

OWNER-MANAGERS' EQUITY PORTFOLIO CHOICE

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Abstract

Some studies have shown that managers concentrate large fractions of their wealth in the equity of their own firm. In this paper we use a unique dataset and investigate how Swedish owner-managers invest remaining wealth conditional on a major investment in their own firm. We find no evidence that owner-managers seek diversification benefits when they invest remaining wealth. Instead some owner-managers invest remaining wealth in the industry where they already have a substantial capital investment. We conclude that some owner-managers seek to exploit their industry-specific superior information when they invest wealth not tied up in their own firms

Keywords: Portfolio choice; Under-diversification, Owner-managers.

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1. Introduction

A central tenet of financial theory is that individuals seek portfolio diversification. However, agency costs and adverse selection costs suggest that managers should hold a large stake in the firm to avoid incentive alignment problems (Jensen and Meckling, 1976; Leland and Pyle, 1977). If managers hold a large stake in the firm they incur costs stemming from increased risk in the form of poor portfolio diversification (Fama and Jensen, 1983). Models of managers' behaviour and executive compensation frequently account for managers' exposure to idiosyncratic firm risk.¹ Contrary to these models, Ofek and Yermack (2000) empirically show that managers hedge their executive stock options by selling shares. However, we are not aware of any evidence on whether and how managers hedge their equity ownership in the firm by strategically choosing investments outside the firm. This highlights the contribution of our study. Using information about owner-managers' equity portfolios we examine how they invest wealth not invested in the firm.

How shall owner-managers invest their wealth that is not invested in the firm? On the one hand, the benefits of portfolio diversification suggest that they should choose other stocks with negative or low correlation with their own firm. Taking the investment in the firm as a constraint the optimal

strategy for remaining wealth is probably not a combination of the risk-free asset and the market

portfolio (Merton, 1971).

On the other hand, Coval and Moskowitz (1999 and 2001) and Hau (2001) suggest that investors may limit their investments to stocks on which they have superior information. It could be argued that owner-managers have superior information about firms that are in similar lines of business as their own firm. Since the returns from firms in similar lines of business most likely are highly correlated, this would be the contrary to portfolio diversification.

In this paper, we attempt to answer two questions: First, do owner-managers choose other equity investments i) with negative or low correlation with their firms, ii) with negative or low correlation among themselves, and iii) that are superior to just investing remaining wealth in the market portfolio? We define the value of other equity investments as remaining wealth. Second, do owner-managers that are active in industries characterized by high degree asymmetric information to a larger extent invest their remaining wealth in the same industry (Merton, 1987)? We define informational technology and telecom as industries with high degree of asymmetric information.

We investigate these issues using a unique dataset which includes the complete ownership structure of all Swedish public firms. Our sample consists of the equity holdings of 109 managers in listed Swedish firms as of December 28, 2001.² For these

¹ see e.g. Fama, 1980; Fama and Jensen, 1983; Jensen, 1986; Stulz, 1990; Lambert, Larcker, and Verrecchia, 1991; Carpenter, 2000.

² To conform to Swedish law, our data-set is made anonymous, i.e. firm and manager names were removed.

equity portfolios we estimate several risk-characteristics.

We find limited evidence that owner-managers strategically choose stocks with low correlation. Instead, the average owner-manager would significantly reduce his exposure to idiosyncratic risk would he invest remaining wealth in the market portfolio. This result is driven by owner-managers in high-tech industries who choose to invest also remaining wealth in information technology and telecom. However, the owner managers would be better off still would they invest remaining wealth in a portfolio that would hedge their main investment. Finally, by comparing Sharpe ratios we provide a casual estimate of the cost the owner-managers bear in terms of under diversification. On average, the owner-managers could have improved their Sharpe ratios by 45 percent would they have sold their main investment and invested in a well diversified portfolios (see Meulbroek, 2001).

Researchers have looked at how much wealth managers and entrepreneurs invest in their own firm. Himmelberg et al (1999) find that the higher is the firm's risk, the lower is managerial ownership. They interpret this as increased firm risk raises the cost of managerial ownership in terms of reduced portfolio diversification and therefore managerial ownership is reduced. Heaton and Lucas (2000) report that entrepreneurs receive a large fraction of their income from risky business ventures and that this risk is undiversifiable. Bitler et al (2004) find that entrepreneurs concentrate large fraction of their wealth in firm equity and that entrepreneurial ownership increases with outside wealth and decreases with firm risk. None of these studies look at how managers invest remaining wealth.

Other researchers have investigated investor behaviour in general. Contrary to standard theory, investors hold undiversified portfolios made up of a limited number of stocks (Barber and Odean, 2000; Goetzman and Kumar, 2002). Stocks also appear to be chosen based on geographical or professional nearness to the investor (Grinblatt and Keloharju, 2001; Coval and Moskowitz, 2001; Goetzmann et al, 2003).

By focusing on owner-managers' portfolio choice we add to the literature on investment and portfolio choice. Goetzman et al (2003) investigate how non-financial risks in the form of undiversifiable human capital affect portfolio choice. The owner-managers in our study also have a large capital investment in the firm.³ How investors choose to invest remaining wealth conditional on a large investment in a particular firm has to our knowledge not been studied before. Additionally, owner-managers should have better knowledge of standard portfolio theory than the average investor. Finally, by comparing owner-managers active within

information technology where informational advantages, real or perceived, should be stronger than within traditional industry, we shed additional light on to what extent superior information affects portfolio choice.

We also indirectly add to the literature on executive compensation. Ofek and Yermack (2000) find that managers hedge their stock options by selling shares. If managers also hedge their equity by taking offsetting position in the stock-market, it would further negate the incentive effects of equity based compensation.

The remainder of the paper is structured as follows. In the next section, we present our sample and how we define various portfolio characteristics. Section 3 reports our results. Section 4 summarizes and concludes.

2. Sample selection and variable definitions

In this section we first explain how our sample is constructed and provide descriptive statistics. We then discuss how various risk-characteristics of the owner-managers' equity portfolios are estimated. Finally, we provide statistics on the industry composition of the owner-managers' portfolios.

