Owners' portfolio diversification and firm investment: Evidence from public and private firms *

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Abstract

We examine the effects of portfolio diversification of controlling owners on firms' capital investment using a large sample of private and public firms. We find that investment of public firms, which tend to be relatively financially unconstrained, is positively related to their owners' portfolio diversification. This relation is economically sizable and is not driven by omitted owner characteristics, selection of firms by owners, reverse causality, or endogeneity of firms' mode of incorporation. For private firms, which tend to be relatively financially constrained, the relation between owners' portfolio diversification and firm investment is significantly weaker. This suggests that relatively constrained firms may not operate at their first-best investment levels and may be unable to significantly alter their capital investment in response to changes in their controlling owners' portfolio diversification. Our results show that owners' portfolio diversification is an important determinant of firms' investment strategies, and that the effect of owners' diversification on investment depends crucially on the degree of financial constraints that firms face.

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1 Introduction

The vast majority of firms are controlled by imperfectly diversified owners (e.g., Benartzi and Thaler (2001), Moskowitz and Vissing-Jørgensen (2002), Agnew, Balduzzi and Sunden (2003), Heaton and Lucas (2004), Faccio, Marchica and Mura (2011), and Thesmar and Thoenig (2011)).[1] Imperfect diversification of a firm's decision maker's portfolio negatively impacts her willingness to take risks, as Rotschild and Stiglitz (1971) noted over 40 years ago. One of the most important channels through which decision makers can affect their firms' risk taking and the resulting variability of firms' cash flows is investment strategy (e.g., Kothari, Laguerre and Leone (2002) and Anderson, Duru and Reeb (2012)).[2] As a consequence, a firm controlled by a well-diversified owner would undertake positive-NPV projects, including relatively risky ones. On the contrary, a firm controlled by a less diversified owner may reject positive-NPV but risky projects. It is surprising that the impact of portfolio diversification of firms' controlling owners on their firms' capital investment has not received much attention in the empirical literature.[3] In this paper, we attempt to fill this gap.

Extensive literature on corporate investment has documented, both theoretically and empirically, that a firm's access to capital (i.e. financial constraints) significantly shapes its investment decisions (e.g. Hubbard (1998), Stein (2003), and Hadlock and Pierce (2010)). Consequently, financial constraints are also likely to affect the relation between firm owner's portfolio diversification and her firm's capital investment. A relatively unconstrained firm can easily increase its investment in response to higher owner's portfolio diversification. On the other hand, a relatively constrained firm may not operate at its first-best investment level and may be unable to significantly alter its capital investment in response to

[1] This lack of diversification may be due to corporate control (e.g., Demsetz and Lehn (1985)), costly information acquisition (e.g., Van Nieuwerburgh and Veldkamp (2010)), and/or asymmetric information (e.g., Gaspar and Massa (2007) and Goetzmann and Kumar (2008)).

[2] Additional important channels through which decision makers may influence their firms' cash flow variability are operating strategy (e.g., Rothschild and Stiglitz (1971) and Chod and Lyandres (2011)) and capital structure and payout policy (e.g., Chen, Miao and Wang (2010)). Analyses of the effects of owners' portfolio diversification on firms' operating strategies and capital structure and payout choices are subjects of an ongoing research.

[3] The effects of owners' portfolio diversification on firm valuation has received substantially more attention (e.g., Chemmanur and Fulghieri (1999), Benninga, Helmantel and Sarig (2005), Bodnaruk, Kandel, Massa and Simonov (2008), Pastor, Taylor and Veronesi (2009), Chen, Miao and Wang (2010), and Chod and Lyandres (2011)).

an increase in its owner's portfolio diversification. Thus, we expect to observe a positive relation between firms' capital investment and their owners' portfolio diversification for firms facing relatively low financial constraints. We expect the relation between owners' diversification and firms' investment to be weaker for more financially constrained firms.

A key to our empirical analysis is a proxy for owners' portfolio diversification. A measure of an owner's diversification is nearly impossible to obtain from standard (U.S.) data sources. Thus, we turn to a data source that allows us to reconstruct significant portions of firms' controlling owners' portfolios – Bureau Van Dijk's Amadeus Top 250,000 database, which contains comprehensive accounting and ownership data for the universe of European firms satisfying certain size requirements.

To build measures of firm owner's portfolio diversification, we identify all shareholders of each firm in the sample while accounting for ownership pyramids, and define the controlling owner as the ultimate shareholder having the largest proportion of voting rights in the firm. We then reconstruct large parts of the controlling owner's equity portfolio. Using the composition of each controlling owner's portfolio, we construct three measures of portfolio diversification, following Faccio, Marchica and Mura (2011). The first measure is the number of companies (across the entire Amadeus database) in which the controlling shareholder holds any stake. The second measure is the Herfindahl index of her portfolio holdings. The third measure is based on the estimated correlation between the controlled firm's equity return and controlling owner's portfolio return.

In addition to enabling us to construct measures of owners' portfolio diversification, Amadeus data has two further advantages. First, it covers both publicly-traded and privately-held firms. Following Farre-Mensa and Ljungqvist (2014), we use the private/public status as a measure of a firm's financial constraints. Farre-Mensa and Ljungqvist (2014) show that public firms appear to behave in ways consistent with being financially unconstrained, whereas private firms seem to behave as if they were constrained. They argue that traditional measures of financial constraints fail to identify (publicly-traded U.S.) firms that behave as if they were constrained. The use of firms' mode of incorporation as a proxy for financial constraints is also supported by a vast literature showing that public firms tend to have cheaper access to external funds than private ones (e.g., Pagano, Panetta and Zingales (1998), Derrien and Kecskés (2007), Brav (2009), Hsu, Reed and Rocholl (2010), Schenone (2010), and Saunders and

Steffen (2011)).[4]

Second, examining capital investment of private firms is important in its own right because of the role private firms play in the economy. Privately-held companies are responsible for over 70% of total investment in fixed assets and of revenues of all European firms.[5] Disclosure requirements obligate European private companies to publish both ownership and accounting information annually, therefore we are able to access these data for a very large set of firms. As a result, 96% of the observations in our sample correspond to privately-held firms.

Public (unconstrained) firms' capital investment is positively related to their owners' portfolio diversification – a one standard deviation increase in diversification is associated with a 7%-8% increase in capital investment rate, whereas the association between owners' portfolio diversification and investment is much weaker and, in most cases, close to zero or even negative for private (more constrained) firms. These findings are consistent with the hypothesized relation between owners' portfolio diversification and their firms' investment. In particular, a better-diversified owner, who is less concerned with her firm's cash flow volatility would be more prone to accepting positive-NPV but risky projects that her firm has access to. If a firm is relatively financially unconstrained, this leads to a positive relation between owner's portfolio diversification and firm investment, which is close to the level preferred by its owner. On the other hand, if a firm is relatively constrained, its investment level is also partially determined by the availability of external financing, leading to a weaker or nonexistent relation between owner's portfolio diversification and firm investment.

To address the possibility that omitted unobserved owner characteristics may determine simultaneously the degree of owners' portfolio diversification and firms' investment decisions, we include owner fixed effects, which capture time-invariant owner characteristics (e.g., utility function, risk aversion). The results show that *changes* in capital investment of public firms are more sensitive to *changes* in their

[4]The reason is that information asymmetry surrounding public firms is lower than that around private ones (e.g., Benveniste and Spindt (1989), Dow and Gorton (1997), and Derrien and Kecskés (2007)). Lower information asymmetry results in lower costs of external financing, i.e. weaker financial constraints (e.g., Myers and Majluf (1984) and Fazzari, Hubbard and Petersen (1988)).

[5]Asker, Farre-Mensa and Ljungqvist (2015) document that private firms play an important role in the U.S. as well, accounting for over 50% of aggregate non-residential fixed investment and of sales. Further, Marchica and Mura (2013) report that worldwide, employment by private firms accounts for 86% of total non-government employment.

owners' portfolio diversification than changes in investment of private firms.

Our fixed-effects results may still be affected by self-selection: better diversified owners may self-select to invest in companies with higher investment rates, which better suit their risk preferences. To address the selection issue, we employ a quasi-natural experiment. In particular, we analyze cases in which a firm's owner increases her portfolio diversification by investing in an additional firm (an acquisition event). While acquiring a stake in a firm is clearly an endogenous decision, such an acquisition should not affect capital investment of the other firms in the owner's portfolio unless owner's portfolio diversification has implications for firms' investment strategies. Indeed, we observe that, following an acquisition, there is a significant increase of about 4 percentage points in mean investment-to-assets ratio of public firms controlled by diversifying owners, which corresponds to almost 40% increase in investment relative to pre-acquisition levels. On the other hand, private companies controlled by diversifying owners experience a small decrease in their mean investment-to-assets ratio of about 0.6 percentage points. This result is consistent with capital investment of relatively financially unconstrained firms being affected by changes in owners' portfolio diversification more than that of relatively constrained firms.

To control for a potential feedback effect from firms' investment decisions to their owners' portfolio diversification (reverse causality) we use an instrumental variables approach. In particular, we instrument owner's portfolio diversification with the geographical distance between the owner and her country's stock market. This instrument is based on the findings in Goetzman and Kumar (2008) that investors' under-diversification is associated with the severity of home bias, which, in turn, is higher for investors located far from the stock markets (e.g., Zhu (2003) and Grinblatt and Keloharju (2001)). The sensitivity of firms' capital investment to their proximity to a stock exchange, which instruments for portfolio diversification, is positive for public companies and close to zero for private ones, consistent with our hypothesis that investment of relatively unconstrained firms depends more on their owners' portfolio diversification than investment of relatively constrained ones.

Owners' portfolio diversification is not the only potential source of endogeneity. An additional concern is that a firm's mode of incorporation is not random. To address the endogeneity of firms' public/private status, we adopt two strategies. First, we document that our results hold in a matched sample, in which we use propensity score matching procedure to find for each public firm a private counterpart along

multiple dimensions. Second, we employ a Heckman-type two-stage selection model, in which we first model firms' decision to be publicly-traded or privately-held and then re-estimate the relations between owners' portfolio diversification and firms' investment, while controlling for the self-selection of firms' mode of incorporation. The results remain consistent with our baseline findings.

