JEL classification: G30, G32, F31

[*] We thank Marcel Allscher, Joachim Schnurbus and Marco Wilkens for very helpful comments and suggestions on an earlier draft of this paper. All remaining errors are our own. We gratefully thank Markus Grottke for sharing his code for automated search in annual reports with us and Martina Merkel for excellent research assistance.

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1 Introduction

There has been an enormous increase in the use of financial derivatives by non-financial corporations in recent decades. The question of how and why firms use (or should use) derivatives has been the subject of many studies on the risk management of firms. Generally, empirical research is based on the assumption that firms use derivatives for hedging purposes (e.g., Tufano, 1996; Geczy et al., 1997; Haushalter, 2000; Graham and Rogers, 2002); such studies interpret the characteristics of firms correlated with their use of derivatives as capturing the costs and benefits of hedging (Chernenko and Faulkender, 2011).[1] A number of more recent studies based on survey evidence, however, have focused on the variation in firms' hedge ratios as linked to managers' views of the market, commonly referred to as "selective hedging" (Stulz et al., 1996).[2] These studies provide empirical evidence that the use of derivatives by firms varies for speculative reasons (e.g., Faulkender, 2005; Brown, et al., 2006; Chernenko and Faulkender, 2011; Beber and Fabbri, 2012).[3]

Moreover, in recent years an increasing strand of literature has focused on behavioral explanations for corporate decision-making (e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Malmendier et al., 2011). While traditional economic theories generally do not attach much importance to the way firm managers make corporate decisions, behavioral approaches

[1] Theoretical literature presents a number of reasons why firms should use derivatives for risk management purposes to add value to the firm (Allayannis et al., 2012); these include reducing the costs of financial distress and expected taxes, and taking advantage of the debt shield or mitigating underinvestment (e.g., Stulz, 1984; Smith and Stulz, 1985; Froot et al., 1993; Leland, 1998).

[2] Such survey evidence includes Dolde (1993), Bodnar et al. (1998) and Glaum (2002) reporting that many firms base their hedging positions on views about future market developments.

[3] In particular, Brown et al. (2006) show that firms in the gold mining industry adjust derivative positions based on lagged changes in gold prices. Geczy et al. (2007) find that firms use derivatives to take active views on currency and interest rate movements. Chernenko and Faulkender (2011) analyze variations in derivative holdings and find that firms change their use of interest-rate derivatives over time with respect to movements in the term structure. Moreover, Beber and Fabbri (2012) show that firms alter their currency derivative holdings in response to the past dynamics of foreign currency rates.

acknowledge that decision makers are heterogeneous agents who differ in their skills, beliefs and preferences and that such factors influence their decisions.

So far, only a few studies link these two strands of literature (e.g., Beber and Fabbri, 2012, who find significant relationships between managers' personal characteristics and FX market timing). Our paper extends the existing literature by investigating whether the educational background of firm managers is related to the amount firms use FX derivatives and to corporate speculation on the FX market. We focus especially on the extent to which a research education, as measured by a PhD as the highest degree in research, plays a role in managers' decision-making in corporate risk management. To the best of our knowledge, we are the first to explicitly investigate the relationship between a research education and corporate decisions.

Generally, empirical research in this field has focused on MBA degrees, finding that managers with an MBA choose more aggressive strategies (including speculation) when making corporate decisions, which is typically explained by the fact that managers with an MBA are more likely to be overconfident due to their supposedly superior education (e.g., Bertrand and Schoar, 2003; Beber and Fabbri, 2012; Hu and Liu, 2015; King et al., 2016). These studies usually examine U.S. firms, where possession of an MBA is a common educational qualification among board members. On continental European management boards, on the other hand, the MBA is less well represented, but many executives have a PhD, which is in turn uncommon for managers in the United States.[4] Unlike in the U.S. (and many other countries) a PhD in continental Europe is not necessarily acquired for an academic career, but also to qualify for a business career, because a PhD, especially in a business-related field, is generally valued by companies and rewarded with

[4] For example, at the end of the year 2013, 43% of the executive board members of the German blue chips (DAX) had a PhD degree.

higher salaries after graduation as well as by enhanced career expectations. Moreover, people with PhDs in continental European countries enjoy high social status, their titles being part of their social and professional identities. For example, in Germany the doctoral title appears on passports and IDs as part of the owner's name.

In our study, we investigate the importance of managers' educational backgrounds in German firms, which make up the largest economy in Europe. We focus on German firms, as especially in this country the PhD ("Doktor") is highly prestigious; many firm managers have a doctorate in a business-related area – in our sample almost 20% of all CFOs. Considering the findings discussed in the literature mentioned above regarding the behavior of managers with MBAs in the U.S., i.e. that a superior education engenders overconfidence, one might also expect (German) managers with a business PhD to show analogous behavior to MBA managers when making corporate decisions.

However, in contrast to the MBA, a PhD is a strongly research-oriented degree, rather than a degree that extends a student's general education. Earning a PhD involves extensive and in-depth work in a particular research area, continuous critical review and verification of research findings, as well as participation in ongoing discussions and a regular defense of the research results. Moreover, doctoral training, especially in German-speaking countries, often involves work as an academic assistant in the faculty of a university, including lecturing and the tutoring of students. Accordingly, PhD graduates acquire both a wide range of research skills and deep knowledge and expertise in their chosen fields of research, as well as practical working experience in the teaching activities of the faculty. Earning a doctorate thus schools a PhD student's critical faculties and ability to rationally consider and weigh a variety of opinions and behaviors. As a result, managers with a PhD may be more critical in their evaluation of situations; they may have a more long-term-oriented style of thinking and acting, with a different attitude towards risk-taking in terms of speculation than MBAs or executives with another (business) education such as a diploma or a MSc. degree.

For our analyses we use a unique, hand-collected dataset that includes information on firm managers' personal characteristics as well as notional values of FX derivative holdings from 225 firms over the time period 2004 to 2013. After controlling for fundamental firm characteristics, as well as managers' compensation structure and personal characteristics, such as gender, age and work experience, our key results show that firm managers' education is linked to both the amount they use FX derivatives and their propensity to speculate.[5]

In particular, we find strong evidence that CFOs with a general business education use, on average, more derivatives than CFOs without a business education. In contrast, we find some evidence that managers with a PhD in a business-related area, as well as CFOs who hold MBAs, make less use of currency derivatives, though the links are not always statistically significant among the different methodologies. We apply a set of (panel) regressions, including propensity score-matching procedures, and find similar results in all analyses, implying that the economic relationships are quite robust.

To find whether the research education of firm managers is linked to corporate speculation, we construct an empirical measure of speculation. Similar to Beber and Fabbri (2012), we interpret the variability in firms' FX derivative holdings (scaled by total assets) that cannot be explained by the intention of derivative usage for hedging (as a response to changed foreign business activity and other firm characteristics) as a firm's speculation on the FX market. Our key

[5] Empirical research has identified a number of firm characteristics that are associated with the use of currency derivatives for risk management purposes. Typically, foreign (business) activity, firm size, growth opportunities, leverage and liquidity are linked to derivative usage (e.g., Geczy et. al., 1997; Allayannis and Ofek, 2001; Bartram et al., 2009).

approach is a fixed-effects model that directly links heteroscedasticity of the residuals to personal, manager-specific characteristics. We estimate the coefficients via maximum likelihood. We additionally apply more robust two-step procedures and obtain qualitatively similar results for our key focus of analysis.

We find strong evidence that CFOs with a PhD in business speculate less than other CFOs. Accordingly, our results do not support the notion that PhDs display overconfidence as measured by higher speculation activity. On the contrary, they suggest that a research education is associated with less of a propensity to take risks in the context of speculating with FX derivatives, lending support to the hypothesis that PhD graduates are more long-term oriented and conservative in making financial decisions.

Concerning the relation between MBA and speculation we find mixed results that are largely not in line with the findings in the U.S. However, we do not put too much emphasis on this, as the sample of MBA-holders among the German CFOs is very small as already mentioned.

The remainder of this paper is organized as follows. Section 2 introduces our sample and reports summary statistics on use of FX derivatives. Section 3 describes our empirical setups and the explanatory variables and presents the empirical results, including robustness tests. Finally, Section 4 concludes.

2 Sample selection and firms' use of derivatives

Our sample comprises firms that have been listed at least once in the Prime or General Standard during 2004 and 2013.[6] To qualify for our sample, a firm must have had both total assets and total sales of more than 50 million euros at least once during this period. We exclude financial firms (SIC Code 60-67) from the sample as they may be market makers in currency derivatives or they may have different motives for using derivatives than non-financials. Moreover, because we are focusing on firms that are FX derivative users, i.e. firms that have used FX derivatives at least once, we omit firms that did not use currency derivatives during the sample period.[7]

We build a panel data set that includes all firm-years between 2004 and 2013. However, since some of the firms entered or left the Prime or General Standard during the observation period, we only include those years in which the firm was listed in one of the indices mentioned above to provide uniform accounting standards among the firm observations.

For these firms we hand-collect the year-end notional values of FX derivative holdings reported in the annual reports of the companies. The use of this kind of continuous variable is crucial for explaining the extent of firms' use of FX derivatives. Unfortunately, IFRS only require firms to report market values of derivatives categorized by the appropriate risk, but not the total national value and the nature of the derivatives; nevertheless, many firms provide this information on a voluntarily basis.[8] However, using notional amounts has the disadvantage that

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[6] We chose to start in 2004 because German law requires companies listed in the Prime and General Standard to prepare their annual reports for the years after 2004 in accordance with the International Financial Accounting Standards (IFRS). Since most firms in our sample had already started to use IFRS in 2004 or show adjusted results for 2004 in their annual reports of 2005, our analysis starts in 2004 (excluding the few observations in 2004 which do not correspond to IFRS) so as to have homogenous accounting standards.

[7] Limiting the sample to derivative users is important, as this holds the costs constant for setting up the risk-management operations (Beber and Fabbri, 2012).