2.1. Sample selection

The sample consists of the equity portfolios held by owner-managers (CEO or chairman) active in firms on the Stockholm Stock Exchange (SSE) as of December 28, 2001. The source of ownership data is a unique database provided by the Swedish Securities Register Centre (VPC AB).⁴ VPC AB manages the share registers of all companies on the SSE or other authorised Swedish market places as well as the share registers of many non-listed Swedish companies. Admittedly, neither do we know how much wealth the owner-managers have besides direct investments on the Swedish stock-market, nor how this wealth is invested. However, we argue that if the owner-managers try to reduce their exposure to idiosyncratic risk it would affect their portfolio of direct investments in Swedish equity. Choosing equity investments strategically would also be a cheap way of reducing their exposure to idiosyncratic risk.

Our sample only includes top managers (CEOs or Chairmen) that are among the 25 largest shareholders in their firm. The reason for this is that we identify the managers with data provided by SIS Ownership Service Corp (SIS Ågarservice AB) which provides statistics of share ownership of the

³ We do not analyze why they hold a large block in the firm.

⁴ Ownership of more than 500 shares in a Swedish firm is by law made public each half year, end of June and end of December. In our data-set ownership of less than 500 stocks in a Swedish stock is also included. In the database we are also able to extract; age, sex and domicile of the owner-managers.

largest 25 investors for all firms listed on a Swedish stock-market in the book; "Owners and Power in Sweden's Listed Companies" (Sundin and Sundqvist, 2002).⁵ In total we find 192 top managers that are among the 25 largest shareholders in their firm. Because some of the owner-managers own stocks indirectly through another company we are not always able to capture all their investments in Swedish stocks and therefore we exclude 47 managers from the sample. In addition eight managers are excluded from the sample because they are active as chairman in several companies or active as both CEO and chairman in different companies. Another 28 managers are excluded because they own stocks through a foreign deposit or are active in firms with poor equity return data.⁶ The final sample consists of equity portfolios held by 109 owner-managers (63 CEOs and 46 chairmen) active in 93 out of the 304 firms on the Stockholm Stock Exchange in December 2001. There are 370 different firms in the equity portfolios held by the owner-managers in our sample and 288 of those firms are listed on a stock exchange in Sweden. Security prices of the listed firms are provided by SIX AB. If a firm has stocks with different voting rights and only one type of the stock is traded we proxy the stock return of the non-traded stock with the return of the traded stock.⁷ If a firm has several listed stocks we use returns data for the most traded stock.

In table 1 panel A we report the age of the owner-managers, statistics about the owner-managers' investments in their own firms, and risk characteristics of these firms. The average age of the owner-managers is 51 years with a median of 52 years. CEOs are relatively younger with an average age of 49 years compared to the chairmen in the sample which have an average age of 57 years (not reported in table). There are only two equity portfolios held by females in our sample so essentially all the owner-managers in the sample are males (98 percent).

The average owner-manager in our sample has 78.8 percent of his direct investment in Swedish stocks invested in his own firm. On average (median) the owner-managers hold 11 percent (5.3 percent) of the cash flow rights and 17.6 percent (8 percent) of the voting rights in their own firms. The average market capitalization of the owner-managers' firms is smaller than the average firm on the Stockholm Stock Exchange (2806 million SEK vs. 9363 million SEK). The average systematic risk measured as beta of the companies the owner-managers' firms are close to unity, with an average beta of 1.08 and a

median beta of 0.949.⁸ The average (median) total risk of these firms measured as annualized standard deviation is 67.9 percent (64.3 percent). [See appendices, table 1].

2.2. Risk Characteristics Owner-Managers' Portfolios

Table 1 Panel B presents the number of firms in the owner-managers equity portfolios and the risk characteristics of those portfolios. The average (median) number of firms in the owner-managers' equity portfolios is 11 (6). When calculating the value and risk characteristics of the owner-managers portfolios, non-listed firms are not considered since market values and historical returns data are lacking for these firms.⁹ Risk characteristics of the equity portfolios held by the owner-managers are calculated using weekly equity return data during 2001. Because some stocks were only traded a short period in 2001 and some stocks were very illiquid, the risk characteristics are only estimated for 255 out of the 288 listed firms held by the owner-managers. The average beta of the owner-managers portfolios is 1.062 (median 0.946), and the average total risk measured by annualized standard deviation is 57.9 percent (median 52.5 percent). The fraction of idiosyncratic risk in relation to total risk measured as variance is on average 73.4 percent (median 63.3 percent). The high degree of idiosyncratic risk in the portfolios indicates that much of the total risk in the portfolios could be reduced with a higher degree of diversification. [See appendices, table 2].

Table 2 panel A provides statistics on the most widely held stocks among the owner-managers in our sample. It appears as if Swedish owner-managers roughly invest in the same stocks as the general investor. The most common Swedish stocks among all shareholders (Rank number of shareholders) are also the most common stocks among the owner-managers in our sample. One exception is Föreningsparbanken which is the third most common stock ranked on number of shareholders (tenth largest stock according to market capitalization) in general but not one of the 18 most popular stocks among our sample of owner-managers. Another bank, Nordea, was the third largest Swedish stock ranked on market capitalization but not one of the 18 most popular stocks in our sample.

Panel B reports the industry sectors in which the owner-managers' firms are active. Almost half of the sample is active in Information Technology

⁵ Swedish companies domiciled abroad are not included.

⁶ Owner-managers active in companies with shares traded less than three months during 2001 are also removed from the sample.

⁷ Swedish firms often issue two types of shares (A and B) with equal cash flow rights but different voting rights. Typically, A shares are one-share-one-vote while B-shares carry 1/10 vote per share.

⁸ Beta and standard deviation are estimated with weekly equity return data during 2001. Affärsvärldens Generalindex (AFGX) is used as the market portfolio.

⁹ This shouldn't be a major issue since on average only one out of the average 11 firms in the portfolios is a non-listed firm (median is zero firms).

(47 percent) and Telecom (2 percent). The other classified industry sectors are Industrials (24 percent), Consumer Discretionary (10 percent), Financials (10 percent), Health care (4 percent), and Materials (3 percent). [See appendices, table 3].

2.3. Industry Concentration of Portfolios

Table 3 presents industry composition and statistics on the degree of industry concentration in the owner-managers' equity portfolios. All the listed firms held by the owner-managers are categorized as belonging to one of ten industry sectors according to the Global Industry Classification System (GICS) provided by Morgan Stanley Capital International and Standard & Poor's.