We perform a battery of additional tests to examine the robustness of our results to potential measurement errors. First, our findings are robust to using alternative measures of investment. Second, they are not driven by the possible separation of firm ownership and control due to prevalence of dual-class shares in some countries, and by potential agency conflicts stemming from this separation. Third, the results are unlikely to be due to potential measurement errors in our portfolio diversification proxies. Finally, our findings are not due to potentially subpar accounting and reporting standards in some countries.

While we expect private firms to be on average more financially constrained than public ones, the two types of firms may be different along dimensions other than financial constraints. Therefore, we use an alternative proxy – a modified Campello and Chen's (2010) financial constraints index – which is not based on the firms' mode of incorporation. Consistent with previous results, we find that the sensitivity of firms' investment to their owners' portfolio diversification is monotonically decreasing in the severity of financial constraints.

To summarize, the contribution of our paper is twofold. First, we provide novel evidence on the role played by owners' portfolio diversification on corporate investment. We show that the relation between a firm's capital investment and its owner's portfolio diversification depends crucially on the firm's degree of financial constraints. Owners' diversification has a significantly positive impact on their firms' capital investment, but only for relatively financially unconstrained firms.

Second, our paper contributes to a small but growing empirical literature that examines differences between public and private firms' decisions. In particular, previous studies that investigate differences in public and private firms' capital investment find contrasting results. Similar to us, Mortal and Reisel (2013) document that European public firms tend to invest more than private ones. On the other hand, Asker, Farre-Mensa and Ljungqvist (2015) and Sheen (2011) report that private firms in the U.S. invest more than public ones and attribute this finding to more severe agency costs within public firms. Our findings suggest that owners' portfolio diversification is an important and so far overlooked driver of

firms' investment decisions.

Our results have potentially relevant policy implications, given the crucial role in the economy played by private firms. Our findings suggest that to improve the allocation of capital and foster economic growth through capital investment, policy makers should not only improve firms' access to capital, but also reduce barriers to firm owners' portfolio diversification.

The remainder of the paper is organized as follows. The next section describes the data and variable construction. In Section 3 we study the relation between private and public firm owners' portfolio diversification and firms' capital investment. Section 4 concludes.

2 Data and variables

2.1 Sample

The data used in our paper are assembled from Amadeus Top 250,000. Amadeus is maintained by Bureau Van Dijk Publishing and covers European public and private companies. From this database we gather ownership and accounting information for every European publicly-traded firm and also for all privately-held companies that satisfy a minimum size threshold. For France, Germany, Italy, Spain, and the United Kingdom, the database includes all companies that meet at least one of the following criteria: (1) revenues of at least €15m, (2) total assets of at least €30m, (3) at least 200 employees. For other countries, the database includes all companies that meet at least one of the following criteria: (1) revenues of at least €10m, (2) total assets of at least €20m, (3) at least 150 employees.[6] Disclosure requirements in Europe obligate private companies to publish annual information. Consequently, we are able to gather accounting and ownership information for a very large set of firms.[7]

We collect the data from the Amadeus Top 250,000 DVDs using the April issue of each year during the period 1999-2010. Information is typically incomplete for the year that just ended. Further, Amadeus

[6] Amadeus data are being used by an increasing number of scholars and policy-making institutions. Previous studies have checked the accuracy of Amadeus data with respect to representation of the population (e.g., Arellano, Bai, and Zhang (2012) and Bena and Ortiz-Molina (2013)) and accounting and ownership data (e.g., Faccio, Marchica, and Mura (2011) and Marchica and Mura (2013)).

[7] In Bosnia and Herzegovina, Germany, Macedonia, Netherlands, Portugal, Serbia, and Switzerland not all companies comply with the filing requirements, while in Austria the disclosure of financial information covers fewer items than elsewhere.

removes firms from the database five years after they stop reporting financial data.[8] In order to avoid biases related to both survivorship and incomplete information, we ensure that no firm-year observations are dropped from the sample because of delisting. We do so by collecting accounting data starting with the 2012 DVD and progressively moving backwards in time, each year collecting data on firms that were alive in that year. By doing so, we ensure that no firms are dropped from the sample. We gather accounting data for all firms having data available for the relevant variables for at least one year during the period 1999-2010.

In addition to accounting data, for all firm-years in our sample we collect direct ownership data. In doing so, we follow Faccio, Marchica and Mura (2011). In particular, in each DVD the information on ownership is only given as of the current year. Therefore, we collect these data one year at a time for each DVD. Indirect (pyramidal) ownership is quite common in our sample (e.g., de Jong, DeJong, Hege and Mertens (2012)). Thus, for each company that has available ownership data, we identify first all ultimate shareholders, while removing shareholders that are only generally identified in Amadeus. That is, in cases in which a direct shareholder of a firm is another firm, we identify its owners, the owners of its owners, and henceforth until we cannot trace back any further. We trace back pyramids of any length without imposing any cut-off threshold. Following Claessens, Djankov and Lang (2000), Faccio and Lang (2002) and Faccio, Marchica and Mura (2011), we calculate cash flow rights of each ultimate shareholder as the product between the links along the ownership chain; and her control rights as the weakest link along the chain. After tracing each ownership stake to its ultimate shareholders, we call the shareholder controlling the largest fraction of voting rights in each firm the firm's largest ultimate shareholder. We exclude all firms in which the government is a shareholder, as these firms may have objectives other than value maximization. After combining accounting and ownership information, we end up with the final sample of 528,110 firm-year observations for 162,688 unique firms across 34 European countries.

An important implicit assumption in our analysis is that a firm's largest ultimate shareholder is the decision maker on the firm's behalf. We base this assumption on several pieces of evidence. First, we observe that the average largest shareholder holds 62% of the cash flow rights and 63% of the voting rights in her company. Second, we exploit the information on the full names of directors in each company

[8]These drawbacks are also discussed in Popov and Roosenboom (2009), Marchica and Mura (2013), and Klapper, Leaven and Rajan (2012).

available in Amadeus. For a random sample of 5% of public and private firms we check whether the controlling owner (or a member of her family) sits on the board of the controlled company. We find that controlling owners that we identify sit on their firms' boards in more than half the cases or have their relatives (i.e. people with the same last names) sitting on firms' boards in additional 11% of the cases. Further, ultimate controlling shareholders act as their firms' CEOs in about 30% of the cases. Taken together, this evidence is consistent with our presumption that ultimate controlling shareholders have a significant say in their firms' investment decisions.

2.2 Variables

Dependent variable

The dependent variable is *Investment-to-assets* ratio, defined as the year-to-year change in gross fixed assets divided by lagged total assets. Total assets are computed as the sum of fixed and current assets. To reduce the impact of outliers, the investment-to-assets ratio is winsorized at the top and bottom 1% of its distribution.

Measures of owner's portfolio diversification

We follow Faccio, Marchica and Mura (2011) in constructing our measures of portfolio diversification. Our first measure of a firm's owner's portfolio diversification is *Ln(number of firms)*, defined as the natural logarithm of the total number of firms in which the owner holds shares, directly or indirectly, in a given year, across all countries in our sample. This measure is commonly used as a proxy for portfolio diversification (e.g., Barber and Odean (2000) and Goetzman and Kumar (2008)). The motivation behind this measure is that diversification is increasing in the number of stocks in investor's portfolio. While this measure of portfolio diversification is admittedly crude, it has an important advantage of not requiring any information regarding the distribution of stock returns, which is particularly important in our sample that consists mostly of privately-held firms.

Our second measure of portfolio diversification, *1–Herfindahl index*, is also commonly used (e.g., Bodnaruk, Kandel, Massa and Simonov (2008) and Goetzman and Kumar (2008)). To compute the Herfindahl index of firm owner's holdings, we first calculate the dollar value of her investment in each firm in her portfolio as the book value of the company's equity multiplied by the shareholder's ultimate

ownership stake in the firm. We use book equity instead of market equity because our sample consists predominantly of private firms. We then compute the weight of each stock in the owner's portfolio. The Herfindahl index of portfolio holdings is the sum of these squared weights. In the analysis, we use one minus the Herfindahl index to make the interpretation of the coefficients comparable to the number-of-firms-based measure. The advantage of using a value-weighted measure, such as one minus the Herfindahl index, over an equally-weighted measure based on the number of firms, is that it reduces the potential downward bias in a portfolio diversification measure, which follows from small holdings in non-controlled firms.

Our third measure of portfolio diversification is *–Correlation*, defined as the correlation between the mean stock return of public firms in the firm's industry and the shareholder's overall portfolio return, multiplied by -1, as in Bodnaruk, Kandel, Massa and Simonov (2008) and Faccio, Marchica and Mura (2011). This measure of diversification is higher for firm owners whose portfolio returns are less correlated with the returns in the industry in which their firm operates. We use mean industry return as a proxy for stock return of a given firm, which is unavailable for private firms. The drawback of this measure is that it is likely to understate diversification, as returns of two stocks within the same industry are assumed perfectly correlated by construction. An industry (weekly) return is defined as the weekly average return across all publicly traded European firms within a given 3-digit SIC industry. We include only firms that have stock price data available in Datastream. For each controlling owner, weekly portfolio return is computed as the weighted average of returns of individual stocks in her portfolio (or industry returns in cases in which individual stock returns are unavailable), where the weights are based on book equity.

It is important to note that despite the wide coverage of firms in Amadeus, our portfolio diversification measures may be subject to some limitations. First, small ownership stakes as well as positions in companies below the size threshold are not covered in Amadeus and, therefore, are not included in the portfolios. The exclusion of the smallest companies, though, is unlikely to have a major impact on value-weighted portfolio diversification measures. Second, we do not capture non-equity investments, such as investments in bonds and real estate, and, more importantly, we do not capture indirect equity investments. For instance, the exclusion of investments in mutual funds and hedge funds may bias our measures of diversification downwards. To control for this potential bias, we perform a number of

robustness tests, discussed in detail below, which show that the exclusion of non-equity or indirect equity investments has only a limited impact on our findings. Third, we are unable to include equity investments in firms incorporated outside Europe. Thus, we may possibly understate the diversification of investors who are well diversified across continents. However, since investors typically exhibit home bias (e.g., French and Poterba (1991) and Coval and Moskowitz (1999)), the magnitude of this measurement error is likely to be small. Only a very small proportion of European firms' controlling owners hold larger-than-5% shares of equity in non-European firms (e.g., Faccio, Marchica and Mura (2011)). In addition, Fons-Rosen, Kalemli-Ozcan, Sørensen,Villegas-Sanchez and Volosovych (2013) show that the presence of foreign ownership is not widespread worldwide: only 4% (3%) of European (U.S.) companies have non-zero foreign ownership.