[8] In particular, 88.3% of the firms that use FX derivatives report notional values.

we do not know whether the amounts represent long or short positions, nor do we know the underlying currency. But as we focus on absolute values of FX derivatives and as evidence shows that firms seem to first net single currency positions before aggregating them, this should not bias our results.[9] Our sample's notional values of FX derivatives include forward contracts and foreign currency options. Following existing literature we do not include foreign currency swaps, as these instruments are primarily used to change foreign debt into liabilities denominated in domestic currency (Allayannis and Ofek, 2001; Beber and Fabbri, 2012). Accordingly, we also exclude foreign debt in our analyses. Our final sample contains 225 firms and we end up with an unbalanced panel of 1,879 firm-years that we group into 17 industry sectors (based on their two-digit SIC). Table 1 presents summary statistics on the use of FX derivatives.

[Table 1 about here]

The notional value of our sample's FX derivative holdings averages 1,228 million euro. However, the median is much smaller (12 million euro), implying that there are some firms with really large derivative holdings. Following most of the literature on corporate risk management, we use the notional value of FX derivatives scaled by total assets, referring to this as the FX derivatives ratio. On average FX derivative holdings make up 9.2% of firms' total assets, but the level is widely distributed across the firms as suggested by the standard deviation and the 10% and 90% quantiles. Scaling the notional value of FX derivatives by total sales shows a quite similar pattern.

[9] Beber and Fabbri (2012) argue that non-financial firms may also hold offsetting positions as they have decentralized trading departments for foreign currency derivatives and managers can manage their own exposure. However, there are no other obvious reasons, such as for financial firms.

When making use of the time-series dimension of our data (Panel B), we find that the notional value of currency derivatives increased sharply in the observation period, from 964.4 to 1,609.7 million euro, with an interim decline around the subprime crisis. However, since 2007 the notional value of FX derivatives has almost doubled. When looking at the FX derivatives ratio, we observe that the use of currency derivatives varies over time and that there are phases with more changes from one year to another.

3 Empirical analyses

3.1 Empirical setup

We investigate how the education of firm managers is related to (i) how much they use FX derivatives and to (ii) how much they speculate on the FX market. The analyses of both issues control for a number of variables that have been identified as being associated with derivatives use in previous papers. In particular, we take into account a set of fundamental firm characteristics, managers' compensation structures and personal characteristics of firm managers.

To analyze the relationship between the education of firm managers and the degree to which they use FX derivatives, we relate the notional value of derivatives (scaled by total assets) to the explanatory variables. We start with applying between-effects, Fama-MacBeth (1973) and pooled OLS regressions. To control for time-invariant characteristics that may be correlated with omitted explanatory variables, we then exploit the panel dimension of our data and run fixed-effects regressions to control for industry-specific and firm-specific characteristics, respectively. To mitigate concerns on non-random selection, we also employ propensity score matching

(Rosenbaum and Rubi, 1983) that allows us to analyze the differences in the use of derivatives between CFOs with and without a specific education.

As already mentioned, we measure speculation as the variability in a firm's FX derivatives ratio that is unexplained by fundamental firm characteristics. To do so, we run a fixed-effects model that links heteroscedasticity of the residuals to the manager-specific personal characteristics; this allows us to directly test the relationship between manager education and speculation. For robustness, we also perform more robust two-step procedures. The methodologies will be discussed in detail later in Section 3.4.

3.2 Explanatory variables

3.2.1 Managers' personal characteristics

Traditionally, economic theories ascribe no role to firm managers in corporate decision-making. In this view, corporate choices are related to firm conditions, such as its cash flows or investment opportunities. If at all (e.g., in agency conflicts), managerial decision-makers are modeled as homogenous agents (Graham et al., 2013). However, the literature provides several indications of how the personal characteristics of managers may determine corporate activity. Recognizing this, financial research has started to pay attention to the influence of manager-specific attributes on the behavior of firms.

Bertrand and Schoar (2003) show that managers differ in their financial aggressiveness and management style, finding that manager fixed-effects are important determinants in a wide range of corporate decisions. More recently a stream of research investigates how managerial characteristics impact corporate financial decisions. In particular, optimism (in the sense of overconfidence) and personal attitudes to risk have been the subject of behavioral explanations for firm decisions (e.g., Malmendier and Tate, 2005 and 2008; Malmendier et al., 2011; Graham et al., 2013). Optimistic managers overvalue their own corporate projects and attach a higher probability of positive outcomes to their actions (Heaton, 2002) making them more aggressive in decision-making (as shown by Malmendier and Tate, 2005 and 2008, respectively, in the context of capital structure and acquisition decisions). Logically, overconfidence leads to a more positive attitude towards risk-taking and is hence more likely to be associated with speculation on the FX market (Gezcy et al., 2007).

According to existing literature, overconfidence may develop with the professional education of firm managers. Viewed thus, managers with more advance degrees and a higher quality of education may be more likely to be overconfident than others because of an assumed superiority. Indeed, empirical evidence shows that executives holding an MBA – probably the best general management degree – choose more aggressive corporate strategies (e.g., Beber and Fabbri, 2012; Hu and Liu, 2015; King et al., 2016).[10] Considering this, we assume that the educational background of its managers plays a role in a firm's decision-making style and expect that managerial education is related to both a firm's use of FX derivatives and its level of speculation. We use *BUSINESS* and *MBA* as dummy variables that take the value of 1 if the manager has a business education or an MBA degree, respectively, and zero otherwise. However, while the MBA is still relatively rare in Germany, many German executives hold a PhD (in a business-related area). As mentioned above, a PhD in German-speaking countries confers relatively high social status and is generally very well remunerated. It would perhaps be logical to assume that a

[10] For example, Bertrand and Schoar (2003) and Frank and Goyal (2007) find that CEOs holding an MBA are more aggressive in their strategic choices.

PhD in a business-related field might also be related to derivative use and speculation in the same way as an MBA. However, a PhD in continental Europe typically involves both research training and teaching, which may cause PhD-holders to develop a more critical attitude when making decisions; thus based on a different training background the propensity of PhD-holders to take risks may differ from those with an MBA. To shed light on this, we use a dummy variable *PHD-BUSINESS* that takes the value of 1 if the manager has a PhD in business and zero otherwise.

Of course, overconfidence may not only result from education, but may also be associated with other personal characteristics of firm managers. We therefore control for some of these that are possibly linked to managers' use of FX derivatives and their level of speculation.

We include a dummy variable *MALE*, that takes the value of 1 if the firm manager is male and zero otherwise, as males tend to be more overconfident than female managers (e.g., Barber and Odean, 2001; Croson and Gneezy, 2009). Moreover, we include *AGE* (the age of the manager), *TENURE* (the years the manager has been in his current position) and *COMPANIES* (the number of companies the manager has worked for before joining his/her present company). According to Gervais and Odean (2001), traders are most overconfident when they are inexperienced and overconfidence decreases over time. Hence, age and working experience may be relevant to corporate decisions. However, it is worth noting that these features also may be associated with corporate decision-making for reasons related to risk attitudes, skills or concerns regarding career and reputation rather than to overconfidence. Older managers might be more averse to risk-taking because they may prefer to minimize random fluctuations in portfolios if they are close to retirement or because re-employment is more difficult for them in the face of job loss due to decision failures (Tufano, 1996; Hu and Liu, 2015). Moreover, managers with long industry affiliation are naturally keen to protect their reputation and hence are less opportunistic – or more cautious – about investing in risky projects (Diamond, 1989; Ashiq and Weining, 2015). On the other hand, older managers are more experienced and have more managerial skills which may make them more confident about taking risks.[11] Additionally, experienced executives may have less need to establish a reputation and may therefore be more venturesome (Gibbons and Murphy, 1992; Graham et al., 2013).

For our analysis, we construct a unique dataset that captures personal characteristics of its CFOs.[12] To do so, we hand-collect data on managers' personal characteristics from the annual reports of the firms, their homepages, social-network services like Xing and LinkedIn, and other publications. Table 2 presents summary statistics.

[Table 2 about here]

Overall, our sample comprises 397 CFOs. Among them, 13 are female, 318 have a business education, 19 hold an MBA and 74 have a PhD in business. As Panel B shows, for more than 28.5% of all firm-years the CFO is simultaneously the CEO. The CFO is on average 49 years old, has been in their current position for almost 5 years and in the company for more than 8 years. Before joining the company, he or she has worked for 2.3 different companies.

3.2.2 Managers' compensation

There are several theories as to why equity-sensitive compensation for executives may be linked to managerial decisions (see Murphy, 1999, for an extensive review). Equity-based compensation

[11] Empirical evidence suggests that the sophistication of financial decisions varies with age (Agarwal et al., 2009), but also that personal risk aversion appears to increase till the age of 70 and then declines (Shefrin, 2005).

[12] We focus on the CFO, as generally the CFO is charged with all risk management functions (Graham and Harvey, 2001) and as survey evidence from Geczy et al. (2007) suggests that CFOs generally make the key decisions about speculation and derivative positions. The results for CEOs are similar (see robustness tests in Section 3.5).

may lead to a firm manager owning a certain percentage of a firm's shares, especially when holding periods are long. Accordingly, their wealth is strongly affected by variance in their firm's expected profits and they may direct their firms to use derivatives to hedge their private positions – rather than doing this by themselves (Tufano, 1996; Geczy et al., 1997).

Theoretical models (such as Smith and Stulz, 1985, with respect to derivatives) predict a positive relation between option-based compensation and the incentive for managers to take risks, as stock price volatility increases call option values.[13] Moreover, Geczy et al. (2007) show that speculating firms use incentive aligning compensation arrangements to encourage managers to speculate. In addition, the literature argues that compensation contracts create incentives for firm managers to take risk (Mehran, 1995; Minnick et al., 2011).

We control for the relationship between the use of FX derivatives and executives' compensation scheme by including manager's variable compensation. We obtain data on executive compensation from Kienbaum Management Consultants GmbH that includes information on senior managers' fixed and bonus payments. Based on this scheme, we construct *CFO variable compensation*, as measured by the executive's variable compensation over its total compensation.[14] Executives with high levels of variable compensation typically receive high bonus payments, including both equity-based and/or nonequity-based payments.[15] Generally, such variable cash compensation is typically based on the performance of the firms in the

[13] However, existing empirical evidence on the relationship between compensation and derivative usage is mixed (e.g., Tufano, 1996; Geczy et al., 1997; Brown et al., 2006).