We use the Herfindahl Index (HI) as a measure of the industry concentration in the owner-managers' equity portfolios.¹⁰ The Herfindahl Index of equity portfolio j is defined as the sum of the squared value weights of each industry i in the equity portfolio:

$$HI_j = \sum_{i=1}^N w_{i,j}^2, \frac{1}{N} \leq HI_j \leq 1 \quad (1)$$

The Herfindahl Index is constrained between a maximum of one, i.e. the equity portfolio only consists of stocks in one industry sector and a minimum of 1/10, when the equity portfolio consists of an equal value in each of the ten industry sectors.

The median equity portfolio among the owner-managers has a very high proportion of investments in few industry sectors since the Herfindahl Index is close to one (0.948). Even if we exclude the owner-managers' investments in their own firms the Herfindahl Index for the median equity portfolio is high (0.529).

3. Empirical Results

In this section we first report results on how owner-managers choose to invest remaining wealth given a large investment in their own firm. We then investigate whether the owner-managers would have been better off had they invested remaining wealth in the market portfolio. Finally, we explore whether owner-managers in high-tech industries try to use their superior industry specific knowledge by investing also remaining wealth in the information-technology and telecom sectors.

3.1. Correlation between the firm and other investments

In table 4 panel A we report the correlation between the owner-manager's firm and the other stocks in his portfolio. We compare this correlation to the firm's correlation with a randomly chosen Swedish stock,

i.e. the average correlation between the firm and other Swedish stocks. We report results for equally and value weighted portfolios.

The results for the equally weighted portfolios suggest that managers choose to invest remaining wealth in stocks with significantly higher correlation with their own firm than a randomly chosen Swedish stock. This is inconsistent with owner-managers seeking to minimize their exposure to idiosyncratic risk. However, if we account for the different stocks' weight in the portfolios, owner-managers chose stocks with similar correlation with their own firms as the average Swedish stock. Hence, it appears as if the average owner-manager chooses other stocks without taking the correlation with the firm in which he has a substantial block into account. This is still inconsistent with owner-managers seeking to minimize their exposure to idiosyncratic risk. In fact, for all owner-managers in our sample there are other Swedish stocks with negative correlation with the firm in which they have their main investment. [See appendices, table 4].

3.2. Correlation among other investments

It is not only the correlation with owner-manager's firm that affects the idiosyncratic risk of the owner-manager's portfolio. The correlation among the other stocks chosen by the owner-manager is also of interest. In table 4 panel B we report the correlation between the other stocks in the owner-managers' portfolios. The average correlation between the other stocks in the owner-managers' portfolios is 0.291. If the owner-manager's firm is included, the average correlation is 0.283. These correlations are compared to the average correlation between Swedish stocks. Would the owner-manager pick two other stock at random they would have a significantly lower correlation coefficient at 0.227. Thus, it appears as if the owner-managers choose other stocks with significantly higher correlation between themselves than the average stocks. We return to this issue in section 3.4.

3.3. Unique (Idiosyncratic) Risk

In panel A we show that owner-managers do not choose other stocks with lower correlation with their own firms than the average Swedish stock. In panel B we show that the other stocks in the owner-managers' portfolio show higher correlation between themselves than the average Swedish stocks. In panel C we investigate how this affects their portfolio risk. We compare the owner-manager's actual *Portfolio* to an *Alternative* where remaining wealth, i.e. wealth invested on the Swedish stock market but not in his own firms, is invested in the market portfolio.

Taking the investment in the firm as a constraint the optimal strategy for remaining wealth is probably not a combination of the risk-free asset and the

¹⁰ The Herfindahl Index is a popular measure of concentration in economics and is also used by the Department of Justice in the U.S. to determine whether mergers are equitable to society.

market portfolio (Merton, 1971). Thus, the *Alternative* portfolio is not the optimal portfolio. It is a simple alternative that would not require solving for the constrained optimum portfolio weights.

Both the actual *Portfolio* and the *Alternative* portfolio have beta-values close to unity. However, the return variance is significantly higher for the actual *Portfolio* compared to the *Alternative* portfolio. And this difference stems from higher idiosyncratic risk. The market risk does not differ between the portfolios. Thus, the owner-managers would significantly reduce their exposure to idiosyncratic risk would they invest remaining wealth in the market portfolio instead of the stocks they have chosen.

3.4. Owner-managers in high-tech industries

Our results so far suggest that owner-managers do not seek portfolio diversification when they invest remaining wealth. An alternative hypothesis is that they seek to exploit their industry specific superior knowledge and invest also remaining wealth in the same sector as their own firm, i.e. stocks with high correlation between themselves and with the owner-managers' own firms. This would be contrary to portfolio diversification and roughly consistent with our results so far. We conjecture that superior knowledge is most valuable in high-tech industries. The information technology and telecom sectors are defined as high-tech industries and we split the sample according to whether the owner-manager's firm is active in a high-tech industry or not. A firm is defined as being active a high-tech industry if it report information technology or telecom as its main sector. 53 owner-managers in our sample (49 percent) are active in high-tech industries.

In table 5 panel A we report various portfolio characteristics for owner-managers in high-tech industries and traditional industries, respectively. The value of the owner-managers' investment in the firm, its fraction of the total portfolio of Swedish equity, and the number of firms in the portfolio do not differ between the two subsamples.¹¹ However, the risk characteristics, i.e. beta, variance, market risk, and idiosyncratic risk, are all significantly higher for owner-managers in the high-tech industry. This is of course due to the turbulence in the information technology and telecom sectors in 2001. However, the average owner-manager in high-tech industries lose more diversification benefits (*Lost Diversification*) from not investing remaining wealth in the market portfolio than the average owner-manager in traditional industries. This result is not

necessarily due to the turbulence in the information technology and telecom sectors. *Lost Diversification* is defined as the difference between the actual *Portfolio's* idiosyncratic risk and the *Alternative* portfolio's idiosyncratic risk.