Control variables

Sales growth is used as a proxy for investment opportunities, as an available substitute for Tobin's q, which is the usual measure of investment opportunities (e.g., Kaplan and Zingales (1997) and Cleary (1999)). We use sales growth instead of Tobin's q, since the latter is unavailable for private firms. In addition, Erickson and Whited (2000), Gomes (2001), and Alti (2003) show that there may be a measurement error in estimated average Tobin's q, which may bias coefficient estimates in investment regressions. Sales growth is defined as the annual relative growth rate in total revenues. As sales growth exhibits large positive skewness, it is winsorized at the bottom 1% and at the top 5% of its distribution.

Cash flow, which was shown to be related to investment (e.g., Fazzari, Hubbard and Petersen (1988), Kaplan and Zingales (1997), and Erickson and Whited (2000)) is the ratio of income plus depreciation to beginning-of-year total assets.

Firm age was shown to be related to investment opportunities, as investment opportunities of mature firms may be different from those of young firms (e.g., Anderson and Reeb (2003)). Firm age is defined as the number of years since a firm's incorporation. Because of its skewness, we winsorize age at the top 1% of its distribution and use $\ln(1 + age)$.

3 Owners' portfolio diversification and firm investment

3.1 Descriptive statistics

Table 1 reports the descriptive statistics for our sample that includes over half million firm-year observations from 1999 to 2010.

Insert Table 1 here

As evident from Panel A, the most represented countries in our sample are: United Kingdom (23.36%), France (20.31%), Spain (11.37%), and Italy (8.98%). In almost all countries (with the exception of Liechtenstein, Macedonia, and Russia) we have at least 100 observations. The vast majority of firms are privately-held (95.9%).

Panel B reports descriptive statistics at firm level of the dependent variable (investment-to-assets ratio), main independent variables, and control variables. The first three columns report full-sample statistics, which are followed by those for subsamples of public and private firms separately. On average, public companies have significantly higher investment-to-assets ratios than private firms: mean (median) investment rate of public firms is 10.9% (6.1%), compared with 6.9% (3.1%) for private firms. This result is consistent with the evidence in Mortal and Reisel (2013), obtained using a sample of Western European firms. This evidence is also in line with the view that public firms tend to be less financially constrained than private ones.[9]

Average (median) values of all portfolio diversification measures are significantly different between public and private firms. The ultimate largest shareholder in our sample holds on average 21 firms in her portfolio (20 for private firms and 42 for public ones).[10] However, the median number of firms in the largest shareholder's portfolio is 2 (4 for public firms). Thus, a typical largest shareholder is only moderately diversified. This evidence is consistent with Faccio, Marchica and Mura (2011) in a similar sample and with the evidence reported in Barber and Odean (2000), Moskowitz and Vissing-Jørgensen (2002), and Goetzman and Kumar (2008) in the U.S. market, and with Karhunen and Keloharju's (2001)

[9]Interestingly, this evidence differs from the results in Asker, Farre-Mensa and Ljungqvist (2015), who show that in the U.S. publicly-traded firms invest less than matched private firms.

[10]Note that these statistics are reported at firm-year level. At owner-year level (when each firm owner is counted once each year regardless of the number of firms she controls), the average number of firms in a portfolio is 4 in the full sample.

evidence in the Finnish market. Portfolio diversification exhibits large heterogeneity. For instance, 42% of largest ultimate shareholders hold more than two companies in their portfolios, 10% of them hold at least 5 companies, and 0.5% of controlling shareholders hold at least 50 companies in their portfolios. Mean (median) 1-Herfindahl Index of holdings of private firms is 33% (26%), compared with 42% (46%) for public firms, consistent with public firm owners being better diversified than private firm owners, although heterogeneity in portfolio diversification is exhibited by private firm owners too. Similarly, mean correlation between private firm owners' portfolio returns and the returns in the industry in which the controlled firm operates is 81%, compared with 73% for public firm owners. As for additional, non-diversification-related variables, public firms tend to be significantly older and larger, and exhibit significantly larger sales growth.

3.2 Basic regression

We begin by estimating the differential relations between private and public firms' investment on one hand and their owners' portfolio diversification on the other hand:

$$Inv\_to\_assets_{i,t} = \alpha PUB_{i,t} + \beta PRI_{i,t} + \gamma(PUB_{i,t} * Diver_{i,t}) + \delta(PRI_{i,t} * Diver_{i,t}) + \overline{\theta X_{i,t}} + Country * IndustryFE + YearFE + u_{i,t}, \quad (1)$$

where $PUB_{i,t}$ ($PRI_{i,t}$) is a indicator variable equalling one if company i is publicly-traded (privately-held) in year t, and equalling zero otherwise; $Diver_{i,t}$ stands for one of our three measures of portfolio diversification (Ln(number of firms), 1-Herfindahl index, and -Correlation); $PUB_{i,t} * Diver_{i,t}$ ($PRI_{i,t} * Diver_{i,t}$) is the interaction variable equalling the product of public (private) firm indicator and one of the diversification measures; $\overline{X_{i,t}}$ is a vector of control variables that includes 1) sales growth, 2) cash flow, and 3) ln(1+age). Following Gormley and Matsa (2014), all regressions include country*3-digit SIC industry and year fixed effects. Standard errors are clustered at the industry-country level.

The columns in Table 2 correspond to the three portfolio diversification measures. $\widehat{\gamma}$ and $\widehat{\delta}$ represent the estimated sensitivities of investment rate to variation in owners' portfolio diversification for public and private firms separately. We also compute the economic impacts of these estimated coefficients. The economic impact is calculated as follows: $\widehat{\gamma}$ ($\widehat{\delta}$) is multiplied by one standard deviation of a portfolio diversification measure. The product is then standardized by the mean of the investment-to-assets ratio.

Table 2 reports results of estimating the regression in (1).

Insert Table 2 here

It is evident from the intercepts in all three specifications (6.8% to 9.7% for public firms and 3.8% to 4.2% for private ones) that public firms invest more than private ones, ceteris paribus. More interestingly, controlling owners' portfolio diversification has significantly different impacts on capital investment of public and private firms. Across all three measures of portfolio diversification, the relation between owners' diversification and their firms' investment-to-assets ratios is positive and significant for publicly-traded firms. The overall impact of portfolio diversification is also economically important for public companies. For example, a one-standard-deviation increase in ln(number of firms) corresponds to an average increase of almost 8% in the investment-to-assets ratio, ceteris paribus. On the other hand, the relation between owners' portfolio diversification and firms' investment is close to zero and economically insignificant for privately-held firms. Finally, consistent with our hypothesis, the difference in the sensitivity of firms' investment to their owners' portfolio diversification between public and private firms is significantly positive across all models, as evident from the p-value for the difference row.

Taken together, these results lend support to our hypothesis. Owners with more diversified portfolios tend to increase their firms' investment levels if the firms face little or no financial constraints. On the contrary, relatively financially constrained firms are not able to operate at their optimal investment levels, leading to a weaker or close-to-zero sensitivity of capital investment to owners' portfolio diversification for such firms.

3.3 Endogeneity of portfolio diversification

One possible concern that arises when one regresses firms' investment rates on measures of their owners' portfolio diversification is that the latter may be determined endogenously. Admittedly, we cannot unequivocally rule out the effects of endogeneity on our results. However, we try to address the endogeneity issue in several ways.

3.3.1 Omitted variable bias: Owner fixed effects

It is possible that in addition to the potential causal effect of owner's portfolio diversification on her firm's investment, owner's unobserved characteristics, such as her utility function or risk aversion, simultaneously affect owner's portfolio diversification and firm's investment. This omitted variable bias could make our estimates in Table 2 biased and inconsistent (e.g., Wooldridge (2002)). To address this concern, we exploit the panel dimension of our database by including in the baseline regressions owner fixed effects, which should capture all time-invariant owner characteristics, and re-estimate the regression in (1).

Insert Table 3 here

In line with our baseline findings, the results in Table 3 show that a positive change in portfolio diversification is associated with a positive change in investment rate for publicly-traded companies. The relation is statistically significant at the 5% level in all three specifications and is economically larger than in the baseline regression in Table 2: a one-standard-deviation increase in measures of portfolio diversification is associated with 10%-12% increase in capital investment rate. Interestingly and surprisingly, the relation between owners' diversification and firms' investment is significantly negative for privately-held firms in two out of three specifications. This relation is somewhat economically sizable: a one standard deviation increase in measures of portfolio diversification is associated with 1%-6% reduction in investment rates of private firms. The difference in the sensitivity of investment to owner's diversification between public and private firms is significantly negative, consistent with the hypothesis that relatively financially unconstrained firms can more easily adjust their investment in response to changes in their owners' portfolio diversification.

3.3.2 Owner self-selection: Acquisitions

An additional concern related to firm owners' choices could be that more diversified owners may select to invest in companies with higher investment rates that suit better their own preferences towards risk, rather than directly affect investment decisions of these companies. If this is the case, then the causality would run from firms' investment to owners' portfolio diversification, and not the other way around.

To address possible self-selection, we use the event of acquisitions as instances of a change in the composition of an owner's portfolio, and examine subsequent changes in investment rates of public and

private firms controlled by that owner. This test is close in spirit to the one in Faccio, Marchica and Mura (2011). Acquiring an equity stake in a company is obviously an endogenous decision. However, if an investor is simply acquiring a firm with investment characteristics that suit her risk preferences, then we should observe no change in capital investment of the *other* existing firms in her portfolio following the acquisition of a new firm.