[14] We are deeply grateful to Kienbaum Management Consultants GmbH for generously sharing with us this information. However, while the database includes extensive information on management compensation, detailed firm-specific payments to the CFO are not available for every year. Thus, if that information is unavailable we proxy the CFO's compensation with the average board member's compensation. If we are unable to obtain that information, we interpolate the variable compensation between two years. Doing so, we gain 85 additional firm-years, which increase our observations by 5.5%. If interpolating is not possible, we leave the firm-year.

[15] As information on the management compensation structure for the firms in our sample is not available to the extent it is for U.S. firms, we cannot construct the sensitivity measures of manager's compensation to firm's stock price (delta) and stock price volatility (vega), respectively, that are typically used in such analyses.

previous year, and we expect a positive relationship with speculation (Geczy et al., 2007). A limitation of our measure is that it only displays the effective variable compensation, but not the highest level possible. Therefore, our measure does not give direct information on whether firm managers have an incentive to take risks in order to increase their compensation. However, as the effective and the potential variable compensation should be highly correlated, our measure should be a good proxy for the incentive to take risk. Panel A of Table 3 presents summary statistics of the compensation scheme.

[Table 3 about here]

On average, the CFOs receive 48.1% of their compensation through variable payments. However, the broad distribution shows that there are managers with high and low levels of variable compensation.

3.2.3 Fundamental firm characteristics

We control for a set of fundamental characteristics of firms that have been shown to be associated with the use of FX derivatives in previous studies (e.g., Geczy et al., 1997; Beber and Fabbri, 2012). We obtain data from Thomson Reuters Worldscope and the OECD, respectively, and hand-collect information on foreign sales and on expenditures for research and development from the annual reports of the companies.

We include the *foreign sales ratio* (measured by foreign sales over total sales) and the ratio of *foreign purchases over total sales,* as proxies for firms' foreign business activity. While information on foreign sales is available from the annual reports, firms are not required to report information on foreign purchases. We therefore construct a proxy for foreign purchases. To do so, we classify the sample firms into the 17 industry sectors mentioned above and multiply the observed firm-specific foreign sales by the relation of imports to exports of the particular industry group – using the OECD's industry-level data on imports and exports for the industry sectors.[16]

We include *firm size*, here measured by the log of total assets, since larger firms may have more efficient risk management due to lower market participation costs and benefit from economies of scale, and they may also profit from risk reduction due to product and customer diversification. Accordingly, they may achieve a particular exposure without using derivatives or may have lower transaction costs so that firm size may be related to the amount of FX derivative use (Nance et al., 1993; Dominguez and Tesar, 2006).

We employ the *debt ratio*, measured by total debt over total assets, as a measure for the expected costs of financial distress. According to Smith and Stulz (1985), hedging decreases the expected costs of financial distress as it reduces firms' cash-flow volatility. Firms with less debt should be less concerned about financial distress and accordingly about risk from exchange rate movements. In contrast, firms with high leverage have a higher probability of financial distress – and thus higher possible cost consequences – which could be reduced by hedging, meaning that they would use more derivatives (Tufano, 1996; Geczy et. al., 1997; Graham and Rogers, 2002).

We include the *R&D intensity*, measured by research and development expenditures over total sales, as a proxy for growth options in a firm's investment opportunity. According to Froot et al. (1993), firms that do not hedge are more likely to pursue suboptimal investment projects (see also

[16] The underlying assumption of our calculations is that firms that have a certain share of an industry sector's total exports will very likely have a similar share of that industry sector's total imports. We group firms into industry sectors as suggested by the OECD. The OECD provides trade information at industry level for the years 2000, 2005 and 2008-2011. For these years we calculate each trading partner's export and import share. For the years in which trade information is not available, we simply interpolate these values. For the years 2012 and 2013, we carry forward the shares calculated for the year 2011.

Myers, 1977). Hedging can reduce this underinvestment problem as it reduces the costs of external financing. Because firms with greater growth opportunities could be more prone to underinvestment – since underinvestment is most severe for firms with high investment opportunities (Graham and Rogers, 2002) – they should have a higher incentive to hedge. Accordingly, firms with high levels of R&D would be expected to use more derivatives (Allayannis and Ofek, 2001).[17]

Finally, we use the *quick ratio*, defined as cash and marketable securities over current liabilities, as a proxy for a firm's liquidity. Firms that are able to pay their short-term operating liabilities with (almost) readily available cash are less exposed to cash-flow volatility and hence to financial distress. It follows that firms with a higher quick ratio would make less use of FX derivatives (Geczy et. al., 1997; Opler et al., 1999).

Panel B of Table 3 presents summary statistics of the variables included in our analyses. We stress some distinctive features. Measured by total assets and total sales, our sample includes both small and large companies. The medians are much smaller than the means, implying that we have some very large firms in our sample. The average foreign sales ratio is 55.3%, thus more than half of the average firm-year's total sales is earned on the foreign market (outside Germany); this demonstrates the export activity of the German economy. The median is even higher, but the broad distribution shows that there are firms with high and low levels of foreign activity. The average ratio of foreign purchases to total sales is slightly below the foreign sales ratio, but even more widely distributed as implied by the high standard deviation. Moreover, our average firm has a debt ratio of 59.1%. Table 4 shows pairwise correlations of the explanatory variables.

[17] R&D expenditures include both direct expenses (excluding depreciation) and activated expenditures for research and development.

While the correlations between most variables are low, we find sizeable correlations between the debt ratio and the quick ratio as well as between the foreign sales ratio and foreign purchases/total sales. However, the correlation between these variables is still below a relevant level.

[Table 4 about here]

3.3 The amount of FX derivative use

We start with applying between-effects, Fama-MacBeth (1973) and pooled OLS regressions using the FX derivatives ratio, defined as the notional amount of FX derivative holdings scaled by total assets, as the dependent variable. First, we only include the fundamental firm characteristics as explanatory variables to study the standard determinants driving the amount of FX derivative use (Table 5). Next, we examine net exporting and net importing firms separately to identify possible asymmetric relationships of the explanatory variables (Table 6). We then also add the personal characteristics of managers and look for any links between these and FX derivative holdings (Table 7). Moreover, to control for unobservable characteristics that may affect the amount of FX derivative use, we set industry and firm fixed-effects (Table 8). Finally, we control for non-random selection by performing propensity score matching procedure (Table 9).

[Table 5 about here]

Table 5 shows significant relationships between derivative use and firm size, R&D intensity and foreign business activity. In particular, the positive relationship of size indicates that larger firms use more derivatives. A possible explanation is that larger firms are generally more engaged in foreign markets and hence exposed to exchange rate risk (Dominguez and Tesar, 2006), making them more prone to use derivatives. In contrast, the link between the level of R&D and use of derivatives is negative, suggesting that firms with higher R&D expenses (scaled by total sales) use derivatives less. This finding is not as expected, which would namely be that companies with higher investment growth opportunities (which R&D intensity proxies for) benefit more from hedging (so as to reduce underinvestment costs) and hence use more derivatives (Allayannis and Ofek, 2001). Moreover, both proxies for foreign business activity are highly significant and show positive links to derivative use.[18] Thus altogether the results suggest that firms with higher foreign sales and foreign purchases have larger derivative holdings.

However, the relationships between the foreign business activity measures and the level of FX derivative use may be different depending on whether the firm is net exporting or net importing. If firms use FX derivatives for hedging, higher foreign sales by net exporters should be associated with greater use of derivatives because these firms are more exposed to risk from exchange rate movements. In contrast, net exporters with higher foreign purchases have less exchange rate exposure and hence less need for derivatives. Analogously, the relationship for net importers should be the reverse. Table 6 shows the results of our investigation of net exporters and net importers separately.

[Table 6 about here]

[18] As already mentioned in Section 2, the foreign sales ratio and foreign purchases/total sales are notably correlated. When including them jointly in the following regressions, they are not always statistically significant, but when we do so separately we find significant links for both proxies.

Again, we find that use of derivatives is significantly related to firm size and growth opportunities, as already discussed above. As expected, we now find asymmetric relationships between derivative use and our foreign activity proxies that are statistically significant. For net exporters, we find that firms with higher foreign sales use more derivatives, while firms with more foreign purchases use them less. In contrast, the relationships for net importers are reversed. Our findings therefore support theories that firms use derivatives for hedging.

Next, we include CFOs' compensation schemes and their personal characteristics in our regressions. Table 7 presents the results.

[Table 7 about here]

Besides the links discussed above, we also find statistically significant relationships between use of derivatives and managers' compensation, age, gender, past working experience and education. In particular, the coefficient on the CFO variable compensation measure indicates that firms whose managers receive a higher percentage of variable compensation use more derivatives. The male dummy is also positively linked to the use of foreign currency derivatives, indicating that male managers use more derivatives than females.[19] However, these results should be treated with caution as the number of female managers is quite low as already documented above. Likewise, we find that firms with older managers use more derivatives. In contrast, firms with CFOs who have worked for several companies use derivatives less.

Moreover, and most interestingly for our analyses, the results show significant links between derivative use and the type of education of the firm manager. In particular, a business education is positively linked to use of FX derivative, indicating that firms that have a CFO with an

[19] Because in between-effects regressions the variables enter as average values, average dummy variables may take values between 0 and 1.

education in business use more derivatives. When analyzing in more depth the relationship between use of derivatives and education, we find that the coefficient on the MBA dummy is slightly negative, but not statistically significant. On the other hand, we find a significantly negative relationship between derivative use and the PHD-BUSINESS dummy. This finding suggests that firms with a CFO having a PhD in business use fewer derivatives.[20]

Finally, we apply a fixed-effects regression to control for unobserved heterogeneity. We set industry fixed-effects (based on the 17 industry sectors mentioned above) and firm fixed-effects, respectively. Moreover, we include, year dummies and calculate robust standard errors according to Driscoll and Kraay (1998), controlling for heteroscedasticity, autocorrelation and cross-sectional dependence. Table 8 presents the results.