In panel B, C, and D we investigate whether the owner-managers in high-tech industries choose other stock in their portfolios differently from owner-managers in traditional industries. We first concentrate on the correlation with the owner-manager's own firm in panel B. On average, owner-managers in high-tech sectors chose other stocks that have correlation coefficients with the owner-managers' firm above 30 percent. Owner-managers in traditional industries chose stocks with significantly lower correlation with their main investment. On average, the correlation coefficients for the stocks chosen by owner-managers in traditional industries are 0.216 and 0.228 for the equally and value weighted portfolio, respectively.

In panel C we look at the correlation between the chosen stocks. Again, owner-managers in high-tech industries chose stocks that among themselves show correlation coefficients above 0.3. And owner-managers in traditional industries chose stocks that among themselves show significantly lower correlations. The same pattern is evident also when the owner-managers main investment is included in the correlation matrix.

Panel B and C suggest that owner-managers in high-tech industries invest in other stock that are highly correlated among themselves and highly correlated with the owner-managers main investment. Thus, it appears as if owner-managers in high-tech industries try to exploit their industry specific superior information (real or perceived). However, so far we have only looked at correlations and not explored in what firms and industries the owner-managers actually invest. We turn to this issue in panel D.

We first look at how much of the portfolio that is invested in the main industry, i.e. the industry in which the owner-manager's firm is active. With respect to this measure, the portfolios of owner-managers in high-tech industries show no significant differences compared to the portfolios of owner-managers in traditional industries. As an alternative measure we estimate the Herfindahl index based on the portfolio's industry composition. The Herfindahl index suggests no significant differences.

However, the results based on the remaining wealth suggest significant differences. Owner-managers in high-tech industries invest significantly more of their remaining wealth in the same sector as their main investment. The average owner-manager invests more than 40 percent of remaining wealth in the same sector as his main investment. The average owner-manager in traditional industries invests about 20 percent of remaining wealth in the same sector as his main investment. Would the owner-manager seek

¹¹ The skewed distribution (average 1241 and median 17) of the *Value of manager's investment* in Traditional industries is due to one observation. Therefore, the t-test does not suggest a significance difference between High Tech Industries and Traditional Industries.

diversification, this should probably be zero. Estimating the Herfindahl index only for remaining wealth suggests a similar pattern. Owner-managers in high-tech industries concentrate the remaining wealth to the main sector to a larger extent. The difference is significant at the 10 percent level.

During the IT-boom individuals in general invested substantial amounts in information technology stock. Do owner-managers in information technology really choose to invest remaining wealth in the same industry as their major investment or is this result driven by spurious correlation, i.e. do owner-managers in other industries also invest substantial amounts in the IT sector? For them this would look like diversification. For owner-managers in high tech firms it would look like "specialization". We test this hypothesis and find that owner managers within high tech industries invest significantly more of their remaining wealth in information technology than owner-managers in traditional industries. The median high-tech manager invests 45 percent of remaining wealth in information technology stock. The median manager in traditional industries invests 24 percent of remaining wealth in information technology stock.

3.5. Cross-Sectional Regressions

So far we have not controlled for factors that may affect the owner-managers' portfolios choice. Younger individuals may be more willing to hold more risky portfolios. Likewise, wealthier individuals may be more willing to hold more risky portfolios. And CEOs may to a larger extent hold restricted stocks which they are not allowed to sell. CEOs may also have more industry specific superior knowledge than chairmen. Is it these types of spurious correlations that drive the results reported above?

Indeed we find that younger individuals and CEOs hold more risky portfolios (unreported). However, the CEO result appears to be explained by age, i.e. CEOs are on average significantly younger than Chairmen. And the age result appears to stem from age being positively correlated with wealth. In sum, older individuals are wealthier and they are more likely to be chairmen than CEOs.

In table 6 we report cross-sectional regression with various portfolio characteristics as explanatory variables. An indicator variable, *IT-Dummy*, is used as an approximation of the amount of industry specific superior knowledge that the owner-manager possesses. *IT-Dummy* is equal to one if the owner-manager's firm is active in information technology or telecom. We control for the owner-manager's age, whether he/ she is CEO, and the total wealth they have invested on the Swedish stock market.

In M1, *Lost Diversification* is the dependent variable. *Lost Diversification* is defined as the difference between the actual portfolio's

idiosyncratic risk and the *Alternative* portfolio's idiosyncratic risk. The *IT-DUMMY* variable is positively significant indicating that owner-managers in high-tech industries give up more diversification by not investing in the market portfolio, compared to owner-managers in traditional industries. The control variables are insignificant. In M2-M5 we investigate what aspects of the portfolio choice of owner-managers in high-tech industries that could explain why they forfeit more diversification benefits than other owner-managers. Is it that they invest i) in other stock that is highly correlated with their firms, ii) in other stock that are highly correlated among themselves, iii) the industry composition of the total portfolio and/ or the industry composition of remaining wealth?

In M2, *Correlation(firm, other portfolio stock)* is the dependent variable. It is defined as the value weighted average correlation between the owner-manager's firm and the other stocks in his/her portfolio of Swedish equity. Again the *IT-DUMMY* is positively significant indicating that especially owner-managers in high-tech industries chose to invest remaining wealth in stock that is highly correlated with the firm in which they have a major investment. *AGE* and *CEO DUMMY* are also positively significant at the one percent and ten percent level, respectively.

In M3, *Correlation among other portfolio stock* is the dependent variable. It is defined as the average correlation between other stocks in the owner-manager's portfolio. The *IT-DUMMY* is positively significant at the 10 percent level. Thus, not only do owner-managers in high-tech industries choose other stocks that are highly correlated with their major investment, they also choose stocks that are highly correlated among themselves. The control variables are all insignificant in M3.

In M4 *Main's fraction of total portfolio* is dependent variable. It is defined as the proportion of total wealth invested on the Swedish stock market that is invested in the same industry as the owner-manager's major investment. The *IT-DUMMY* is here negatively significant indicating that owner-managers in high-tech industries in fact have a smaller proportion of their portfolio of Swedish equity in the same industry as their major investment. This stems from the fact that owner-managers in high-tech industries have invested less of their wealth in their own firms compared to owner-managers in traditional industries. It is not a result of owner-managers investing remaining wealth outside the industry in which they have their major investment. This is evident from M5.