To perform this analysis, we first identify controlling owners who experience a net increase in the number of firms in their portfolios. Among these, we focus on acquisitions that account for at least 50% of pre-acquisition portfolio value and that are, therefore, likely to have a substantial impact on the diversifying owners' portfolio structure. We identify 8,867 such instances. We then require: 1) the *existing* firms controlled by the owner to have information on the investment-to-assets ratio before and after the acquisition; and 2) these existing firms to maintain the same private/public status before and after the acquisition to avoid possible confounding effects. We end up with a final sample of 2,357 private and 97 public companies.

As Table 4 shows, an acquisition event indeed increases (mechanically) controlling owner's portfolio diversification.

Insert Table 4 here

If firms' controlling owners influence corporate investment decisions, then we should observe a change in the investment-to-assets ratio of existing firms controlled by the owner. In particular, we expect to observe an increase in investment rates of existing public firms, which are likely to be relatively financially unconstrained, while we do not necessarily expect to see an increase in investment of existing private (more constrained) firms in the diversifying owners' portfolios. Consistent with this logic, Table 4 demonstrates that there is an increase following an acquisition in the mean investment-to-assets ratio of public firms controlled by diversifying owners, of about 4 percentage points (or close to 40% of mean pre-acquisition investment-to-assets ratio), which is significant at 10% level. On the other hand, existing private companies in the diversifying owner's portfolio experience a slight decrease in investment of about 0.6 percentage points following an acquisition. Both findings are consistent with the regression results in Tables 2 and 3.

3.3.3 Reverse causality: Instrumental variables analysis

Although panel estimates with shareholder fixed effects and the event of acquisitions partially address both the omitted variable bias and the potential endogeneity of owners portfolio composition, there may still be a feedback effect present from a firm's investment decisions to its owner's portfolio diversification. To address this issue we employ an instrumental variable approach as an alternative way to capture the part of owners' portfolio diversification that is arguably independent of their controlled firms' investment decisions. In particular, we use the *geographical distance* between the owner's location and the stock market of the country in which she is based as an instrument for her portfolio diversification.

The choice of this instrument is based on evidence regarding biases that shape individual and institutional investors' strategies. On one hand, home bias is inversely associated with the degree of investors' portfolio diversification (e.g., Goetzmann and Kumar (2008)). That is, the level of under-diversification of individual investors is greater among those who invest locally. On the other hand, home bias is lower for investors located closer to the stock markets (e.g., Grinblatt and Keloharju (2001) and Zhu (2003)). Based on these two pieces of evidence, we argue that the degree of portfolio diversification is inversely related to firm owners' geographical distance from the stock markets. That is, high density of finance-related professionals around stock market areas is likely to help firm owners increase their portfolio diversification.

Importantly, the exclusion restriction in our setting – i.e. that the distance to the country's stock market does not have a direct effect on firms' investment decisions through its effect on the availability of external finance – is likely to be satisfied. For privately-held firms, the crucial determinant of the availability of external finance is their proximity to local banks (e.g., Alessandrini, Presbitero, and Zazzaro (2009) and Agarwal and Hauswald (2010)), which tend to be more geographically dispersed than stock markets. For publicly-traded firms, external financing is readily available in public markets regardless of the firms' physical distance from them.

Our instrument is constructed in the following manner. For each controlling owner we collect information on her location using the postal code provided by Amadeus and find its latitude and longitude. Similarly, for each country we identify the location of its main stock market area. We then calculate the spherical distance $d_{j,c}$ between each shareholder j and the stock market of country c, where she is based,

using the following formula:

$$d_{j,c} = \arccos(\cos(lat_j) * \cos(lon_j) * \cos(lat_c) * \cos(lon_c)$$
$$+ \cos(lat_j) * \sin(lon_j * \cos(lat_c) * \sin(lon_c) + \sin(lat_j) * \sin(lat_c)) * r, \quad (2)$$

where lat and lon refer to the latitude and longitude in radians and r is the radius of Earth in miles. In cases in which a country has more than one stock market area (i.e. Denmark, Germany, Russia, Spain and Switzerland), we use the distance from the closest market. We are able to estimate the geographical distance to the stock market for 82,726 unique owners, corresponding to 258,324 firm-year observations. Half of firm owners are located less than 70 miles away from the stock market of their country.

In the first stage, we regress firm owner's portfolio diversification on the geographical distance between the firm owner and her country's stock market, along with all exogenous variables and (3-digit SIC) industry, country, and year fixed effects.[11] In the second stage, we employ the predicted values of owner's portfolio diversification and its interaction with private/public status and estimate the relation between the investment-to-assets ratio and the instrument for owner's portfolio diversification interacted with the firm's public/private indicators.

In Panel A of Table 5 we report the second stage estimates.

Insert Table 5 here

The relation between capital investment rate and our instrument for owner's portfolio diversification is positive and significant for public firms. The relation for private firms, while statistically significant, is economically weaker than that for public firms.

For brevity, in Panel B we report only the estimates of the geographical distance from the first stage regressions and their associated F-statistics. The instrument of geographical distance is significantly correlated with portfolio diversification across all models, and the F-statistics suggest that this is not a weak instrument, as discussed in Staiger and Stock (1997).

[11] Since in our tests portfolio diversification is interacted with the private/public indicator, it is possible that this interaction term is also endogenous. Therefore, following Wooldridge (2010) we use the product between geographical distance and the private/public indicator as an instrument for that interaction term and we estimate an additional first-stage model in which we regress the interaction term on its corresponding instrument along with all other exogenous variables. For brevity, we only show the first-stage regressions with portfolio diversification as dependent variable.

3.4 Self-selection of the mode of incorporation

The previous subsection focused on addressing potential endogeneity of firm owners' portfolio diversification. The second potential source of endogeneity is firms' mode of incorporation. Descriptive statistics in Panel B of Table 1 show that subsamples of public and private companies differ significantly across all independent variables. Thus, it is important to examine whether and to what extent our results are potentially affected by firms' self-selection into the public and private modes of incorporation. We address this issue in two ways.

3.4.1 Matched sample

First, we repeat our tests within a sub-sample of public firms matched with private firms. We use the propensity score matching procedure to find for each public firm a possible match within the subsample of private firms (e.g., Rosenbaum and Rubin (1983) and Michaely and Roberts (2012)). To implement this methodology, we calculate the probability (e.g., the propensity score) of being a public firm. This probability is computed within a country-industry-year category, as a function of all firm characteristics that we include in the baseline model. To ensure that the two groups of firms are sufficiently similar, we require that the maximum difference between the propensity score of a public firm and that of its matching peer does not exceed 0.1% in absolute value. We then re-estimate the regressions in (1) within the matched sample. The results are reported in Table 6.

Insert Table 6 here

The results for public firms are qualitatively similar to the full-sample results in Table 2. The coefficients on the interaction between public firm indicator and owner's portfolio diversification are positive for all three measures of diversification and are statistically significant in two specifications out of three. The economic significance is somewhat smaller than in the baseline regressions in Table 2: a one-standard-deviation increase in a measure of portfolio diversification is associated with 3%-6% increase in public firms' capital investment rate. The coefficients on the interaction between private firm dummy and owner's portfolio diversification are tend to be statistically and economically weaker: a one-standard-deviation increase in a typical private firm owner's diversification is associated with a 0%-4% reduction in its investment-to-assets ratio, this reduction being significant for only one measure of portfolio diversification

out of three. The differences in the sensitivity of investment to owners' portfolio diversification between public and private firms is statistically significant in two specifications out of three. Similar to Table 2, the intercepts demonstrate that, ceteris paribus, public firms invest more than private ones.

3.4.2 Treatment effect model

To deal with potential self-selection of companies into public and private, we estimate a two-stage Heckman (1979) selection model. In the first stage, we explicitly estimate the choice between public and private status using a probit regression. In the second stage, we re-estimate our baseline model while augmenting it by the inverse Mills ratio from the first-stage regression in order to correct for potential self-selection. Following Maddala (1991), the binary choice model of the mode of incorporation is represented as:

$$P^*_{i,t} = \kappa' Z_{i,t} + v_{i,t}, \tag{3}$$

where $Z_{i,t}$ is a vector of exogenous variables that influence the choice of firm i to be either private or public: $P_{i,t}$=1 if $P^*_{i,t} > 0$ and $P_{i,t} = 0$ if $P^*_{i,t} \leq 0$. If a firm's decision to be private is correlated with that firm's capital investment, we would have a non-zero correlation between the error term, $v_{i,t}$ in (3), and the error term in the investment model. Therefore, estimating the latter model via a simple OLS may lead to inconsistent estimates.

Instead, in the first stage of the Heckman (1979) model we estimate (3) with a probit regression and obtain consistent estimates of κ'. These coefficient estimates are then used to compute the inverse Mills ratio, the correction for self-selection.[12] This parameter is then included in the second-stage regressions along with all other independent variables. In this way, we can explicitly test whether a firm's private/public status is still related to its investment and operating decisions after the self-selection due to unobservable factors has been controlled for (e.g., Çolak and Whited (2007)).

For this model to be correctly specified, it is important to include at least one exogenous variable from the first-stage choice model (e.g., Lennox, Francis, and Wang (2011)). For this purpose, we use the fraction of privately held companies in each 3-digit SIC industry in a country in which a company is headquartered in order to predict the decision to be private or public without otherwise affecting capital

[12]The inverse Mills ratio is equal to: $\lambda_1(\kappa' Z_{it}) = \frac{-\phi(\kappa' Z_{it})}{\Phi(\kappa' Z_{it})}$ for public firms and $\lambda_2(\kappa' Z_{it}) = \frac{\phi(\kappa' Z_{it})}{1-\Phi(\kappa' Z_{it})}$ for private firms, where ϕ is the standard normal pdf, and Φ is the standard normal cdf.

investment. One may argue that private firms could be more clustered in certain industries. In this case, the exclusion restriction may be correlated, although indirectly, with the left-hand side of the second-stage model. To mitigate this effect, we include industry, country, and year fixed effects in both the first-stage and second-stage regressions. The results of the second-stage regressions are reported in Table 7.