[Table 8 about here]

When controlling for industry-specific effects (Columns (1) - (3)), we get results quite similar to those reported above, though some coefficients (in particular on the foreign sales ratio and on foreign sales/ total sales) lose significance.[21] More interestingly, we now find – besides the significantly negative coefficient on the PHD-BUSINESS dummy – also statistical significance for the negative coefficient on the MBA dummy, suggesting that managers with an MBA degree also use derivatives significantly less.

[20] The regressions are again done separately for net exporters and net importers. Apart from the asymmetric effects of foreign sales and purchases (already discussed above), the findings are similar to those reported in Table 7. For the sake of brevity we therefore do not tabulate them here, but they are available from the authors upon request.

[21] We also estimate the fixed-effects regression by including only firms that experience a change from a CFO with a specific education to another CFO (without that education). In particular, we run three separate regressions that include (i) firms that experience a change from a CFO with a business education to a CFO with a non-business education, (ii) firms that experience a change from a CFO with an MBA to a CFO without an MBA, and (iii) firms that experience a change from a CFO with a PhD to a CFO without a PhD, or vice versa. We find qualitatively similar results.

When including firm fixed-effects (Columns (4) - (6)), the coefficients on both foreign activity measures are again positive and mostly significant.[22] Moreover, we again find a significantly positive link with the variable compensation measure. We also find that the number of companies the CFO has worked for is positively associated with the amount of FX derivative usage. Additionally, there is a significantly positive link between derivative use and business education, and a negative link with the MBA dummy, corroborating the relationships already reported above. However, we do not find evidence that a PhD in business is linked to the use of derivatives when setting firm fixed-effects.[23]

To reduce concerns regarding the non-random selection problem, we perform propensity score matching procedure (Rosenbaum and Rubi, 1983). In doing so, each firm-year in which a CFO has a PhD in business is matched with a firm-year in which a CFO does not have a business PhD and where no other observable differences in firm characteristics are exhibited. As a result, each matched observation pair is identical, except for the education of the CFO. Firm-years are matched on the propensity scores, i.e. the probability that a firm with certain firm characteristics is run by a CFO with and without a business PhD. To ensure that the observations are sufficiently

[22] Again, we separately analyze net exporters and net importers. The results (not tabulated, but available from the authors upon request) are quite similar to those reported in Table 8. However, we again find the expected asymmetric effects of the foreign activity measures discussed above. Accordingly, for net exporters, increases in foreign sales are associated with an increase in derivative holdings. These findings corroborate that derivatives are used for hedging foreign sales. Conversely, the relationship between use of derivatives and foreign purchases is negative, suggesting that net exporting firms reduce derivative use when foreign purchases increase. This is plausible and indicates that firms use expenses in foreign currency to offset risk positions. In doing so, they are less exposed to risk and thus need fewer derivatives to achieve their optimal hedge ratio. Analogously, the relationships for net importers are reversed, suggesting that firms use derivatives to hedge foreign purchases and that they use foreign currency netting to reduce exposure to exchange rate risk.

[23] We also find that some of the coefficients change their signs. In particular, the coefficient on size is negative suggesting that larger firm size is associated with lower FX derivative use. Moreover, the coefficients for firm manager's age and the male dummy now become negative, indicating that higher CFO age and male gender are associated with lower derivative use. However, the coefficient on age is quite small and the number of female managers in our sample is quite low, so that the results should not be overrated. Moreover, we now also find a significant link between derivative use and the tenure of managers in their current position, indicating that managers with more working experience use more derivatives.

similar, the difference between the propensity scores of the matched firm-years were required to be less than 0.1% in absolute terms (see Faccio et al., 2016). Analogously, we repeat the same matching procedure for (general) business education and non-business education as well as for MBA and non-MBA. Table 9 presents the results.

[Table 9 about here]

Panel A shows the differences that emerge on comparing the samples when matched with propensity scores based on firm characteristics, i.e. foreign activity, firm size, debt ratio, quick ratio, R&D intensity. A comparison between the matched samples shows that firms with CFOs who have a business education use significantly more derivatives than firms with non-business CFOs, even when several other observable characteristics between the firms are identical. In contrast, firms with CFOs who have a PhD in business use significantly fewer derivatives than their peers. We also find that firms with CFOs holding an MBA use derivatives less, but the difference between the matched samples is not statistically significant. In Panel B we additionally match observations within a particular industry group. As a result, we find that the number of matched firm-years decreases, but the relationships are similar to those reported above. Moreover, the statistical significance of the differences between the matched samples is notably higher – so that even the difference between firms with MBA-CFOs and non-MBA-CFOs is close to a statistical significance at the 10% level.[24] Hence, the results from propensity score matching basically corroborate the previous findings.

Summarizing our results, the amount firms use FX derivatives is associated with a number of firm characteristics (identified by theory and empirical evidence) as well as with a number of the

[24] It should be noted that the number of matched pairs, i.e. 46, is quite low.

personal characteristics of firms' decision-makers. These findings add to recent empirical evidence that personal traits and experiences influence managers in their corporate decisions (e.g., Benmelech and Frydman, 2015; Bertrand and Schoar, 2003; Cain and McKeon, 2016; Cronquist et al., 2012; Faccio et al., 2016; Malmendier and Tate, 2005; Malmendier et al., 2011). Most interestingly, our results show that managers with a general business education use more FX derivatives. In contrast, though the relationships are not always statistically significant, our findings indicate that both a business PHD and an MBA are associated with lower levels of FX derivative use.

3.4 Speculation

As FX derivatives are typically used to reduce foreign currency risk (Allayannis and Ofek, 2001; Bartram et al., 2010), less use of FX derivatives may result in a higher exchange rate exposure. Indeed, firms that use fewer derivatives are *ceteris paribus* more exposed to foreign currency movements, which may be seen as a form of speculation. However, the level of FX derivative holdings may be due to a firm's individual risk management policy, and the optimal FX derivatives ratio may be different for different firms; thus firms may leave open an unhedged FX risk position due to their individual policies. However, following such specific risk management policies is not what one typically defines as speculation. In fact, speculation may be more seen as actively altering positions according to expected future developments in the context of active market timing (see, e.g., Faulkender, 2005; Brown, et al., 2006; Chernenko and Faulkender, 2011; Beber and Fabbri, 2012).[25] Hence a lower level of derivative use is not necessarily associated with higher speculation.

However, higher speculation (in the sense of market timing) should increase the variability of derivative holdings. More precisely, it should increase that part of the derivative holdings variability that cannot be explained by the hedging intention, e.g. by changed firm characteristics such as foreign sales (see Beber and Fabbri, 2012). Thus if a firm speculates more, we should observe a higher variance in their residuals in a fixed-effects regression of the FX derivatives ratio for the firm characteristics that are associated with hedging; i.e. speculation should induce heteroscedasticity. Therefore, if manager characteristics such as a PhD were linked to speculation, the variance in the residuals should be linked to manager characteristics. To directly test this relationship, our first regression design looks like this (Model 1):

$$FXDR_{j,i,t} = \mu + \alpha_{j,i} + \delta_t + \sum_{n=1}^{N} \beta_n X_{n,j,i,t} + \varepsilon_{j,i,t} \ , \tag{1}$$

with $\varepsilon_{j,i,t} \sim N(0, \sigma^2_{j,i,t})$, independently distributed,

$$\text{and} \quad \sigma^2_{j,i,t} = \exp\left(\mu' + \alpha'_j + \sum_{k=1}^{K} \gamma_k PC_{k,j,i,t}\right). \tag{2}$$

$FXDR_{j,i,t}$ denotes the FX derivatives ratio of firm i in industry j in t, and $\alpha_{j,i}$ denotes the respective firm fixed-effects (one omitted); the $X_{n,j,i,t}$ represent firm characteristics and δ_t time dummies. Equation (2) shows that the variance of the residuals is assumed to be a log-linear combination of the personal characteristics $PC_{k,j,i,t}$, where we set industry fixed-effects α'_j. This

[25] We also find that firms actively time the market. For the sake of brevity, we do not report our results here, but rather in the Appendix of this paper.

means that there is a certain amount of industry-specific variance, but we allow for deviations in every firm-year caused by managers' personal characteristics.

We estimate Model 1 in one step using the maximum likelihood approach and calculate robust standard errors clustered at the firm-level. However, since the firm fixed-effects in Equation (1) may lead to a significant bias due to the incidental parameter problem in an ML approach (e.g., Lancaster, 2000) when the number of observations per firm is small, we also estimate a slightly different specification that is based on demeaned variables. By doing so, we can test whether managers' personal characteristics are related to the degree a firms' derivative holdings deviate from the firm-specific average. We set $FXD^*{}_{j,i,t} = FXD_{j,i,t} - \overline{FXD}_{j,i}$ and $X^*{}_{n,j,i,t} = X_{n,j,i,t} - \bar{X}_{n,j,i}$, where the dash denotes the average over *t*. Demeaning eliminates the firm fixed-effects at the firm level. This leads to the following regression (Model 2):[26]

$$FXD^*{}_{j,i,t} = \mu + \delta_t + \sum_{n=1}^{N} \beta_n \; X^*{}_{n,j,i,t} + \varepsilon^*{}_{j,i,t} \;, \tag{3}$$

with $\varepsilon^*{}_{j,i,t} \sim N(\,0,\, \sigma^2_{j,i,t})$, independently distributed,

$$\text{and} \quad \sigma^2_{j,i,t} = \exp\left(\mu' + \alpha'_j + \sum_{k=1}^{K} \gamma_k \, PC_{k,j,i,t}\right). \tag{4}$$

Again, we estimate the parameters using the maximum likelihood approach and calculate clustered standard errors.

[26] For ease of notation we use the same parameters β, γ, etc. in Model 1 and Model 2. We do not expect them to be identical, as the models are not equivalent. In fact, it should be noted that Model 2 is not the within-transformation of Model 1 as the within-transformation would induce autocorrelation in the transformed residuals, which is hard to handle in an ML approach.