In M5 *Main sector of remaining portfolio* is dependent variable. It is defined as the proportion of the owner manager's remaining wealth that is invested in the same sector as the owner-manager's firm reports as its main sector. The *IT-Dummy* positive and highly significant. This is stronger

evidence consistent with the argument that owner-managers in high-tech try to exploit their industry specific superior knowledge when choosing how to invest remaining wealth.

3.6. Optimal Portfolios

Merton (1971) points out that given investment constraints the optimal portfolio is not a combination of the risk-free asset and the market portfolio. Thus, given the large investment in the main firm remaining wealth could probably be invested better than in the market portfolio. In this section we investigate this issue.

We first solve for the owner-manager's optimal portfolio given the large investment in the own firm. This portfolio is labelled the *Hedge portfolio*. This is done by taking the volatility of the actual portfolio as given and maximizing expected return. Thus, we conjecture that the volatility of the actual portfolio captures the owner-managers risk-aversion and find the maximum expected return given the chosen risk. The owner-manager can choose to invest in ten different industry indices.¹² The expected return is defined according to CAPM where the risk-free rate is set to 2 percent and the market risk-premium to 5 percent.¹³ Second, we solve for the *Optimal portfolio* setting the main investment to zero. The expected return is maximized given the same volatility as the actual portfolio. Finally, we compare the Sharpe ratios for the different portfolios.

In Table 7 panel A we report the expected return, yearly volatility, and the Sharpe ratio for the actual portfolio, the *Alternative portfolio* (remaining wealth in the market portfolio), the *Hedge portfolio*, and the *Optimal portfolio*. The mean volatility is not the same for the actual portfolio, the *Hedge portfolio* and the *Optimal portfolio* since it was not always possible to construct a portfolio with as high volatility as the actual portfolio with the ten sector indices. The medians are however, the same for these three portfolios. It differs for the *Alternative portfolio* since it is constructed without conditioning on volatility. We therefore focus on the Sharpe ratios. The mean and median Sharpe ratios increase linearly when we go from the actual portfolio to the *Optimal portfolio*. In panel B the difference tests show that i) the *Alternative portfolio* has a significant higher Sharpe ratio than the actual portfolio, ii) the *Hedge portfolio* is significantly better than the *Alternative portfolio*, and iii) the *Optimal portfolio* is superior to the *Hedge portfolio*. However, even though statistically significant, the economic importance of the difference between the actual

portfolio and the *Alternative portfolio* and the *Hedge portfolio*, respectively, is moderate. The median Sharpe ratio of the actual portfolio is 0.095. The Sharpe ratio of the *Hedge portfolio* is 0.101. The small difference is a function of that, on average, remaining wealth is a small part of the owner-managers' equity portfolios, just over 20 percent. Our results suggest that even if it possible to form statistically better portfolios using these 20 percent, the economic difference is small.

Finally, we note that the median owner-manager in our sample could have increased the Sharpe ratio of his equity portfolio by 45 percent (0.174 compared to 0.095) would he sell the large block. This is a casual estimate of the cost of under diversification. Heaney and Holmen (2004) uses direct estimates of Swedish owner-managers' total wealth and an approach based on utility functions. Given a constant relative risk aversion parameter of 2, they report a median cost associated with under diversification of 17 percent. The difference between our estimate of under diversification, 45 percent, and Heaney and Holmen's (2004) estimate might be a result of the different wealth estimates used. In this paper we only use wealth invested in Swedish equity. Heaney and Holmen use estimates of total wealth and report that the average owner-manager has roughly 50 percent of total wealth invested in the own firm.

4. Summary and Conclusion

Previous empirical work has found that investors tend to hold under diversified portfolios made up of a limited number of stocks on which the investors have superior information. Furthermore, there is evidence that managers concentrate large fractions of their wealth in the equity of their own firm. In this paper we use a unique dataset and investigate how Swedish owner-managers invest remaining wealth conditional on a major investment in their own firm. We find limited evidence that owner-managers choose to invest remaining wealth in stocks that show low correlation with the firm in which they have a substantial fraction of their wealth invested. Owner-managers also choose other stocks that show higher correlation among themselves than the average Swedish stocks. Our results appear to be driven by managers in high tech-industries who invest also remaining wealth in the information technology and telecom sectors. We conjecture that the value owner-managers attach to their industry specific knowledge should be highest in these sectors and conclude that instead of seeking diversification benefits, owner-managers seek to exploit their superior information when they choose in which stock to invest remaining wealth.

We also document that owner-managers would be better off would they invest remaining wealth in the market portfolio. However, the owner managers

¹² We choose to focus on the portfolios' industry composition in order to conform to the results reported above. Furthermore, using all the traded Swedish stocks in the optimization would be computationally extensive.

¹³ The choice of risk-free rate and market risk-premium does not qualitatively affect our results.

would be better off still would they invest remaining wealth in a portfolio that would hedge their main investment. Finally, by comparing Sharpe ratios we provide a casual estimate of the cost the owner-managers bear in terms of under diversification. On average, the owner-managers could have improved their Sharpe ratios by 45 percent would they have sold their main investment and invested in a well diversified portfolios.

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Appendices

Table 1: Descriptive Statistics

This table presents characteristics of the owner-managers' firms and equity portfolios. The sample used in this study consists of the equity portfolios held by 109 owner-managers (CEO or Chairman) active in Swedish firms as of December 28, 2001. *Owner-manager's age* is the age of the owner manager as of December 28, 2001. *Market cap firm* is the market capitalization value in million SEK of the owner-manager's firm as of December 28, 2001. *Value of manager's investment in firm* is the value in million SEK of the owner manager's investment in the firm per December 28, 2001. *Value of manager's portfolio* is the value in million SEK of the owner manager's total portfolio of Swedish stocks. *Fraction firm in portfolio* is defined as *Value of manager's investment firm* divided by *Value of manager's portfolio*. *Capital fraction* is the owner-manager's fraction of the firm's equity capital. *Vote fraction* is the owner-manager's fraction of the firm's voting rights. *Beta firm* is the equity beta of the owner-manager's firm. *Std Dev firm* is the annualized standard deviation of stock price changes. *Variance firm* is the annualized variance of stock price changes. *Beta firm*, *Std Dev firm* and *Variance firm* are estimated on weekly data during 2001 (52 observations). *Market Risk firm* is defined as *Beta firm* squared times the variance of the market portfolio. *Idiosyncratic Risk firm* is defined as *Variance firm* - *Market Risk firm*. *Number of firms* is the number of Swedish firms in the owner-manager's portfolio of Swedish equity. *Number of non-listed firms* is the number of non-listed firms in the owner-manager's portfolio of

Swedish equity. *Beta portfolio* is the equity beta of the owner-manager's portfolio. *Std Dev portfolio* is the annualized standard deviation of the return in the owner-manager's portfolio. *Variance firm* is the annualized variance of the return in the owner-manager's portfolio. *Market Risk portfolio* is defined as *Beta portfolio* squared times *Variance portfolio*. *Idiosyncratic Risk portfolio* is defined as *Variance portfolio* - *Market Risk portfolio*.