Insert Table 7 here

Augmenting the regressions by the inverse Mills ratio produces results for public firms that are somewhat stronger and more significant than the baseline results in Table 2. The coefficients on the interaction between public firm indicator and portfolio diversification are positive and statistically significant for all three measures of diversification. These coefficients are somewhat larger than the corresponding figures in the baseline specification (0.0044, 0.0170, and 0.0279 in Table 7 compared with 0.0037, 0.0145, and 0.0213 in Table 2), as is their economic magnitude. The coefficients on the interaction between private firm dummy and owner diversification are close to zero and economically weak, albeit statistically significant in two specifications out of three.

Overall, from the results in Tables 3-7, endogeneity in either owner's portfolio diversification or firm's mode of incorporation does not appear to be responsible for the positive relation between owners' portfolio diversification and their firms' capital investment for public firms and/or for the different sensitivity of public firms' investment to their controlling owners' portfolio diversification than the sensitivity of private firms' investment. While we acknowledge that none of these alternative tests in isolation can provide a fully convincing argument as to the direction of causality, their combination forms an important body of evidence that owners' portfolio diversification affects firms' investment decisions differently for public and private firms.

3.5 Robustness tests

In this section we assess the robustness of our results with respect to a number of alternative specifications and subsamples. In these tests we use the full (unmatched) sample of public and private firms and estimate the regressions using OLS, as in our baseline estimation. Importantly, the vast majority of the robustness results reported below continue to hold when we control in various ways for the endogeneity of firms' mode of incorporation and of their owners' portfolio diversification. In what follows, to conserve space, we

report results using only one measure of portfolio diversification (ln(number of firms)). Results (available upon request) hold when we use the other two measures of diversification. Table 8 reports the summary of the robustness results.

Insert Table 8 here

3.5.1 Alternative dependent variables

Since R&D expenditures may be as important as capital expenditures for some firms, we define an alternative dependent variable, which takes into account R&D expenditures in addition to capital expenditures. Following Giannetti (2003), we use the change in total intangible assets as a proxy for R&D expenditures and assign the value of zero to R&D expenditures in cases in which they are missing. We define total investment-to-assets ratio as the year-to-year change in the sum of gross fixed assets and total intangible assets divided by lagged total assets. The first column shows the results of estimating the baseline regressions using this alternative investment measure. Our main findings are robust to the alternative definition of investment: total-investment-to-assets ratio is increasing in owner's portfolio diversification for public firms, while it is close to zero, albeit marginally statistically significant for private firms.

3.5.2 Ultimate owners: Dual class shares

One limitation of our calculation of each ultimate shareholder's voting rights is that we are unable to take into account the presence of dual class shares. The omission of dual class shares may potentially create a measurement error in the identification of (ultimate) controlling owners and, therefore, in the construction of our proxies for controlling owners' portfolio diversification. The use of dual class shares, when legally allowed, is observed not only within public firms, but also in private companies. However, there are no sources providing accurate information on the extent of dual class shares use among private firms.

Dual class shares are used extensively only in a few European countries (e.g., Faccio and Lang (2002) and Nenova (2003)). Further, Pajuste (2005) documents that an increasing number of firms in continental Europe have recently unified their shares into a single class.[13] In particular, Pajuste (2005) shows that at the end of 2001, after several legal reforms aimed at improving investor protection across Europe,

[13]Similar result is reported by the ECGI in their study commissioned by the European Union (2007).

only six countries still have at least 10% of their public companies using dual class shares: Sweden (46.3%), Denmark (36.6%), Italy (34.6%), Switzerland (26.4%), Finland (23.9%), and Germany (11.5%). Therefore, we believe that this potential measurement error has a limited impact on the identification of firms' ultimate shareholders.

Nevertheless, we re-examine the results in light of this potential bias. As there is no accurate information on the use of dual class shares among private firms, we conservatively assume that private firms' use of dual class shares mirrors the one by public firms. Therefore, we exclude the countries above from our sample and re-estimate the regression in (1). The second column demonstrates that potential bias due to dual class shares is unlikely to be responsible for our findings.

3.5.3 Tunneling

Although in the majority of cases, owners' cash flow rights coincide with their control rights, it is not always the case. Indeed, 17% (24%) of public (private) companies in our sample are controlled by largest shareholders whose voting rights exceed their cash flow rights. This wedge between voting rights and cash flow rights can be a result of dual class shares and/or of a pyramidal ownership structure. In cases in which this wedge is positive, owners may have incentives to siphon ("tunnel") firm's resources to other firms they have stakes in, at the expense of minority shareholders (e.g., Johnson, La Porta, Lopez-de-Silanes and Shleifer (2000), Bertrand, Mehta and Mullainathan (2002), and John, Litov and Yeung (2008)).

The possibility of tunneling may potentially affect the relation between firms' investment and their owners' portfolio diversification. In particular, high diversification (i.e. large number of firms in an owner's portfolio) may facilitate the transfer of controlled firm's assets to other firms in the same owner's portfolio (disinvestment). To examine whether the possibility of tunneling is responsible for our results, we construct a measure of the likelihood of tunneling, which equals the wedge between voting rights and cash flow rights of each controlling shareholder, as in Claessens, Djankov, Fan, and Lang (2002). Then, we exclude firms in the top decile of the wedge distribution – i.e. observations in which controlling owners have the most incentives to engage in tunneling. For excluded companies, the average (median) wedge is over 13% (11%) and the largest wedge is 49%. The results, reported in column 3, are similar to those in the baseline specification – the sensitivity of investment to owners' diversification is large and significant

for public firms, while it is close to zero for private firms. This result suggest that tunneling is unlikely to be driving our results.

3.5.4 Portfolio diversification measures

As mentioned above, a potential limitation of our portfolio diversification measures is that we are not able to capture indirect equity investments. The exclusion of investments in mutual and hedge funds may bias our measures of diversification downwards, especially if the presence of mutual and hedge funds in Europe is as pervasive as in the U.S. For example, Gillan and Starks (2007) show that at the end of 2006 the proportion of total outstanding U.S. equities held by institutional investors exceeded 70%. However, the descriptive statistics of our portfolio diversification measures are similar to the estimates reported in Barber and Odean (2000) and Goetzman and Kumar (2008) for U.S. investors, and in Karhunen and Keloharju (2001) for Finnish investors. In addition, a comparable level of diversification is documented by Moskowitz and Vissing-Jørgensen (2002) for U.S. households investing in the private equity market.

Nevertheless, we attempt to mitigate the potential bias in two ways. First, we look at the fraction of households' total financial assets invested in "Mutual fund shares" as reported in the National Accounts. We calculate this fraction at the end of 2006 to take into account that in the first half of the decade several European countries experienced a significant increase in the holdings of mutual fund shares (e.g., Ynesta (2008)). In 6 out of 22 countries with available information this fraction exceeds 10%: Belgium, Austria, Spain, Sweden, Germany, and Switzerland. In these countries the downwards bias that may potentially affect our portfolio diversification measures is larger. Therefore, we exclude these countries from our sample and re-estimate the investment regression. The results, reported in column 4, are generally consistent with our baseline findings, suggesting that this potential limitation of our portfolio diversification proxies is unlikely to be driving our empirical results.

Second, to proxy for the share of mutual fund investments in each country's stock market, we examine the fraction of market capitalization held by mutual funds as of 2005, reported in Ferreira and Matos (2008). The fraction of market capitalization held by institutional investors in general and by mutual funds in particular in Europe is well below the corresponding figures in the U.S. The average fraction of stocks held by institutional investors (mutual funds) in Europe equals 20% (4%), while the corresponding figures in the U.S. are 66% (18%). In only 6 countries out of 34 in our sample, the ownership of the

stock market by mutual funds exceeds 5%: Sweden, Ireland, Finland, Luxembourg, Netherlands, and Switzerland. As in the previous test, we exclude these countries from our sample and re-estimate the regression of firms' investment on their owners' portfolio diversification. Results, which are reported in column 5, are consistent with the full-sample findings.

Similarly, our diversification measures are unable to account for real-estate investments. Their exclusion may further bias our measures of owners' diversification downwards. As we do not have information on real estate investments at the individual level, we gauge their importance at the country level. We use the ratio of gross value added of the real estate industry to gross value added of the total economy as a proxy for the size of the real estate sector in each country. We calculate this fraction at the end of 2006 using data from the National Accounts at both sector and country levels. The idea is that the larger the size of the real estate sector in each country, the higher the investments in real estate of individuals in that country and, therefore, the larger the potential downward bias of our measures of owners' portfolio diversification.[14] In 8 out of 28 countries with available information, the gross value added of the real estate industry exceeds 10% of total gross value added: France, Italy, Greece, Germany, Finland, Estonia, Bulgaria, and Denmark. As above, we exclude these countries from our sample and re-estimate the investment regression. The coefficient estimates, reported in column 6, are in line with the baseline results.

3.5.5 Disclosure requirements, and accounting and reporting standards

Although most countries in our sample require companies to file financial statements (albeit sometimes in reduced form), in some countries the regulations (and/or filing practices) are different. For instance, in Bosnia and Herzegovina, Romania, Russia, and Switzerland private firms are not required to publish financial statements. In Portugal and Germany, few companies comply with the filing requirements. Additionally, in Liechtenstein, Malta, Monaco, and the Slovak Republic the criteria for publication of financial statements are undefined in Amadeus. Further, in some countries, firms that are not required to

[14]The results are similar when we use an employment-based proxy for the importance of the real estate sector of the economy. Specifically, we calculate the total employment of the real estate industry as a fraction of the total employment of the economy.

file financial reports choose to file them.[15] This could lead to a potential selection bias towards successful (private) companies that choose to file financial reports. While in all our empirical specifications we include country fixed effects, which should control for different levels of disclosure requirements in various countries and/or differences in filing practices, we try to further mitigate this potential bias by excluding private firms incorporated in countries listed above. The results, reported in column 7, mirror our previous findings.

A further potential concern relates to the quality of accounting information across countries. Although all countries in our sample have either adopted the International Financial Reporting Standards (IFRS) during the 2000s or decided to adopt them at some point in the near future (e.g., Russia), there could still be differences in reporting standards. We follow Porter and Schwab (2008) and use the Executive Opinion Survey conducted by the World Economic Forum between 2007 and 2008 to gauge the extent of these differences.[16] The Survey was completed by 2,881 top European business leaders with an average of 88 respondents per country. The Survey asks executives to provide their expert opinions on various aspects of the business environment in which they operate. We are interested in the question related to the strength of financial auditing and reporting standards of financial performance (item 1.16). Countries in the bottom decile of the accounting standards distribution are: Bosnia and Herzegovina, Ukraine, Russia, and Bulgaria. To control for potential misreporting bias, we exclude these countries from the sample. The results, reported in column 8, are similar to those reported in column 7 and to the baseline results in Table 2.