The results of both models are reported in Table 10. We concentrate on the results of Model 1 (Columns (1) and (2)) concerning the determinants of the variance of the residuals. The results of Model 2 are very similar.

[Table 10 about here]

Most importantly for our study, the PHD-BUSINESS dummy in Column (2) is significantly negative. This implies that managers with a PhD in business speculate less on the FX market. Accordingly, the results do not support the hypothesis that a research education is linked to the risk-taking attitude of managers in the context of derivative speculation in the same way as it is to an MBA degree in the U.S. On the contrary, our finding lends empirical evidence to the hypothesis that a research education in Germany is associated with less speculative behavior, which may be due to a more critical and conservative attitude when making corporate decisions, as already discussed in the introduction.

Surprisingly, we also find the MBA dummy to be significantly negative. This seems to contradict recent empirical evidence in the U.S. that managers holding an MBA are more aggressive when making financial decisions, because they are presumably more susceptible to overconfidence and thus have a more tolerant attitude towards risk and speculation (e.g., Bertrand and Schoar, 2003; Frank and Goyal, 2007; Beber and Fabbri, 2012; Hu and Liu, 2015; King et al., 2016). However, our negative result should be viewed with reservation as the number of MBA-holders in our sample is very small that is why one should not put too much emphasis on this. Further, the MBA dummy loses significance in the subsequent robustness checks.[27]

[27] In a separate analysis not reported here in detail, we split the MBA-holders into two groups according to the MBA-granting institutions: 1) Top MBAs granted by the top 50 business schools according to the ranking of The Economist, which account for 11 out of 19 MBA-holders, and 2) the remaining MBAs. We rerun the above analysis

The insignificant BUSINESS dummy in Column (1) shows that a business education is no more strongly related to speculation than a non-business one. Among the remaining explanatory variables in Columns (1) and (2), CFO variable compensation is significantly positively linked to speculation. As such variable payment is typically linked to the success and performance of a firm, this is in line with the literature linking compensation schemes to incentives for firm managers to take risks (e.g., Mehran, 1995; Geczy, 2007; Minnick et al., 2011). Other variables such as past working experience (COMPANIES) have the expected sign, suggesting that managers who have gained their experience in a larger number of companies are less prone to speculating (see also Beber and Fabbri, 2012), however these are not significant.

While the above approaches have the advantage of being integrated and elegant, the assumption that the residuals are normally distributed and independent is not likely to hold in reality. Additionally, there may be reasons other than the personal characteristics of managers that cause heteroscedasticity. We therefore next apply a more robust two-step procedure. First, we estimate a firm fixed-effects regression (via OLS) of the derivative use ratio using the firm characteristics and time fixed-effects as explanatory variables to exclude the fundamental effects (which is analogous to Column (4) of Table 8). Then, we use the square of the resulting residuals of each firm-year as an estimate for the variance in the residuals for that firm-year, which results in a new panel data set. Next, we run an industry fixed-effects regression of the squared residuals on the managers' personal characteristics and again calculate cluster-robust standard errors. The results are reported in Columns (1) and (2) of Table 11.

[Table 11 about here]

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and also the subsequent robustness checks with two respective dummies and find the top MBAs to be insignificant but positive in the robustness checks. Economically the positive sign makes sense, as top institutions are more likely to breed overconfidence than other business schools. However, the sample is far too small to finally judge on this.

We obtain results that are analogous to those above, though most variables lose significance. This is not unexpected, as a squared residual is a rather rough estimate of the variance, producing a lot of noise. *A fortiori*, we stress that the PHD-BUSINESS dummy is still significantly negative, implying a strong economic robustness in the relationship between speculation and PhD. As already mentioned, an MBA is no longer significant here.

The same holds when applying another two-step procedure (see Columns (3) and (4) of Table 11). Here we take again the residuals of the firm fixed-effects regression from above, but now estimate their variance via the standard variance estimator for each firm, which is basically the same procedure applied by Beber and Fabbri (2012), i.e. we achieve one estimate per firm. Using the standard variance estimator is of course a "logical break" if we assume heteroscedasticity also on the firm level, for example if a CFO with a PhD joins the firm. Nevertheless, regressing this variance on managers' characteristics, which are averaged over time, should reveal a negative coefficient for, e.g. PHD-BUSINESS, if it is associated with lower speculation and if industry effects (that we cannot control for in this setting) are not too large. In fact, we find a significantly negative coefficient for PHD-BUSINESS in Table 11, again showing the robustness of our key result on the relation between research education and speculation.

3.5 Further Analyses

We perform some additional tests to further check the robustness of our results. First, we normalize the notional amount of foreign currency derivatives by total sales (rather than by total assets) and re-run all analyses using this alternative measure of a firm's FX derivatives use ratio as the dependent variable. The results remain qualitatively unchanged.

Second, as already mentioned, the CFO is typically charged with all risk management functions, including the decisions about how to use FX derivatives (see Graham and Harvey, 2001; Geczy et al., 2007). However, the CEO may influence the general risk culture of a company. In fact, many studies on behavioral corporate finance focus on the personal characteristics of the CEOs (e.g., Beber and Fabbri, 2012; King et al., 2016) – maybe also due to a lack of data on CFOs. Moreover, our sample includes some firms that are family-owned and the firm owner (or one of the firm owners) works as CEO in the company. In such firms the authority for decision-making in financial issues may be different, so that not the CFO, but the CEO may decide on the use of derivatives. Therefore, we repeat all regressions using respective data for CEOs. We find that the CEO's education is insignificant in most cases for derivatives use and speculation while – as shown in the paper – the research education of CFOs is highly relevant.

4 Conclusion

In this paper, we investigate whether the education of firm managers is related to how much firms use FX derivatives and to their speculative activities on the FX market. In particular, we analyze if a research-oriented background, as measured by a PhD, is linked to CFOs' corporate decision-making regarding the use of FX derivatives in Germany. We use a hand-collected dataset, including the personal characteristics of managers and the notional values of the foreign currency derivative holdings of German firms. After controlling for fundamental firm characteristics, managers' compensation schemes and personal characteristics of the CFOs, we find that the educational background of executives is linked to both the level of firms' FX derivative holdings and to corporate speculation. These findings add to recent empirical evidence that a number of the personal characteristics of firm managers are associated with their financial decision-making (e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Malmendier et al., 2011).

In particular, our results show that on average firm managers with a general business education use FX derivatives more. In contrast, we find some (not always statistically significant) evidence that managers with a PhD in a business-related area, like managers with an MBA, averagely use fewer FX derivatives.

Analyzing the relationships between managers' personal characteristics and speculation, we find strong evidence that firm managers with a PhD speculate less than executives with another type of education. This finding is robust over different methodologies. Our results thus suggest that an education involving research training is associated with less of a risk-taking attitude in the context of speculating with FX derivatives. A possible explanation is that PhD graduates are more long-term oriented and conservative in financial decisions.

For CFOs holding an MBA we arrive at mixed results. However, since the number of German CFOs with an MBA is very small, we do not put too much emphasis on this.

A limitation of our study is that we cannot rule out (or address) all potential endogeneity concerns. While propensity score matching and fixed-effects approaches at least mitigate some concerns regarding the non-random selection of our sample and omitted variables on the firm or industry level, firms with a particular FX derivatives ratio and/or attitude towards speculation may select a manager with a particular education or attitude towards risk that is associated with this education. Hence, similar to other studies that analyze the relationship between managerial traits and corporate choices, the documented links between managers' education and their firms respective use of derivative and corporate speculation, may be the result of endogenous matching between firms and firm managers. Furthermore, our data is not intended to address the question of whether a research-oriented education in the form of a PhD causes PhD-holders to be less prone to speculation or if, for example, people who are naturally less likely to speculate more often self-select themselves towards a PhD rather than an MBA. This must be left for future research.

Appendix

Following previous research (e.g., Chernenko and Faulkender, 2011; Beber and Fabbri, 2012) we investigate if firms time the market by speculating on the development of the exchange rate. As firms generally do not change their risk management strategy as long as they do not fundamentally change their operations, their final exposure to foreign exchange risk (e.g. the exposure after risk management mechanisms took place) should be relatively stable. Hence, if firms use currency derivatives for hedging, their FX derivatives ratio should stay constant over time as well, as long as their business activities do not change simultaneously. Accordingly, movements that are unexplained by fundamental firm characteristics may be due to market timing (Chernenko and Faulkender, 2011). Accordingly, non-fundamental variables that explain variation in the FX derivatives ratio can be interpreted as being associated with speculation.

Market timing may be driven by firm managers' expectations about future exchange rate developments. We use past FX returns (like Beber and Fabbri, 2012) and forecasted FX returns (average forecasts across analysts) as proxies for market timing. We then construct industry-specific exchange rates (for the 17 industry sectors already mentioned above) based on each industry sector's exports and imports, to best capture different trade patterns among the industry sectors. These calculations are based on Schmitz et al. (2012), and include Germany's 25 major trading partner countries (see Klau and Fung, 2006) which account for direct bilateral trade and third-market competition (see Turner and Van't dack, 1993). We obtain bilateral exchange rates from Thomson Reuters Datastream, analyst forecasts from Bloomberg and industry-specific trade data from the OECD.

Table A1 presents the results from the firm fixed-effects regression with fundamental firm characteristics and market timing proxies. We find statistically significant links for both market timing proxies, indicating that firms change their derivative holdings for reasons unrelated to their operations. In particular, the significant link regarding the lagged exchange rate suggests that firm managers time the FX market based on information from past FX returns (adding to Beber and Fabbri, 2012) and on analyst forecasts.

When analyzing net exporters and net importers separately (Table A2), we find that primarily net-importing firms time the market. The negative link suggests that they reduce their FX derivatives ratios when they expect an appreciation of the euro. Because an appreciation of the euro generally benefits net importers as the costs for imported goods decrease, these links are plausible. For net exporters, the links are also negative, but not statistically significant.