Panel A: Risk and ownership characteristics of the owner-managers' firms

	Mean	Min	Median	Max	Stdev
<i>Owner-manager's age</i>	51	34	52	77	9
<i>Market cap firm</i>	2,806	9	377	158,483	15,853
<i>Value of manager's investment in firm</i>	664	0.050	16	61,513	5,901
<i>Fraction firm in portfolio</i>	0.788	0.007	0.939	1	0.289
<i>Capital fraction</i>	0.110	0.001	0.053	0.609	0.135
<i>Vote fraction</i>	0.176	0.001	0.080	0.906	0.222
<i>Beta firm</i>	1.080	-0.026	0.949	2.883	0.773
<i>Std Dev firm</i>	0.679	0.163	0.643	1.622	0.339
<i>Variance firm</i>	0.575	0.027	0.413	2.632	0.553
<i>Market Risk firm</i>	0.123	0.001	0.065	0.600	0.139
<i>Idiosyncratic Risk firm</i>	0.452	0.021	0.309	2.353	0.469

Panel B: Characteristics of the owner-managers' equity portfolios

	Mean	Min	Median	Max	Stdev
<i>Value of manager's portfolio</i>	683	0.371	22	61,827	5,932
<i>Number of firms</i>	11	1	6	83	14
<i>Number of non-listed firms</i>	1	0	0	7	1.334
<i>Beta portfolio</i>	1.062	-0.006	0.946	2.683	0.628
<i>Std Dev portfolio</i>	0.579	0.163	0.525	1.465	0.281
<i>Variance portfolio</i>	0.414	0.027	0.275	2.148	0.375
<i>Market Risk portfolio</i>	0.109	0	0.065	0.519	0.116
<i>Idiosyncratic Risk portfolio</i>	0.304	0.013	0.174	1.671	0.303

Table 2: Most Widely Held Stocks and Industries among Owner Managers

In this table we provide statistics on the most widely held stocks and industry sectors in the owner-managers' equity portfolios. The sample used in this study consists of the equity portfolios held by 109 owner-managers (CEO or Chairman) active in Swedish firms as of December 28, 2001. In total the 109 owner-managers have invested in 370 different Swedish firms. In this table we report the 18 firms in which more than 10 percent of the owner-managers have invested. The firms are ranked according to market capitalization on the Stockholm Stock Exchange and number of shareholders.

Panel A: Most widely held stocks

<i>Firm</i>	<i>Industry Sector</i>	<i>Percent of sample</i>	<i>Market Cap</i>	<i>Rank Market Cap</i>	<i>Rank number of shareholders</i>	<i>Equity Beta</i>	<i>Stdev</i>
Ericsson	IT	39	461	1	2	2.25	0.69
Telia	Telecom	21	140	4	1	0.61	0.39
Skandia	Financials	20	78	7	9	2.02	0.64
SEB	Financials	18	67	11	4	1.01	0.47
H & M	Consumer Discretionary	17	180	2	7	0.99	0.51
Tele2	Telecom	17	54	15	20	1.55	0.54
Volvo	Industrials	15	77	8	5	0.76	0.33
Electrolux	Consumer Discretionary	14	57	14	21	1.21	0.47
Sandvik	Industrials	14	58	13	22	0.93	0.36
Skanska	Industrials	14	26	23	18	0.71	0.44
Billerud ¹	Materials	13	4	62	6	-	-
Scania	Industrials	13	38	19	26	0.54	0.28
Gambro	Health Care	12	23	26	15	0.36	0.31
Investor	Financials	12	88	6	8	0.77	0.31
SCA	Materials	11	67	12	19	0.57	0.28
Atlas Copco	Industrials	10	49	18	28	1.12	0.42
SSAB	Materials	10	10	40	34	0.71	0.36
SHB	Financials	10	110	5	12	0.42	0.23

Billerud was listed in the end of November 2001. Reliable estimates of Equity Beta and Standard Deviation are therefore not available at December 28, 2001.

Panel B: Industry sectors in which the owner-managers' firms are active

<i>Industry Sector</i>	<i>Percent of sample</i>	<i>Frequency</i>
Information Technology	47	51
Industrials	24	26
Consumer Discretionary	10	11
Financials	10	11
Health Care	4	5
Materials	3	3
Telecom	2	2
	100	109

Table 3: Industry Concentration of Portfolios

In this table we provide statistics on owner-managers' portfolio composition in terms of different industries. The sample used in this study consists of the equity portfolios held by 109 owner-managers (CEO or Chairman) active in Swedish firms as of December 28, 2001. Industries are defined according to Global Industry Classification Standard (GICS). *Main sector of total portfolio* is the fraction of the total portfolio that is invested in the same sector as the owner-manager's firm report as its main sector. *Main sector of remaining portfolio* is the fraction of the remaining portfolio, i.e. wealth not invested in the firm, that are invested in the same sector as the owner-manager's firm report as its main sector. *Herfindahl total portfolio* is the Herfindahl index estimated on the industry composition of the total portfolio. *Herfindahl remaining portfolio* the Herfindahl index estimated on the industry composition of the remaining portfolio.