We also control for potential corporate corruption, since the higher the perceived corruption in a country the higher the probability for firms in that country to cheat (also) in their financial statements. To control for this potential issue, we use a proxy of perceived ethical behavior of firms at country level (item 1.15 in the Executive Opinion Survey). To obtain a sample with relatively reliable accounting information we exclude these countries in the bottom quartile of the business ethic ranking: Bosnia and Herzegovina, Ukraine, Russia, Romania, Macedonia, Bulgaria, Serbia, Greece, Hungary, Czech Republic,

[15]See Marchica and Mura (2013) for a more detailed analysis of the disclosure requirements in European countries.

[16]The World Economic Forum has conducted the annual Survey for nearly 30 years. The Executive Opinion Survey results serve as a major component of research by a number of international and national organizations, government and research bodies, and companies.

and Slovakia. The results, reported in column 9, are consistent with our baseline findings.

3.6 An alternative measure of financial constraints

While a firm's mode of incorporation is likely to be related to the degree of financial constraints that the firm faces, as shown in Asker, Farre-Mensa and Ljungqvist (2015), public firms may be different from private ones along dimensions other than financial constraints. To ensure that our results are not driven by these non-financial-constraints-related differences, in this section we examine the relation between owners' portfolio diversification and firms' investment using a different measure of financial constraints, which is not based on firms' mode of incorporation.

The investment literature offers a number of alternative measures of financial constraints (e.g., Kaplan and Zingales (1997), Lamont, Polk and Saa-Requejo (2001), Whited and Wu (2006), and Hadlock and Pierce (2010)). However, since these indices are based on U.S. publicly-traded companies, they are less suitable for our sample that includes both public and private European firms. Therefore, we largely follow Campello and Chen (2010) in constructing an alternative financial constraints measure. (A few changes to Campello and Chen's (2010) methodology are necessary because of data availability in our sample.)

First, each year we independently sort firms based on several characteristics employed in Campello and Chen (2010): size, coverage ratio (defined as the ratio of earnings before interest and taxes to interest paid), cash flow, and cash holdings (defined as the ratio of cash and cash equivalents to total assets).[17] We include additional characteristics that previous studies showed to be associated with access to external finance: age (included in Hadlock and Pierce (2010) index), firm-level sales growth and 2-digit SIC industry-level sales growth (both included in Whited and Wu (2006) index).[18]

Second, we rank firms into quintiles by each of the seven characteristics described above and give a score of 1 to 5, with a higher number indicating lower degree of financial constraints. We then compute the total score of each firm by adding all seven scores. This final composite financial constraints index

[17] Replacing coverage ratio with total leverage (as in Kaplan and Zingales (1997) and Whited and Wu (2006)) does not affect the results.

[18] We do not include Tobin's q (as in Kaplan and Zingales (1997)), dividend payout (as in Kaplan and Zingales (1997), Whited and Wu (2006), and Campello and Chen (2010)), and commercial paper and bond rating (as in Campello and Chen (2010)), as these variables are unavailable in our sample.

ranges from 7 to 35. Finally, we sort firms according to this index into quintiles of financial constraints. Firms in the lowest (highest) quintile are the most (least) financially constrained.

We begin by verifying our assertion that private firms are on average more constrained than public ones. In the least constrained quintile we find almost 41% of all public firms, compared to only 25% of all private ones. On the contrary, only 14% of public firms, compared to 20% of private ones are found in the most constrained quintile. These figures are consistent with public firms typically facing less severe financial constraints than private ones. We proceed to estimating the relation between firms' investment and their owners' portfolio diversification for firms belonging to various quintiles of financial constraints:

$$Inv\_to\_assets_{i,t} = \alpha + \sum_{j=2}^{5} \beta(j)\, CONST(j)_{i,t} + \gamma(1)\, Diver_{i,t} + \sum_{j=2}^{5} \gamma(j) \left(Diver_{i,t} CONST(j)_{i,t} \right) + \overline{\theta X_{i,t}} + Country * IndustryFE + YearFE + u_{i,t}, \quad (4)$$

where $CONST(j)_{i,t}$ for $j = 2..5$ is a dummy variable equalling one if firm i belongs to j's quintile of financial constraints in year t, and the rest of the variables are defined as in (1). The results of estimating (4) are reported in Table 9.

Insert Table 9 here

The specification in (4) allows testing the hypothesis according to which the sensitivity of firms' investment to their owner's portfolio diversification is decreasing in the degree of financial constraints. Consistent with this hypothesis, we find that the coefficient on the stand-alone measure of portfolio diversification is positive and significant for all three measures of diversification. This means that firms' investment rates are increasing in their owners' portfolio diversification for the most unconstrained firms. The coefficients on the interaction between financial constraints indicators and portfolio diversification are negative and become progressively larger in absolute value as we move towards more constrained quintiles. This shows that the relation between firms' capital investment and their owners' portfolio diversification is almost monotonically decreasing in financial constraints that firms face. In addition, consistent with the baseline results in Table 2, the level of investment is decreasing in financing constraints, as evident from the monotonically decreasing coefficients on the financial constraints quintile indicators.

Overall, the estimates in Table 9 are consistent with the results of regressions in which we use firms' mode of incorporation's as a measure of financial constraints. These results highlight the importance of

financial constraints in shaping the effect of firm owners' portfolio diversification on their firms' capital investment.

4 Conclusions

We investigate the relation between firms' capital investment and the diversification of their owners' portfolios. We examine this relation using Amadeus Top 250,000 database, which provides comprehensive accounting and ownership data on both private and public firms in 34 European countries over a twelve-year period. Using this dataset allows us to reconstruct equity portfolios of a large number of firms' controlling owners, which we use to build measures of owners' portfolio diversification. We find that investment of relatively unconstrained (public) firms is positively related to their owners' portfolio diversification and that this relation is typically economically meaningful. On the other hand, the relation between firms' investment and their owners' diversification is typically weak and sometimes negative for relatively constrained (private) firms.

Using owner fixed effects estimation, a quasi natural experiment, and instrumental variables technique, we show that these results are not likely to be driven by the endogeneity of firm owners' portfolio diversification. In addition, we demonstrate using matched sample estimation and using treatment effect model that the results are not due to possible self-selection of firms' mode of incorporation either. Further, the results are robust to a battery of additional tests, which include: using an alternative measure of investment, and estimating the investment regression in subsamples in which the problems of a) potential separation of firm ownership and control due to prevalence of dual-class shares, b) potential agency considerations of owners of firms with large wedge between voting and cash flow rights, c) potential measurement errors in our portfolio diversification proxies, and d) subpar accounting and reporting standards, are less acute.

We hypothesize that a potential reason for our findings is the difference between the degree of financial constraints that a typical private firm faces and the degree of financial constraints of a typical public firm. Our finding that the sensitivity of firms' investment to measures of their owners' portfolio diversification is monotonically decreasing in an index of financial constraints constructed from observable firm characteristics, is consistent with this hypothesis.

Our results suggest that controlling owners' portfolio diversification is an important determinant of firms' investment strategies, and that the effect of owners' diversification on investment depends crucially on the degree of financial constraints that firms face. The real effects of firm owners' portfolio diversification lead to important policy implications. In particular, if policymakers' goal is to encourage corporate investment, then it is important not only to reduce firms' financial constraints by enhancing capital market development, but also to increase firm owners' portfolio diversification by fostering their participation in capital markets.

In this paper we focus on the effects of owners' portfolio diversification on firms' capital investment, while purposely abstracting from the effects on firms' financing strategies, such as their capital structures, cash holding policies, and payout policies. Given the strong effects of owners' portfolio diversification on firms' investment that we report, an analysis of its effects on private and public firms' financing strategies seems a promising direction of future research, which could enhance our understanding of the impact of firm owners' objectives on firms' strategies.

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Table 1. Summary statistics

Panel A reports country coverage of our sample and the proportion of public and private firms in each country. Panel B reports descriptive statistics of the dependent and independent variables for the full sample, and separately for subsamples of public and private firms. Investment-to-assets ratio is defined as the year-to-year change in gross fixed assets divided by lagged total assets, where total assets are computed as the sum of fixed and current assets. Private is a dummy equalling 1 if a company is privately-held in a given year and equalling zero otherwise. No. firms is the total number of firms in which a company's controlling owner holds shares, directly or indirectly, in a given year, across all countries in our sample. 1-Herfindahl index is one minus the sum of the squared values of the weight that each investment has in the controlling owner's portfolio, where the weights are based on the book value of assets. -Correlation is the correlation of mean stock return of public firms in a controlled firm's industry with the controlling owner's overall portfolio returns, multiplied by -1. Sales growth is defined as the annual relative growth rate in total revenues. Cash flow is the ratio of income plus depreciation to lagged total assets. Age is the number of years since incorporation. Total assets are reported in thousands $ U.S. and expressed in 1999 prices.