Table A1
Market timing

Variable name	(1)	(2)
Foreign sales/ total sales	0.069** (2.124)	0.061 (1.493)
Foreign purchases/ total sales	0.116*** (6.869)	0.096*** (3.690)
Size (log of total assets)	-0.023*** (-3.274)	-0.019** (-2.208)
Debt ratio	0.014 (0.791)	-0.004 (-0.230)
Quick ratio	-0.000 (-0.298)	-0.000 (-0.671)
R&D intensity	-0.065 (-0.518)	-0.205 (-1.573)
Past FX return	-0.369* (-1.916)	
Forecasted FX return		-1.257*** (-2.874)
Intercept	0.148*** (3.202)	0.144** (2.519)
Firm fixed-effects	Yes	Yes
Observations	1879	1507
R-squared	0.065	0.046

This Table reports results from firm fixed-effects regressions using the notional amount of foreign currency derivatives, scaled by total assets, as the dependent variable and a set of firm characteristics and proxies for market timing as the explanatory variables, including year fixed-effects. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using robust standard errors according to Driscoll and Kraay (1998).

Table A2
Market timing: net exporting and net importing firms

	Net exporters		Net importers	
Variable name	(1)	(2)	(3)	(4)
Foreign sales/ total sales	0.422*** (5.920)	0.317*** (3.882)	-0.336*** (-6.759)	-0.287*** (-4.701)
Foreign purchases/ total sales	-0.228** (-2.518)	-0.138 (-1.374)	0.178*** (11.868)	0.174*** (7.331)
Size (log of total assets)	-0.023** (-2.348)	-0.012 (-0.966)	-0.010 (-1.015)	-0.022* (-1.957)
Debt ratio	0.012 (0.524)	-0.001 (-0.055)	-0.017 (-0.588)	-0.043 (-1.374)
Quick ratio	-0.000 (-0.172)	-0.000 (-0.360)	-0.004 (-0.718)	-0.010* (-1.843)
R&D intensity	-0.352* (-1.811)	-0.642*** (-3.041)	0.219 (1.417)	0.263* (1.671)
Past FX return	-0.005 (-0.017)		-0.818*** (-3.633)	
Forecasted FX return		-1.095 (-1.413)		-1.451*** (-2.829)
Intercept	0.089 (1.343)	0.064 (0.769)	0.174*** (2.997)	0.237*** (3.432)
Firm fixed-effects	Yes	Yes	Yes	Yes
Observations	1211	969	668	538
R-squared	0.066	0.056	0.229	0.156

This Table reports results from firm fixed-effects regressions using the notional amount of foreign currency derivatives, scaled by total assets, as the dependent variable and a set of firm characteristics and proxies for market timing as the explanatory variables, including year fixed-effects. Results are reported separately for net exporting and net importing firms. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using robust standard errors according to Driscoll and Kraay (1998).

References

Agarwal, S., Driscoll, J., Gabaix, X., Laibson, D., 2009. The age of reason: financial decisions over the life cycle. Brookings Papers on Economic Activity 2009, 51-101.

Allayannis, G., Ofek, E., 2001. Exchange rate exposure, hedging, and the use of foreign currency derivatives. Journal of International Money and Finance 20, 273-296.

Allayannis, G., Brown, G., Klapper, L., 2003. Capital structure, foreign debt and financial risk: evidence from east Asia. The Journal of Finance 58, 2667-2709.

Ashiq, A., 2015. CEO tenure and earnings management. Journal of Accounting and Economics 59, 60-79.

Barber, B.M., Odean, T., 2001. Boys will be boys: gender, overconfidence, and common stock investment. The Quarterly Journal of Economics 116, 261-292.

Bartram, S., Brown, G., Fehle, F., 2009. International evidence on financial derivatives usage. Financial Management 38, 185-206.

Bartram, S.M., Brown, G.W., Minton, B.A., 2010. Resolving the exposure puzzle: The many facets of exchange rate exposure. Journal of Financial Economics 95, 148-173.

Baker, M., Wurgler, J., 2002. Market timing and capital structure. The Journal of Finance 57, 1-32.

Baker, M., Greenwood, R., Wurgler, J., 2003. The maturity of debt issues and predictable variation in bond returns. Journal of Financial Economics 70, 261-291.

Beber, A., Fabbri, D., 2012. Who times the foreign exchange market? Corporate specualation and CEO characteristics. Journal of Corporate Finance 18, 1065-1087.

Benmelech, E., Frydman, C., 2015. Military CEOs. Journal of Financial Economics 117, 43-59.

Bertrand, M., Schoar, A., 2003. Managing with style: the effect of managers on firm policies. The Quarterly Journal of Economics 118, 1169-1208.

Bodnar G.M., Hayt, G.S., Marston, R.C., 1998. Wharton survey of financial risk management by U.S. non-financial firms. Financial Management 27, 70-91.

Brown, G.W., Crabb, P.R., Hausalter, D., 2006. Are firms successful at selective hedging? The Journal of Business 79, 2925-2949.

Cain, M.D., McKeon, S.B., 2016. CEO personal risk-taking and corporate policies. Journal of Financial and Quantitative Analysis 51, 139-164.

Chernenko, S., Faulkender, M.W., 2011. The two sides of derivatives usage: hedging and speculating with interest rate swaps. Journal of Financial and Quantitative Analysis 46, 1727-1754.

Cronqvist, H., Makhija, A.K., Yonker, S.E., 2012. Behavioral consistency in corporate finance: CEO personal and corporate leverage. Journal of Financial Economics 103, 20-40.

Croson, R., and Gneezy, U., 2009. Gender differences in preferences. Journal of Economic Literature 47, 448-474.

Diamond D.W.,1989. Reputation acquisition in debt markets. Journal of Political Economy 97, 828-862.

Dolde, W., 1993. The trajectory of corporate financial risk management. Journal of Applied Corporate Finance 6, 33-41.

Dominguez, K.M.E., Tesar, L.L., 2006. Exchange rate exposure. Journal of International Economics 68, 188-218.

Driscoll, J.C., Kraay, A.C., 1998. Consistent covariance matrix estimation with spatially dependent panel data. Review of Economics and Statistics 80, 549-560.

Faccio, M., Marchica, M.T., Mura, R., 2016. CEO gender, corporate risk-taking, and the efficiency of capital allocation. Journal of Corporate Finance 39, 193-209.

Fama, E.F., MacBeth, J.D., 1973. Risk, return, and equilibrium: Empirical tests. Journal of Political Economy 81, 607-636.

Faulkender, M.W., 2005. Hedging or market timing? Selecting the interest rate exposure of corporate debt. The Journal of Finance 60, 931-692.

Frank, M.Z., Goyal, V.K., 2007. Corporate leverage: How much do managers really matter? Unpublished working paper, University of Minnesota and Hong Kong University of Science and Technology.

Froot, K.A., Scharfstein, D.S., Stein, J.C., 1993. Risk management: coordinating corporate investment and financing policies. The Journal of Finance 48, 1629-1658.

Gervais, S., Odean, T., 2001. Learning to be overconfident. Review of Financial Studies 14, 1-27.

Gezcy, C., Minton, B.A., Schrand, C., 1997. Why firms use currency derivatives. The Journal of Finance 52, 1323-1354.

Gezcy, C., Minton, B.A., Schrand, C., 2007. Taking a view: corporate speculation, governance, and compensation. The Journal of Finance 62, 2405-2443.

Glaum, M., 2002. The determinants of selective exchange risk management–evidence from German non-financial corporations. Journal of Applied Corporate Finance 14, 108-121.

Gibbons, R., Murphy, K.J., 1992. Optimal incentive contracts in the presence of career concerns: theory and evidence. Journal of Political Economy 100, 468–505.

Graham, J.R., Harvey, C. R., 2001. The theory and practice of corporate finance: evidence from the field. Journal of Financial Economics 60, 187-243.

Graham, J.R., Rogers, D.A., 2002. Do firms hedge in response to tax incentives? The Journal of Finance 57, 815-839.

Graham, J.R., Harvey, C.R., Puri, M., 2013. Managerial attitudes and corporate actions. Journal of Financial Economics 109, 103-121.

Guay, W., Kothari, S.P., 2003. How much do firms hedge with derivatives? Journal of Financial Economics 70, 423-462.

Haushalter, G.D., 2000. Financing policy, basis risk, and corporate hedging: Evidence from oil and gas producers. The Journal of Finance 55, 107-152.

Heaton, J.B., 2002. Managerial optimism and corporate finance. Financial Management 31, 33-45.

Hu, C., Liu, Y.J., 2015. Valuing diversity: CEOs' career experiences and corporate investment. Journal of Corporate Finance 30, 11-31.

King, T., Srivastav, A., Williams, J., 2016. What's in an education? Implications of CEO education for bank performance. Journal of Corporate Finance 37, 287-308.

Klau, M., Fung, S.S., 2006. The new BIS effective exchange rate indices. BIS Quarterly Review, 51-65.

Lancaster, T., 2000. The incidental parameter problem since 1948. Journal of Econometrics 95, 391-413

Leland, H.E., 1998. Agency costs, risk management, and capital structure. The Journal of Finance 53, 1213-1243.

Malmendier, U., Tate, G., 2005. CEO overconfidence and corporate investment. The Journal of Finance 60, 2661-2700.

Malmendier, U., Tate, G., 2008. Who makes acquisitions? CEO overconfidence and the market's reaction. Journal of Financial Economics 89, 20-43.

Malmendier, U., Tate, G., Yan, J., 2011. Overconfidence and early-life experiences: the effect of managerial traits on corporate financial policies. The Journal of Finance 66, 1687-1733.

Mehran, H., 1995. Executive compensation structure, ownership, and firm performance. Journal of Financial Economics 38, 163-184.

Minnick, K., Unal, H., Yang, L., 2011. Pay for performance? CEO compensation and acquirer returns in BHCs. Review of Financial Studies 24, 439-472.

Murphy, K.J., 1999. Executive compensation. Handbook of Labor Economics 3 (B), 2485-2563.

Myers, S.C., 1977. Determinants of corporate borrowing. Journal of Financial Economics 5, 147-175.

Nance, D.R., Smith, C.W., Smithson, C.W., 1993. On the determinants of corporate hedging. The Journal of Finance 48, 267-284.