	Mean	Min	Median	Max	Stdev
<i>Main sector of total portfolio</i>	0.852	0.077	0.973	1	0.223
<i>Main sector of remaining portfolio</i>	0.315	0	0.206	1	0.343
<i>Herfindahl total portfolio</i>	0.821	0.193	0.948	1	0.222
<i>Herfindahl remaining portfolio</i>	0.580	0.182	0.529	1	0.306

Table 4: Risk Characteristics Owner Managers' Portfolios

In this table we provide risk characteristics of the owner-managers' portfolios of Swedish equity. The sample used in this study consists of the equity portfolios held by 109 owner-managers (CEO or Chairman) active in Swedish firms as of December 28, 2001. *Correlation (firm, other portfolio stocks)* is the average correlation between the owner-manager's firm and the other stocks in his/ her portfolio of Swedish equity. *Correlation (firm, other Swedish stocks)* is the average correlation between the owner-manager's firm and other Swedish stocks. *Correlation portfolio stocks* the average correlation between the stocks in the owner-manager's portfolio of Swedish equity. This is estimated with and without the owner-manager's firm. *Correlation Swedish stocks* is the average (median) correlation between the 255 Swedish stocks used in this study. *Portfolio* is the owner-manager's actual portfolio of Swedish equity. *Alternative* is a portfolio where remaining equity investments, i.e. wealth not invested in the firm, has been invested in the market portfolio. The market portfolio is approximated by Affärsvärldens General Index (AFGX). *Beta* is beta for *Portfolio* and *Alternative*, respectively. *Variance* is annualized variance of value changes for *Portfolio* and *Alternative*, respectively. *Beta* and *Variance* are estimated on weekly equity return data during 2001 (52 observations). *Market Risk* is defined as *Beta* squared times *Variance*. *Idiosyncratic Risk* is defined as *Variance* minus *Market Risk*. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Correlation between main investment and other stocks in portfolio

	<i>Correlation (firm, other portfolio stocks)</i>		<i>Correlation (firm, other Swedish stocks)</i>		<i>Difference test</i>	
	Mean	Median	Mean	Median	t-test	Wilcoxon ranksum
Equally	0.265	0.278	0.226	0.235	1.774*	1.990**
Value weighted	0.276	0.275	0.277	0.290	0.980	1.004

Panel B: Correlation between stocks in portfolio

	<i>Correlation portfolio stocks</i>		<i>Correlation Swedish stocks</i>		<i>Difference test</i>	
	Mean	Median	Mean	Median	t-test	Wilcoxon ranksum
Excluding firm	0.291	0.292	0.227	0.231	4.955***	4.445***
Including firm	0.283	0.288	0.227	0.231	4.565***	4.588***

Panel C: Risk measures

	<i>Portfolio</i>		<i>Alternative</i>		<i>Difference test</i>	
	Mean	Median	Mean	Median	t-test	Wilcoxon ranksum
<i>Beta</i>	1.061	0.946	1.042	0.975	0.880	0.793
<i>Variance</i>	0.414	0.275	0.389	0.269	2.017**	4.494***
<i>Market Risk</i>	0.109	0.065	0.103	0.068	1.287	0.921
<i>Idiosyncratic</i>	0.304	0.174	0.286	0.164	2.406**	5.828***

Table 5: Risk Characteristics and Industry Composition Sorted by High Tech Industry (IT and Telecom)

In this table we provide statistics on the risk-characteristics of the owner-managers' portfolios and split the sample according to whether the owner-manager's firm is active in a High-Tech Industry (Informational Technology or Telecom) or not. The sample used in this study consists of the equity portfolios held by 109 owner-managers (CEO or Chairman) active in Swedish firms as of December 28, 2001. *Value of manager's investment (MSEK)* is the value in million SEK of the owner manager's investment in the firm per December 28, 2001. *Fraction of portfolio* is defined as *Value of manager's investment (MSEK)* divided by the value of the owner manager's total portfolio of Swedish equity. *Number of firms* is the number of Swedish firms in the owner-manager's portfolio of Swedish equity. *Beta* is beta for the owner-manager's portfolio of Swedish equity. *Variance* is annualized variance of value changes for the owner-manager's portfolio of Swedish stocks. *Market Risk* is defined as *Beta* squared times the variance of the market portfolio. *Idiosyncratic Risk* is defined as *Variance* minus *Market Risk*. *Lost Diversification* is the difference between the idiosyncratic risk of the owner-manager's actual portfolio and the idiosyncratic risk of an alternative portfolio, where remaining wealth, i.e. wealth not invested in the firm, is invested in the market portfolio. The market portfolio is approximated by Affärsvärldens General Index (AFGX). In panel B, the correlation between main investment and other stocks in portfolio is estimated as the average (equally weighted and value weighted) correlation between the owner-manager's firm and the other stocks in his/ her portfolio of Swedish equity. In panel C, the correlation between stocks in portfolio is estimated as the average correlation between the stocks in the owner-manager's portfolio of Swedish equity. This is estimated with and without the owner-manager's firm. In Panel D, *Main sector of total portfolio* is the fraction of the total portfolio that is invested in the same

sector as the owner-manager's firm report as its main sector. *Herfindahl total portfolio* is the Herfindahl index estimated on the industry composition of the total portfolio. *Main sector of remaining portfolio* is the fraction of the remaining portfolio, i.e. wealth not invested in the firm, that is invested in the same sector as the owner-manager's firm report as its main sector. *Herfindahl remaining portfolio* the Herfindahl index estimated on the industry composition of the remaining portfolio. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Risk measures

	High Tech Industry		Other Industries		Difference test	
	Mean	Median	Mean	Median	t-test	Wilcoxon ranksum
<i>Value of manager's</i>	53	9	1241	17	1.051	1.491
<i>Fraction of portfolio</i>	0.743	0.926	0.830	0.963	1.575	1.301
<i>Number of firms</i>	11	6	11	7	0.269	0.046
<i>Beta</i>	1.445	1.445	0.698	0.586	7.696***	6.287***
<i>Variance</i>	0.629	0.612	0.210	0.139	7.007***	6.305***
<i>Market Risk</i>	0.175	0.151	0.047	0.025	6.834***	6.287***
<i>Idiosyncratic Risk</i>	0.454	0.419	0.163	0.110	5.698***	5.335***
<i>Lost Diversification</i>	0.034	0.001	0.002	0.000	2.167**	1.533

Panel B: Correlation between main investment and other stocks in portfolio

	High Tech Industry		Other Industries		Difference test	
	Mean	Median	Mean	Median	t-test	Wilcoxon ranksum
Equally weighted	0.312	0.325	0.216	0.252	3.568***	3.471***
Value weighted	0.325	0.315	0.228	0.223	3.032***	2.938***