Panel A. Number of observations by country

Country	Obs.	% Public	% Private
Austria	2,388	0.02	0.44
Belgium	29,999	0.08	5.60
Bosnia and Herzegovina	247	0.02	0.02
Bulgaria	3,338	0.09	0.54
Croatia	4,848	0.13	0.79
Czech Republic	5,776	0.02	1.08
Denmark	16,194	0.11	2.95
Estonia	1,083	0	0.20
Finland	6,894	0.08	1.23
France	107,285	0.51	19.81
Germany	21,897	0.33	3.81
Greece	14,341	0.31	2.40
Hungary	647	0.01	0.12
Iceland	130	0.01	0.02
Ireland	126	0.01	0.02
Italy	47,401	0.17	8.80
Latvia	102	0	0.02
Liechtenstein	8	0	0
Luxembourg	354	0	0.06
Macedonia	1	0	0
Netherlands	6,980	0.08	1.24
Norway	20,338	0.11	3.74
Poland	9,426	0.02	1.76
Portugal	8,661	0.03	1.61
Romania	5,663	0.05	1.02
Russia	32	0	0
Serbia	2,736	0.22	0.30
Slovak Republic	170	0.01	0.03
Slovenia	644	0.02	0.11
Spain	60,044	0.18	11.19
Sweden	22,922	0.16	4.18
Switzerland	466	0.03	0.05
Ukraine	3,619	0.02	0.67
United Kingdom	123,350	1.3	22.06
Total	528,110	4.13	95.87

Panel B. Summary statistics: Dependent and independent variables

	All firms			Public firms		Private firms		p-values of diff.	
Variable	Mean	Median	St. dev	Mean	Median	Mean	Median	Mean	Median
Investment	0.0709	0.0321	0.1624	0.0693	0.0313	0.1087	0.0612	[0.000]	[0.000]
Private	0.9587	1	0.1989						
No. firms	20.70	2	70.49	42.38	4	19.77	2	[0.000]	[0.000]
Ln(No. firms)	1.3241	0.6931	1.5286	1.8483	1.3863	1.3015	0.6931	[0.000]	[0.000]
1-Herfindhal index	0.3320	0.2733	0.3413	0.4191	0.4643	0.3282	0.2605	[0.000]	[0.000]
-Correlation	-0.8092	-1	0.2344	-0.7276	-0.7531	-0.8128	-1	[0.000]	[0.000]
Sales growth	0.1116	0.0512	0.5161	0.1086	0.0510	0.1822	0.0543	[0.000]	[0.106]
Cash flow	0.0875	0.0723	0.1161	0.0755	0.0753	0.0880	0.0722	[0.000]	[0.000]
Age	25.18	18	21.56	35.44	22	24.74	18	[0.000]	[0.000]
Total assets	167,706	22,753	2,624,713	1,260,874	87,516	120,638	21,895	[0.000]	[0.000]
Firm-year observations		528,110		21,211		506,899			
No. of firms		162,688		6,163		156,525			

Table 2. Regressions of investment-to-assets ratio on measures of portfolio diversification: Full sample

This table reports results of estimating (1) for the full sample of public and private firms during the period 1999-2010. The dependent variable is investment-to-assets ratio, defined as the year-to-year change in gross fixed assets divided by lagged total assets, where total assets are computed as the sum of fixed and current assets. Public (private) is an indicator variable equalling one for publicly-traded (privately-held) firms and equalling zero for privately-held (publicly-traded) ones. Public x diver (private x diver) is the product of public (private) indicator and one of the three portfolio diversification measures: No. firms, 1-Herfindahl index, and -Correlation. All regressions are estimated using OLS and include country*industry, and year fixed effects. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients. The economic significance of the portfolio diversification variables is reported beneath the p-values of coefficients significant at the 10% level; this number is the percentage change in the dependent variable (relative to its mean) associated with a one standard deviation increase in a measure of portfolio diversification. p-values of the significance of the difference between public x diver and private x diver are reported in square brackets underneath the private x diversification economic significance.

Measure of diversification	Ln(# firms)	1-Herf. index	-Correlation
Public	0.0682***	0.0741***	0.0965***
	[0.000]	[0.000]	[0.000]
Private	0.0382***	0.0421***	0.0425***
	[0.000]	[0.000]	[0.000]
Public x diver.	**0.0037*** **	**0.0145*** **	**0.0213*** **
	[0.000]	[0.001]	[0.000]
	7.98%	**6.98%**	**7.04%**
Private x diver.	-0.0003***	-0.0025***	0.0003
	[0.009]	[0.001]	[0.898]
	-0.65%	-1.20%	–
p-value of diff.	**[0.000]**	**[0.000]**	**[0.000]**
Sales growth	0.0554***	0.0555***	0.0552***
	[0.000]	[0.000]	[0.000]
Cash flow	0.2466***	0.2535***	0.2484***
	[0.000]	[0.000]	[0.000]
Ln(1+age)	-0.0033***	-0.0032***	-0.0032***
	[0.000]	[0.000]	[0.000]
R-squared	0.161	0.163	0.162
Obs.	528,110	518,501	525,686

Table 3. Regressions of investment-to-assets ratio on measures of portfolio diversification: Owner fixed effects

This table reports results of estimating (1), augmented by owner fixed effects, for the full sample of public and private firms during the period 1999-2010. See Table 2 for variable definitions. All regressions are estimated using OLS and include country*industry, and year fixed effects. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients. The economic significance of the portfolio diversification variables is reported beneath the p-values of coefficients significant at the 10% level; this number is the percentage change in the dependent variable (relative to its mean) associated with a one standard deviation increase in a measure of portfolio diversification. p-values of the significance of the difference between public x diver and private x diver are reported in square brackets underneath the private x diversification economic significance.

Measure of diversification	Ln(# firms)	1-Herf. Index	-Correlation
Public	0.0598***	0.0593***	0.0992***
	[0.000]	[0.000]	[0.000]
Private	0.0458***	0.0443***	0.0392***
	[0.000]	[0.000]	[0.000]
Public x diver	**0.0046****	**0.0245*****	**0.0375*****
	[0.014]	[0.004]	[0.000]
	9.92%	**11.80%**	**12.40%**
Private x diver	-0.0027**	-0.0075***	-0.0035
	[0.035]	[0.008]	[0.291]
	-5.82%	-3.61%	–
p-value of diff.	**[0.000]**	**[0.000]**	**[0.000]**
Sales growth	0.0551***	0.0553***	0.0550***
	[0.000]	[0.000]	[0.000]
Cash flow	0.2506***	0.2543***	0.2515***
	[0.000]	[0.000]	[0.000]
Ln(1+age)	-0.0037***	-0.0038***	-0.0038***
	[0.000]	[0.000]	[0.000]
R-squared	0.207	0.206	0.206
Obs.	528,110	518,501	525,686

Table 4. Post-acquisition changes in investment-to-assets ratios

This table reports changes in investment-to-assets ratios of (existing) firms controlled by owners who acquire additional (new) firms to their portfolios. Panel A reports results for existing public portfolio firms, while Panel B reports results for existing private portfolio firms. The first two rows in each panel report the mean numbers of portfolio companies pre-acquisition and post-acquisition. Rows 3 and 4 in each panel report the mean investment-to-assets ratios pre-acquisition and post-acquisition. The third column reports the difference between the mean ln(1+ number firms) and mean investment-to-asset ratio after the acquisition and respective pre-acquisition figures. The fourth column reports p-values of the differences in column 3.

Panel A. Public firms

	Obs.	Mean	Diff. mean	P-value diff.
Ln(1+no.Firms)(pre-acquisition)	97	1.3101		
Ln(1+no.Firms)(post-acquisition)	97	1.8147	0.5046	[0.002]
Investment-to-assets (pre-acquisition)	97	0.1058		
Investment-to-assets (post-acquisition)	97	0.1480	0.0422	[0.074]

Panel B. Private firms

	Obs.	Mean	Diff. mean	P-value diff.
Ln(1+no.Firms)(pre-acquisition)	2,357	1.5285		
Ln(1+no.Firms)(post-acquisition)	2,357	1.8699	0.3414	[0.000]
Investment-to-assets (pre-acquisition)	2,357	0.0767		
Investment-to-assets (post-acquisition)	2,357	0.0706	-0.0061	[0.088]

Table 5. Regressions of investment-to-assets ratio on measures of portfolio diversification: Instrumental variables

This table reports results of estimating (1), for the full sample of public and private firms during the period 1999-2010, while using an instrument for portfolio diversification. The instrument is the spherical distance between firm owner and the stock market in her country. In the first stage, we regress owner's portfolio diversification on the geographical distance between the firm owner and her country's stock market, along with all exogenous variables and industry, country, and year fixed effects. In the second stage, we employ the predicted values of the owners' portfolio diversification from the first-stage regressions. In Panel A we report the second-stage estimates. All second-stage regressions are estimated using OLS and include country*industry, and year fixed effects. For brevity reasons, in Panel B we report only the estimated coefficients of the geographical distance. See Table 2 for variable definitions. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients. The p-value of the significance of the difference between public x diver and private x diver are reported in square brackets underneath the private x diversification coefficients. We also report the F-statistics of the instruments from the first stage regressions.

Panel A. Second-stage regressions

Measure of diversification	Ln(# firms)	1-Herfindhal Index	-Correlation
Public	-1.8828	-2.2171	7.0917*
	[0.104]	[0.111]	[0.076]
Private	0.1352***	0.1609**	-0.0990
	[0.005]	[0.020]	[0.264]
Public x predicted diver.	**1.4188***	**6.6196***	**8.8666***
	[0.086]	[0.093]	[0.083]
Private x predicted diver.	-0.0312**	-0.1704*	-0.2634*
	[0.045]	[0.060]	[0.061]
p-value of diff.	**[0.085]**	**[0.092]**	**[0.082]**
Sales growth	0.0549***	0.0550***	0.0587***
	[0.000]	[0.000]	[0.000]
Cash flow	0.2502***	0.2484***	0.2515***
	[0.000]	[0.000]	[0.000]
Ln(1+age)	-0.0234**	-0.0251**	-0.0212**
	[0.036]	[0.046]	[0.038]
Obs.	258,324	254,888	257,407

Panel B. First-stage regressions

IV: distance	-0.005***	-0.001***	-0.003***
	[0.000]	[0.000]	[0.000]
F-test of excl. instr.	207.8	155.3	251.7

Table 6. Regressions of investment-to-assets ratio on measures of portfolio diversification: Matched sample

This table reports results of estimating (1) for the matched sample of public and private firms during the period 1999-2010. We use the propensity score matching estimator to find for each public firm a possible match in the sub-sample of private companies. The propensity score is estimated within a country-industry-year category, as a function of all firm characteristics included in the baseline model: sales growth, cash flow, and firm age. We require that the maximum difference between the propensity score of the public firm and its matching peer does not exceed 0.1% in absolute value. See Table 2 for variable definitions. All regressions are estimated using OLS and include country*industry, and year fixed effects. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients. The economic significance of the portfolio diversification variables is reported beneath the p-values of coefficients significant at the 10% level; this number is the percentage change in the dependent variable (relative to its mean) associated with a one standard deviation increase in a measure of portfolio diversification. p-values of the significance of the difference between public x diver and private x diver are reported in square brackets underneath the private x diversification economic significance.