Newey, W.K., West, K.D., 1987. Hypothesis testing with efficient method of moments estimation. International Economic Review 28, 777-787.

Opler, T., Pinkowitz, L., Stulz, R., Williamson, R., 1999. The determinants and implications of corporate cash holdings. Journal of Financial Economics 52, 3-46.

Rosenbaum, P.R., Rubi, D.B., 1983. The central role of the propensity score in observational studies for causal effects. Biometrika 70, 41-55.

Schmitz, M., De Clercq, M., Fidora, M., Lauro, B., Pinheiro, C., 2012. Revisiting the effective exchange rates of the Euro. ECB Occasional Paper Series No. 134.

Shefrin, H., 2005. A behavioral Approach to Asset Pricing. Academic Press Advanced Finance Series.

Smith, C.W., Stulz, R.M., 1985. The determinants of firms' hedging policies. Journal of Financial and Quantitative Analysis 28, 391-405.

Stulz, R.M., 1996. Rethinking risk management. Journal of Applied Corporate Finance 9, 8–24.

Tufano, P., 1996. Who manages risk? an empirical examination of risk management practices in the gold mining industry. The Journal of Finance 51, 1097-1137.

Turner, P., Van't dack, J., 1993. Measuring international price and cost competitiveness. BIS Economic Papers No. 39.

White, H., 1980. A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. Econometrica 48, 817-838.

Table 1
Summary statistics on derivative use

	No. obs.	Mean	Median	10% quantile	90% quantile	Std. dev.
Panel A						
Notional FX derivative holdings (millions)	1,879	1,228.4	12.2	0.0	1,460.0	6,087.1
FX derivatives ratio: Notional FX derivative holdings/ total assets	1,879	0.092	0.033	0.000	0.258	0.150
Notional FX derivative holdings/ total sales	1,879	0.097	0.034	0.000	0.265	0.233

Panel B		Notional FX derivative holdings			FX derivatives ratio	
	No. Obs.	Mean	Median	Std. dev.	Mean	|Δ| in %
Year 2004	180	964.4	5.3	3,634.3	0.0898	
Year 2005	192	1,156.8	10.7	4,317.7	0.0979	8.96
Year 2006	202	1,180.4	11.7	4,328.6	0.0978	0.07
Year 2007	196	842.1	9.53	3,875.5	0.0919	6.04
Year 2008	192	990.9	13.9	4,728.2	0.0932	1.45
Year 2009	192	1,150.8	13.0	5,570.2	0.0775	16.92
Year 2010	191	1,287.8	12.7	6,545.8	0.0902	16.41
Year 2011	185	1,522.1	16.2	7,821.5	0.1022	13.33
Year 2012	182	1,655.3	14.4	9,260.8	0.0933	8.72
Year 2013	167	1,609.7	17.7	8,402.3	0.0874	6.27

This Table presents summary statistics on foreign currency derivative holdings. |Δ| is the percentage change in the notional value of FX derivative holdings (scaled by totals assets) from one year to another.

Table 2

Summary statistics of firm managers' personal characteristics

Panel A			Manager is/ has							
	No. firms	No. mangers	male	female	business education	technical education	Master	MBA	PhD	PhD in business
CFO	221	397	384	13	318	43	255	19	104	74

Panel B			Average			
	No. Obs.	CEO is CFO	age	tenure in current position (years)	tenure in current company (years)	number of companies he/ she previously worked for
CFO	1,845	28.51%	48.80	4.97	8.32	2.33

This Table reports summary statistics of managers' personal characteristics.

Table 3
Summary statistics of managers' compensation scheme and fundamental firm characteristics

	No. obs.	Mean	Median	10% quantile	90% quantile	Std. dev.
Panel A						
CFO variable compensation	1,612	0.469	0.481	0.168	0.741	0.211
Panel B						
Total assets (million euros)	1,879	6,430.2	481.7	67.1	9,640.6	25,438.5
Total sales (million euros)	1,879	4,949.1	521.7	74.3	9,769.5	16,339.3
Foreign sales/ total sales	1,879	0.553	0.614	0.138	0.857	0.266
Foreign purchases/ total sales	1,879	0.531	0.411	0.141	0.865	0.608
Size (log of total assets)	1,879	6.482	6.177	4.207	9.174	1.921
Debt ratio	1,879	0.591	0.597	0.328	0.807	0.210
Quick ratio	1,879	1.759	1.003	0.510	2.250	16.359
R&D intensity	1,879	0.034	0.014	0.000	0.097	0.056

This Table reports summary statistics of managers' compensation scheme and fundamental firm characteristics.

Table 4

Correlation between the fundamental firm characteristics

	Foreign sales/ total sales	Foreign purchases/ total sales	Size (log of total assets)	Debt ratio	Quick ratio	R&D intensity
Foreign sales/ total sales	1.000					
Foreign purchases/ total sales	0.505	1.000				
Size (log of total assets)	0.181	0.121	1.000			
Debt ratio	-0.029	-0.056	0.181	1.000		
Quick ratio	0.035	0.054	-0.123	-0.482	1.000	
R&D intensity	0.329	0.112	-0.023	-0.146	0.188	1.000

This Table reports Pearson correlation coefficients between the fundamental firm characteristics.

Table 5

FX derivatives ratio: fundamental firm characteristics

	Between-effects regression	Fama-MacBeth regression	Pooled OLS regression
Variable name	(1)	(2)	(3)
Foreign sales/ total sales	0.073** (2.076)	0.081*** (6.924)	0.074*** (4.945)
Foreign purchases/ total sales	0.044*** (3.062)	0.048** (2.976)	0.054*** (3.940)
Size (log of total assets)	0.021*** (5.080)	0.021*** (15.012)	0.020*** (10.857)
Debt ratio	-0.001 (-0.019)	-0.004 (-0.186)	-0.005 (-0.336)
Quick ratio	-0.000 (-0.031)	0.003 (1.135)	0.000 (0.690)
R&D intensity	-0.082 (-0.511)	-0.104*** (-4.860)	-0.094* (-1.927)
Intercept	-0.247 (-1.163)	-0.109*** (-8.545)	-0.096*** (-5.329)
Observations	1879	1879	1879
R-squared	0.252	0.202	0.186

This Table reports results from between-effects, Fama-MacBeth and pooled OLS regressions using the notional amount of FX derivative holdings scaled by total assets as the dependent variable and a set of firm characteristics as the explanatory variables. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using conventional (1), Newey-West (2) and robust (3) standard errors, respectively.

Table 6
FX derivatives ratio: fundamental firm characteristics

	Net exporters			Net importers		
	BE regression	FMB regression	OLS regression	BE regression	FMB regression	OLS regression
Variable name	(1)	(2)	(3)	(4)	(5)	(6)
Foreign sales/ total sales	0.186*** (2.735)	0.205*** (13.222)	0.203*** (7.130)	-0.060 (-0.953)	-0.059* (-1.839)	-0.081*** (-3.113)
Foreign purchases/ total sales	-0.078 (-0.922)	-0.100*** (-4.823)	-0.099** (-2.550)	0.086*** (5.061)	0.085*** (4.328)	0.094*** (6.874)
Size (log of total assets)	0.023*** (4.528)	0.024*** (17.060)	0.023*** (10.327)	0.013* (1.721)	0.013*** (10.822)	0.013*** (4.394)
Debt ratio	-0.032 (-0.558)	-0.007 (-0.365)	-0.017 (-0.995)	0.083 (0.921)	0.023 (1.005)	0.021 (0.812)
Quick ratio	0.000 (0.289)	0.008 (1.768)	0.000* (1.658)	0.009 (0.390)	0.003 (1.147)	0.001 (0.250)
R&D intensity	-0.061 (-0.253)	-0.002 (-0.043)	0.005 (0.060)	-0.209 (-0.753)	-0.213*** (-3.859)	-0.166*** (-3.789)
Intercept	-0.283 (-1.174)	-0.148*** (-9.905)	-0.119*** (-5.094)	-0.017 (-0.032)	-0.055*** (-5.066)	-0.057* (-1.880)
Observations	1211	1211	1211	668	668	668
R-squared	0.273	0.188	0.168	0.427	0.375	0.351

This Table reports results from between-effects (BE), Fama-MacBeth (FMB) and pooled OLS (OLS) regressions using the notional amount of FX derivative holdings scaled by total assets as the dependent variable and a set of firm characteristics as the explanatory variables. Results are reported separately for net exporters and net importers. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using conventional (1 and 4), Newey-West (2 and 5) and robust (3 and 6) standard errors, respectively.