Panel C: Correlation between stocks in portfolio

	High Tech Industry		Other Industries		Difference test	
	Mean	Median	Mean	Median	t-test	Wilcoxon
Excluding main	0.319	0.314	0.266	0.281	2.103**	1.896*
Including main	0.314	0.337	0.251	0.274	2.668***	2.692***

Panel D: Industry Characteristics

	High Tech Industry		Other Industries		Difference test	
	Mean	Median	Mean	Median	t-test	Wilcoxon ranksum
<i>Main sector of total portfolio</i>	0.831	0.966	0.872	0.975	0.964	0.122
<i>Herfindahl total portfolio</i>	0.821	0.934	0.822	0.951	0.040	0.067
<i>Main sector of remaining</i>	0.418	0.315	0.207	0.143	3.048***	2.236**
<i>Herfindahl remaining portfolio</i>	0.637	0.617	0.519	0.433	1.865*	1.746*

Table 6: Cross-Sectional OLS Regressions with Various Portfolio Risk Characteristics as Dependent Variables

In this table we report OLS regression results. The sample used in this study consists of the equity portfolios held by 109 owner-managers (CEO or Chairman) active in Swedish firms as of December 28, 2001. Various portfolio risk characteristics have been used as dependent variables. *Lost diversification (M1)* is defined as the difference between the idiosyncratic risk of the owner-manager's actual portfolio and the idiosyncratic risk of an alternative portfolio, where remaining wealth, i.e. wealth not invested in the firm, is invested in the market portfolio. *Correlation (firm, other portfolio stocks) (M2)* is the value weighted average correlation between the owner-manager's firm and the other stocks in his/ her portfolio of Swedish equity. *Correlation other portfolio stocks (M3)* is the average correlation between the stocks in the owner-manager's portfolio of Swedish equity. This is estimated without the owner-manager's firm. *Main sector of total portfolio (M4)* is the fraction of the total portfolio that is invested in the same sector as the owner-manager's firm report as its main sector. *Main sector of remaining portfolio (M5)* is the fraction of the remaining portfolio, i.e. wealth not invested in the firm, which is invested in the same sector as the owner-manager's firm report as its main sector. Coefficients are reported with heteroscedasticity robust t-values in parentheses (White, 1980). 20 owner-managers only own stocks in one firm. Therefore, in the models where the dependent variable requires at least 2 stocks, the sample is reduced to 89. Furthermore, 11 owner-managers only own stocks in 2 firms. Therefore, in M3, where the dependent variable requires 3 stocks, the sample is reduced to 78. *IT-DUMMY* is equal to one if the owner-manager's firm report informational technology or telecom as their main sector, and zero otherwise. *AGE* is defined as the owner-manager's age. *CEO DUMMY* is equal to one if the owner-manager is CEO in the firm, and zero otherwise. *L WEALTH* is defined as the natural logarithm of value of the owner-manager's portfolio of Swedish equity. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

	M1 <i>Lost Diversification</i>	M2 <i>Correlation (firm, other portfolio stock)</i>	M3 <i>Correlation other portfolio stocks</i>	M4 <i>Main sector of total portfolio</i>	M5 <i>Main sector of remaining portfolio</i>
<i>IT-DUMMY</i>	0.0336	0.1345	0.0533	-0.1213	0.2608
<i>AGE</i>	0.0007	0.0054	-0.0011	-0.0089	0.0074
<i>CEO DUMMY</i>	-0.0001	0.0571	0.0446	0.0811	0.0921
<i>L WEALTH</i>	-0.0039	0.0118	0.0051	0.0153	0.0126
N Adj R ²	109	89	78	109	89

Table 7: Expected Return, Volatility, and Sharpe Ratios for the Actual Portfolio, the Alternative Portfolio and a Hedge Portfolio

In this table we provide statistics on characteristics of the owner-managers' actual portfolio, the alternative portfolio where remaining wealth is invested in the market portfolio, a hedge portfolio where remaining wealth is invested optimally in ten different sector indices based on the 10 sectors in the GICS, and the optimal portfolio (maximum expected return) with the same volatility as the actual portfolio. The hedge portfolio should conform to Merton's (1971) argument that given certain investment constraints, the optimal portfolio is not a combination of the risk-free asset and the market portfolio. The hedge portfolio is found by maximizing expected return given the main investment and the volatility of the actual portfolio. The optimal portfolio is found by maximizing expected return given the same volatility as the actual portfolio. When forming the hedge portfolio and the optimal portfolio 10 sector indices are used. The market portfolio is approximated by Affärsvärldens General Index (AFGX). Expected Return is defined as the risk-free rate plus the portfolio beta times the market risk-premium. The risk-free rate is set to 2 percent and the market risk-premium to 5 percent. *, **, and *** denote significance at the 10%, 5%, and 1% level, respectively.

Panel A: Characteristics of the owner-managers' actual portfolio, the alternative portfolio where remaining wealth is invested in the market portfolio, a hedge portfolio where remaining wealth is invested optimally in ten different sector indices, and the optimal portfolio with the same volatility as the actual portfolio.

		<i>Mean</i>	<i>Median</i>
Actual Portfolio	Expected Return	0.073	0.067
	Standard Deviation	0.579	0.524
	Sharpe Ratio	0.094	0.095
Alternative Portfolio	Expected Return	0.072	0.069
	Standard Deviation	0.558	0.519
	Sharpe Ratio	0.100	0.098
Alternative Portfolio 2	Expected Return	0.076	0.069
	Standard Deviation	0.567	0.524
	Sharpe Ratio	0.103	0.101
Optimal Portfolio	Expected Return	0.103	0.111
	Standard Deviation	0.475	0.524
	Sharpe Ratio	0.176	0.174

Panel B: Mean and median difference tests of the portfolios' Sharpe ratios

	<i>t-test</i>	<i>Wilcoxon Sign-rank test</i>
Actual Portfolio – Alternative Portfolio	3.635***	2.200**
Alternative Portfolio – Hedge Portfolio	2.715***	5.513***
Hedge Portfolio – Optimal Portfolio	17.656***	9.050***