Measure of diversification	Ln(# firms)	1-Herf. index	-Correlation
Public	0.1334***	0.1391***	0.1509***
	[0.000]	[0.000]	[0.000]
Private	0.1114***	0.1151***	0.1099***
	[0.000]	[0.000]	[0.000]
Public x diver.	**0.0026****	**0.0058**	**0.0148****
	[0.013]	[0.251]	[0.033]
	5.61%	**2.79%**	**4.89%**
Private x diver.	-0.0013	-0.0092*	-0.0012
	[0.260]	[0.070]	[0.882]
	–	-4.43%	–
p-value of diff.	**[0.006]**	**[0.035]**	**[0.128]**
Sales growth	0.0587***	0.0584***	0.0584***
	[0.000]	[0.000]	[0.000]
Cash flow	0.3255***	0.3410***	0.3317***
	[0.000]	[0.000]	[0.000]
Ln(1+age)	-0.0127***	-0.0129***	-0.0129***
	[0.000]	[0.000]	[0.000]
R-squared	0.160	0.163	0.161
Obs.	30,640	30,084	30,473

Table 7. Regressions of investment-to assets ratio on measures of portfolio diversification: Treatment effect model

This table reports results of estimating (1) for the full sample of public and private firms during the period 1999-2010 using a two-stage Heckman model. All second-stage regressions are estimated using OLS and include country, industry, and year fixed effects. The independent variables in second-stage regressions are those used in the baseline regressions, augmented by the inverse Mills ratio from the first-stage regressions. See Table 2 for variable definitions. The exclusion restriction is the fraction of private firms in each country, 3-digit U.S. SIC code and year of the company of interest. In the probit model in the first-stage regressions all other control variables are also included along with country*industry, and year fixed effects. The inverse Mills ratio is calculated from the predicted values of the first-stage probit regressions. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients. The economic significance of the portfolio diversification variables is reported beneath the p-values of coefficients significant at the 10% level; this number is the percentage change in the dependent variable (relative to its mean) associated with a one standard deviation increase in a measure of portfolio diversification. p-values of the significance of the difference between public x diver and private x diver are reported in square brackets underneath the private x diversification economic significance. At the bottom of the table we include results from the first stage probit model of the exogenous variable.

Second-stage regressions			
Measure of diversification	Ln(# firms)	1-Herf. index	-Correlation
Public	0.0181***	0.0172***	0.0458***
	[0.000]	[0.000]	[0.000]
Private	0.0131***	0.0112***	0.0128***
	[0.000]	[0.000]	[0.000]
Public x diver.	**0.0044*** **	**0.0170*** **	**0.0279*** **
	[0.000]	[0.000]	[0.000]
	9.49%	**8.18%**	**9.23%**
Private x diver.	-0.0005***	-0.0020***	0.0019
	[0.000]	[0.000]	[0.125]
	-1.08%	-0.96%	–
p-value of diff.	**[0.000]**	**[0.000]**	**[0.000]**
Inverse Mills ratio	-0.0140***	-0.0145***	-0.0144***
	[0.000]	[0.000]	[0.000]
Sales growth	0.0560***	0.0561***	0.0577***
	[0.000]	[0.000]	[0.000]
Cash flow	0.2565***	0.2635***	0.2583***
	[0.000]	[0.000]	[0.000]
Ln(1+age)	-0.0025***	-0.0024***	-0.0025***
	[0.000]	[0.000]	[0.000]
First-stage probit regressions			
Fraction of private firms	5.5042***	5.5092***	5.5139***
	[0.000]	[0.000]	[0.000]
Obs.	528,110	518,501	525,686

Table 8. Robustness checks

This table reports results of estimating (1) using alternative variable definitions and samples. To conserve space, we only report results using ln(1+number of firms) and the main independent variables. (The other control variables are the same as in the baseline model in (1).) See Table 2 for variable definitions. In column 1 we use an alternative measure of investment-to-assets ratio. In particular, we replace investment-to-assets ratio by the sum of investment in CAPEX and investment in R&D, normalized by lagged book assets. In column 2 we re-estimate the regression while excluding observations from countries in which the proportion of dual-class shares exceeds 10%: Sweden, Denmark, Italy, Switzerland, Finland, and Germany. In column 3 we re-estimate the regression while using a subsample of firm-years in which the wedge between owners' voting rights and cash flow rights does not belong to the top decile. In column 4 we re-estimate the regression while excluding observations from countries in which the proportion of households wealth invested in mutual funds exceeds 10%: Belgium, Austria, Spain, Sweden, Germany, and Switzerland. In column 5 we re-estimate the regression while excluding observations from countries in which the ownership of the stock market by mutual funds exceeds 5%: Sweden, Ireland, Finland, Luxembourg, Netherlands, and Switzerland. In column 6 we re-estimate the regression while excluding observations from countries in which the proportion of the gross value added of the real estate sector exceeds 10% of the total gross value added: France, Italy, Greece, Germany, Finland, Estonia, Bulgaria, and Denmark. In column 7 we re-estimate the regression while excluding observations from countries in which the disclosure of accounting information by private firm is either voluntary or not enforced or in which the disclosure criteria are undefined in the Amadeus database: Bosnia and Herzegovina, Romania, Russia, Switzerland, Portugal, Germany, Liechtenstein, Malta, Monaco, and Slovak Republic. In column 8 we re-estimate the regression while excluding countries in which the reporting standards are low: Bosnia and Herzegovina, Ukraine, Russia, and Bulgaria. In column 9 we re-estimate the regression while excluding observations from countries that belong to the lowest quintile of the business ethic ranking: Bosnia and Herzegovina, Ukraine, Russia, Romania, Macedonia, Bulgaria, Serbia, Greece, Hungary, Czech Republic, and Slovakia. All regressions are estimated using OLS and include country*industry, and year fixed effects. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients. The economic significance of the portfolio diversification variables is reported beneath the p-values of coefficients significant at the 10% level; this number is the percentage change in the dependent variable (relative to its mean) associated with a one standard deviation increase in a measure of portfolio diversification. p-values of the significance of the difference between public x diver and private x diver are reported in square brackets underneath the private x diversification economic significance.

	1 Alt. dep. var.	2 Dual-class	3 Tunneling	4 House. hold.	5 Mutual funds	6 Real estate	7 Disc. req.	8 Acc. quality	9 Corruption
Public	0.0795***	0.0549***	0.0702***	0.0672***	0.0668***	0.1273***	0.0364***	0.0737***	0.0716***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Private	0.0355***	0.0259***	0.0381***	0.0372***	0.0378***	0.0993***	0.0694***	0.0367***	0.0336***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Public x diver.	**0.0057*** **	**0.0045*** **	**0.0031*** **	**0.0040*** **	**0.0042*** **	**0.0055*** **	**0.0035*** **	**0.0025*** **	**0.0025*** **
	[0.000]	[0.000]	[0.001]	[0.000]	0.000]	[0.000]	[0.000]	0.000]	0.000]
	11.75%	**10.57%**	**6.59%**	**8.63%**	**9.06%**	**11.86%**	**7.55%**	**5.39%**	**5.39%**
Private x diver.	-0.0003*	-0.0005**	0.0005*	-0.0006*	-0.0006***	-0.0009***	-0.0005*	-0.0005**	-0.0004*
	[0.052]	[0.097]	[0.040]	[0.011]	[0.006]	[0.006]	[0.097]	[0.030]	[0.079]
	-0.62%	-0.22%	-1.06%	-1.29%	-1.29%	-1.94%	-1.08%	-1.08%	-0.86%
p-value of diff.	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.000]**	**[0.001]**	**[0.002]**
R-squared	0.155	0.167	0.161	0.162	0.164	0.154	0.159	0.159	0.155
Obs.	528,110	434,233	475,299	390,394	490,368	309,677	493,540	518,129	486,582

Table 9. Regressions of investment-to assets ratio on measures of portfolio diversification: Financial constraints

This table reports results of estimating (4) for the full sample of public and private firms during the period 1999-2010. Const. j'th quint. for $j = 2..5$ is a dummy variable equalling one if the firm belongs to j's quintile of financial constraints in a given year, and the rest of the variables are defined as in Table 2. All regressions are estimated using OLS and include country*industry, and year fixed effects. p-values, adjusted for heteroskedasticity and clustering at the industry-country level, are reported in brackets below the coefficients.

Measure of diversification	Ln(# firms)	1-Herfindhal Index	-Correlation
Intercept	0.0723***	0.0713***	0.0757***
	[0.000]	[0.000]	[0.000]
Const. 2nd quint.	-0.0130***	-0.0130***	-0.0197***
	[0.000]	[0.000]	[0.000]
Const. 3rd quint.	-0.0174***	-0.0168***	-0.0294***
	[0.000]	[0.000]	[0.000]
Const. 4th quint.	-0.0209***	-0.0204***	-0.0327***
	[0.000]	[0.000]	[0.000]
Const. 5th quint.	-0.0244***	-0.0241***	-0.0407***
	[0.000]	[0.000]	[0.000]
Diver.	0.0010**	0.0038**	0.0098***
	[0.028]	[0.046]	[0.000]
Diver. x const. 2nd quint.	-0.0009*	-0.0040*	-0.0068**
	[0.075]	[0.070]	[0.034]
Diver. x const. 3rd quint.	-0.0017***	-0.0082***	-0.0121***
	[0.002]	[0.000]	[0.000]
Diver. x const. 4th quint.	-0.0019***	-0.0080***	-0.0117***
	[0.001]	[0.001]	[0.001]
Diver. x const. 5th quint.	-0.0026***	-0.0106***	-0.0160***
	[0.000]	[0.000]	[0.000]
Sales growth	0.0515***	0.0517***	0.0513***
	[0.000]	[0.000]	[0.000]
Cash flow	0.2211***	0.2273***	0.2227***
	[0.000]	[0.000]	[0.000]
Ln(1+age)	-0.0069***	-0.0068***	-0.0068***
	[0.000]	[0.000]	[0.000]
R-squared	0.162	0.163	0.162
Obs.	528,105	518,496	525,681