Table 7

FX derivatives ratio: fundamental firm characteristics, managers' compensation and personal characteristics

	Between-effects regression		Fama-MacBeth regression		Pooled OLS regression	
Variable name	(1)	(2)	(3)	(4)	(5)	(6)
Foreign sales/ total sales	0.054 (1.500)	0.061* (1.704)	0.068*** (8.241)	0.074*** (10.605)	0.060*** (3.628)	0.065*** (3.877)
Foreign purchases/ total sales	0.046*** (3.309)	0.045*** (3.232)	0.050** (3.131)	0.049** (3.141)	0.054*** (3.633)	0.053*** (3.634)
Size (log of total assets)	0.018*** (3.178)	0.017*** (3.073)	0.020*** (10.715)	0.020*** (9.065)	0.018*** (8.751)	0.018*** (8.821)
Debt ratio	0.007 (0.113)	0.005 (0.094)	0.005 (0.181)	0.003 (0.116)	0.019 (1.119)	0.013 (0.772)
Quick ratio	-0.002 (-0.149)	-0.003 (-0.280)	0.003 (0.799)	0.003 (0.756)	-0.000 (-0.011)	-0.001 (-0.362)
R&D intensity	-0.040 (-0.241)	-0.061 (-0.367)	-0.110*** (-4.162)	-0.119*** (-4.278)	-0.104** (-2.303)	-0.114** (-2.536)
CFO variable compensation	0.052 (0.865)	0.064 (1.064)	0.060*** (3.649)	0.062*** (3.751)	0.056*** (3.079)	0.060*** (3.228)
MALE	0.100 (1.468)	0.093 (1.363)	0.038*** (4.356)	0.032*** (4.354)	0.056*** (5.143)	0.049*** (4.657)
AGE	0.003* (1.833)	0.003* (1.786)	0.001** (2.433)	0.001 (1.476)	0.002*** (3.239)	0.001*** (2.838)
TENURE	-0.001 (-0.398)	-0.002 (-0.767)	0.000 (1.267)	0.000 (1.145)	-0.000 (-0.211)	-0.000 (-0.448)
COMPANIES	-0.016** (-2.432)	-0.018*** (-2.733)	-0.011*** (-4.394)	-0.011*** (-4.852)	-0.013*** (-6.622)	-0.014*** (-6.655)
BUSINESS	0.027 (1.167)		0.026*** (4.635)		0.022*** (3.087)	
MBA		-0.006 (-0.152)		-0.004 (-0.383)		-0.007 (-0.406)
PHD-BUSINESS		-0.038 (-1.543)		-0.022** (-2.403)		-0.022*** (-2.866)
Intercept	-0.567*** (-2.616)	-0.519** (-2.399)	-0.193*** (-12.903)	-0.150*** (-17.948)	-0.243*** (-6.964)	-0.202*** (-6.236)
Observations	1592	1592	1592	1592	1592	1592
R-squared	0.329	0.333	0.235	0.241	0.234	0.234

This Table reports results from between-effects, Fama-MacBeth and pooled OLS regressions using the notional amount of FX derivative holdings scaled by total assets as the dependent variable and a set of firm characteristics and firm managers' compensation and personal characteristics as the explanatory variables. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using conventional (1 and 2), Newey-West (3 and 4) and robust (5 and 6) standard errors, respectively.

Table 8

FX derivatives ratio: fundamental firm characteristics, managers' compensation and personal characteristics

	Industry fixed-effects regression			Firm fixed-effects regression		
Variable name	(1)	(2)	(3)	(4)	(5)	(6)
Foreign sales/ total sales	0.052 (1.128)	0.044 (1.003)	0.052 (1.152)	0.074*** (2.899)	0.027 (1.026)	0.037 (1.378)
Foreign purchases/ total sales	0.045 (1.280)	0.051 (1.520)	0.048 (1.370)	0.113*** (9.069)	0.130*** (9.381)	0.128*** (9.520)
Size (log of total assets)	0.020*** (13.326)	0.018*** (8.019)	0.019*** (8.257)	-0.023*** (-3.634)	-0.034*** (-3.426)	-0.035*** (-3.526)
Debt ratio	-0.019 (-1.095)	0.003 (0.206)	-0.005 (-0.322)	0.013 (0.747)	0.015 (0.716)	0.008 (0.413)
Quick ratio	0.000*** (3.060)	-0.000 (-0.075)	-0.001 (-0.478)	-0.000 (-0.950)	-0.003 (-1.222)	-0.003 (-1.249)
R&D intensity	-0.068** (-2.402)	-0.090*** (-3.344)	-0.097*** (-3.180)	-0.067 (-0.543)	0.078 (0.519)	0.091 (0.612)
CFO variable compensation		0.059*** (3.418)	0.061*** (3.452)		0.079*** (2.901)	0.081*** (3.038)
MALE		0.026*** (5.120)	0.020*** (4.112)		-0.021** (-2.337)	-0.025*** (-2.918)
AGE		0.001*** (4.347)	0.001*** (3.140)		-0.000 (-0.409)	-0.001* (-1.719)
TENURE		-0.000 (-0.210)	-0.000 (-0.548)		0.001** (2.240)	0.001*** (3.438)
COMPANIES		-0.012*** (-9.745)	-0.012*** (-11.377)		-0.004*** (-4.962)	-0.002*** (-4.883)
BUSINESS		0.028*** (8.981)			0.034*** (4.171)	
MBA			-0.019*** (-2.716)			-0.023*** (-2.711)
PHD-BUSINESS			-0.019** (-2.031)			0.002 (0.325)
Intercept	-0.177*** (-6.209)	-0.290*** (-19.427)	-0.236*** (-12.480)	0.127*** (3.534)	0.183*** (3.458)	0.239*** (4.021)
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1879	1592	1592	1879	1592	1592
R-squared	0.253	0.295	0.293	0.063	0.100	0.094

This Table reports results from fixed-effects OLS regressions using the notional amount of FX derivative holdings scaled by total assets as dependent variable and a set of firm characteristics and firm managers' compensation and personal characteristics as explanatory variables, including year fixed-effects. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using robust standard errors according to Driscoll and Kraay (1998).

Table 9

Propensity score matching

Panel A: firm characteristics

	Mean (treated)	Mean (control)	Difference	T-Statistics	No. Obs.
Business education	0.096	0.069	0.027***	2.74	1,342
MBA	0.117	0.126	-0.009	-0.36	85
PhD in business	0.087	0.111	-0.024**	-1.88	332

Panel B: firm characteristics and industry effects

	Mean (treated)	Mean (control)	Difference	T-Statistics	No. Obs.
Business education	0.116	0.067	0.049***	3.08	884
MBA	0.091	0.133	-0.042	-1.17	46
PhD in business	0.086	0.129	-0.043***	-2.88	235

This Table reports the results from propensity score matching procedure by comparing the notional amount of FX derivative holdings scaled by total assets. In Panel A, the propensity score is estimated using fundamental firm characteristics, i.e. foreign activity, firm size, debt ratio, quick ratio, R&D intensity. The difference between the propensity scores of the matched firm-years is required to be less than 0.1% in absolute terms. In Panel B, the observations are additionally matched within the particular industry group. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 10

Corporate speculation: ML estimation

FX derivatives ratio	Model 1		Model 2	
	(1)	(2)	(3)	(4)
Foreign sales/ total sales	0.082** (2.540)	0.079** (2.379)	0.094*** (2.920)	0.088*** (2.694)
Foreign purchases/ total sales	-0.018 (-1.063)	-0.020 (-1.193)	-0.018 (-1.255)	-0.021 (-1.310)
Size (log of total assets)	-0.009 (-1.248)	-0.013 (-1.630)	-0.008 (-1.593)	-0.009 (-1.576)
Debt ratio	-0.027 (-1.460)	-0.029 (-1.448)	-0.029 (-1.604)	-0.031* (-1.648)
Quick ratio	-0.003 (-1.458)	-0.003 (-1.581)	-0.003 (-1.573)	-0.003* (-1.677)
R&D intensity	-0.110 (-0.892)	-0.074 (-0.686)	-0.104 (-0.821)	-0.095 (-0.777)
Intercept	0.060 (1.240)	0.087* (1.651)	0.003 (1.105)	0.004 (1.308)
Firm fixed-effects	Yes	Yes	No	No
Year fixed-effects	Yes	Yes	Yes	Yes
Variance of residuals				
CFO variable compensation	1.826** (2.197)	1.986** (2.444)	0.642 (1.369)	0.885* (1.903)
MALE	0.531 (0.480)	0.723 (0.706)	0.228 (0.272)	0.300 (0.412)
AGE	0.007 (0.288)	-0.006 (-0.240)	0.016 (0.825)	0.009 (0.476)
TENURE	0.064* (1.791)	0.040 (1.074)	0.028 (1.058)	0.016 (0.607)
COMPANIES	-0.131 (-1.268)	-0.137 (-1.271)	-0.113 (-1.283)	-0.109 (-1.249)
BUSINESS	0.446 (1.056)		0.142 (0.458)	
MBA		-1.104* (-1.856)		-0.898** (-2.020)
PHD-BUSINESS		-0.674** (-2.158)		-0.505** (-2.246)
Intercept	-8.524*** (-5.037)	-7.396*** (-4.808)	-7.756*** (-5.902)	-7.239*** (-5.910)
Industry fixed-effects	Yes	Yes	Yes	Yes
Observations	1592	1592	1592	1592
R-squared (McFadden)	-1.489	-1.509	-0.077	-0.085

This Table shows the results from estimating Model 1 and Model 2 via maximum likelihood. Z-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using cluster-robust standard errors.

Table 11

Corporate speculation: Two-step estimation procedures

Variable name	(1)	(2)	(3)	(4)
CFO variable compensation	0.006 (1.347)	0.007 (1.429)	0.007 (1.139)	0.009 (1.327)
MALE	0.001 (0.431)	0.001 (0.454)	0.010** (1.988)	0.008* (1.711)
AGE	0.000 (0.776)	0.000 (0.779)	0.000* (1.902)	0.000* (1.896)
TENURE	0.000 (0.129)	-0.000 (-0.110)	-0.000 (-1.108)	-0.000 (-1.651)
COMPANIES	-0.001 (-1.587)	-0.001 (-1.628)	-0.001 (-1.411)	-0.001* (-1.791)
BUSINESS	-0.000 (-0.129)		-0.001 (-0.275)	
MBA		-0.001 (-0.536)		-0.000 (-0.046)
PHD-BUSINESS		-0.003* (-1.898)		-0.006** (-2.378)
Intercept	-0.007 (-1.318)	-0.005 (-1.025)	-0.024* (-1.668)	-0.023 (-1.510)
Industry fixed-effects	Yes	Yes		
Observations	1592	1592	203	203
R-squared	0.058	0.059	0.029	0.040

This Table reports the results from two robustness checks for the relationships between manager personal characteristics and speculation. Columns (1) and (2) report the results from industry fixed-effects regression using the square of the residuals obtained from a first-stage firm fixed-effects regression (of the notional amount of FX derivative holdings scaled by total assets on the fundamental firm characteristics) as the dependent variable, and managers' compensation and personal characteristics as the explanatory variables. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using cluster-robust standard errors. Columns (3) and (4) report the results from cross-sectional regression using the variance of each firms' residuals obtained from a first-stage firm fixed-effects regression (of the notional amount of FX derivative holdings scaled by total assets on the fundamental firm characteristics) as the dependent variable and managers' average compensation and average personal characteristics as the explanatory variable. T-statistics are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively, using robust standard errors.

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