Short-horizon insiders and stock trades in personal portfolios

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Abstract

We examine the effect of insider investment horizon on their personal portfolio choices. We observe significantly higher trading activities for short-horizon CEOs compared to those with a longer investment horizon. Short-horizon insiders trade more in own-firm stocks than long-horizon insiders do. Short-horizon insiders also trade more in own firm stock than their expertise stocks, defined based on industry familiarity or local stocks. The trades of short-horizon insiders consistently outperform the trades of long-horizon insiders in both own-firm trades and expertise trades. These results are mainly driven by insiders' purchases rather than their sales. Overall, our findings suggest that short-horizon insiders' trades are more informative compared to that of long-horizon insiders.

Keywords: Insiders' Personal Portfolio, CEOs, Investment Horizon, Expertise vs non-expertise stocks.

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1. Introduction

Despite a vast literature on insider trading, little is known about the personal portfolios of corporate insiders. In this paper, we examine whether insiders' investment horizon affects their personal portfolio choice.[4] The previous literature on investment horizon mainly focuses on outside investors. According to investor clienteles, short-term investors would hold the more liquid assets, while long-term investors would hold the less liquid ones (Amihud & Mendelson, 1991). Regarding retail investors, the literature highlights their preference for familiarity-based investments despite mixed evidence on the payoff (Barber & Odean, 2013). However, general behavior of retail or outside investors might not perfectly characterize the investment decisions of insiders who usually include CEOs, board members, top executives and other managers. Insiders are expected to not only be more wealthy, well-advised and sophisticated than the typical outside investor, but also considered to possess superior information relative to outside investors. Examining the trade composition of insiders, Ben-David et al. (2019) find that insiders trade firms from their own industry (so called expertise stocks) more frequently and outperform exclusively on their own-industry trades. The superior performance is argued to be driven by industry familiarity and expertise rather than the use of private information.

We build on this research and examine the role of expertise investments, defined as industry familiarity, in insiders' own portfolios in relation to insiders' investment horizon.[5] Our focus is on CEOs, the type of insiders usually assumed to have the most private information about the firm. We match insider trading data obtained from the Financial Supervisory Authority in Sweden to our quarterly investor data from Euroclear Sweden that contains 55 waves of investor holdings covering the periods between the first quarter of 2006 and the third quarter of 2019. We first establish that the trading volume of short-horizon insiders is significantly greater than that of long-horizon insiders. Short-horizon insiders trade more in own company stocks than long-horizon insiders do. Short-horizon insiders also trade more in own stock than their expertise stocks or other stocks. For long-horizon insiders, their trades on expertise stocks are more

[4] Following Akbas et al. (2020), we define an insider's investment horizon as the average annual net order flow in the insider's own-company stock over the past 10 years. The annual net order flow is defined as equal shares purchased by the insider minus shares sold by the insider, scaled by total shares traded. The measure ranges from -1 to +1. A net order flow value of -1 and +1 indicate a long-horizon inside trade, an insider is more persistent in selling and buying respectively over time, while net order flow values close to 0 indicates a short-horizon insider trade, and insider switches between buying and selling more frequently. Short-horizon insiders are assumed to update their position in a more timely fashion to realize profits.

[5] As a robustness we also define local stocks as expertise stocks, motivated by the large amount of literature on local bias and familiarity-based investments (see Coval & Moskowitz, 1999, 2001; Massa & Simonov, 2006; Lindblom et al., 2018; Seasholes & Zhu, 2010; Døskeland & Hvide, 2011).

frequent than their trades on non-expertise stocks. These results are consistent with the idea that the presence of short-horizon investors is positively related with the liquidity of the stock (Amihud et al., 2006).

Next, we explore whether short-horizon insiders' trades in their own portfolios are information driven or based on familiarity by examining the profitability of their trades. The existing evidence provides mixed results regarding the abnormal profitability of short-horizon insiders' trades. For instance, Akbas et al. (2020) argue that the trades of short-horizon insiders convey more predictive information relative to those of long-horizon insiders. On the other hand, Ben-David et al. (2019) focus on opportunistic industry insiders, i.e., the insiders whose trades do not follow a routine (Cohen et al., 2012), and find no evidence that they exploit inside information in their expertise trades. We contribute to this nascent literature by examining and comparing whether expertise investments in short-horizon insiders' own portfolios gain abnormal returns relative to their non-expertise investments. To explore this question, we use holdings-based portfolios, calendar time portfolio approach and transaction-based calendar time portfolio approach.

We first construct portfolios and calculate their value-weighted returns in each quarter based on short-horizon insiders, long-horizon insiders and trade type portfolios. The trade type portfolios are constructed for each insider group based on insiders' own company stock, expertise stocks in their portfolios (excluding own company stock), and non-expertise stocks in their own portfolios. Thus, our first analysis is at the insider-portfolio-quarter level.

To examine the performance of insiders' trades using calendar time portfolio approach, we build quarterly return portfolios based on our insider trade groups, assuming that insiders' hold them during each quarter, and rebalance their portfolios at the end of the quarter. We then conduct two-way sorting analysis where we partition the type of insider trades into short-horizon and long-horizon insider trade portfolios. The short-horizon insiders are determined by the median horizon value of the CEOs.[6] Insiders with an investment horizon value below and equal to the median are classified as short-horizon insiders and insiders with an investment horizon value above the mean are long-horizon insiders. Finally, within each type of trade, we take the difference of the returns in the short and long-horizon insider trade portfolios. We calculate and compare the average raw returns, market-adjusted returns, and Carhart (1997) four-factor alphas

[6] In additional analysis we use the mean value of our horizon measure as a cutoff.

in our three times two portfolio analysis. Our main results indicate that short-horizon insiders earn about 0.2% more abnormal returns than long-horizon insiders when trading their own-firm stocks. In addition, short-horizon insiders earn 0.9% more abnormal returns on their own-firm trades than on expertise trades. These findings suggest that short-horizon insiders' trades are information-driven. However, these results do not hold for long-horizon insiders who seem to earn more abnormal returns on their expertise stocks instead. The results indicate that the findings in Ben-David et al. (2019) are mainly driven by long-horizon insiders.

In additional analysis, to examine whether the abnormal profitability, particularly, in short-horizon insiders is driven by purchases or sales, we separate buy and sell transactions as they may indicate different reasons. While insider purchasing might be based on informed trading and signal positive news, insider sale can be related to other reasons than information such as liquidity needs, tax reasons, diversification purposes and it may signal that the firm is not performing well (Lynch & Rothchild, 2000). Consistent with these interpretations Degryse et al. (2014) document that insiders' purchases are followed by abnormal returns but their selling does not seem to generate abnormal returns. However, there is also disagreement in the literature regarding abnormal returns generated by insider purchases. While some studies show that insiders' purchase transactions generate positive abnormal returns (Degryse et al., 2014; Tavakoli et al., 2012), other studies show weak or no evidence of such finding (Cheuk et al., 2006; Van Geyt et al., 2014). This mixed documented evidence motivates us to separate buy and sell transactions when examining short-horizon insiders' trades in expertise stocks.

For the transaction-based portfolio analysis, we identify whether insiders buy or sell the stocks at the end of each quarter by computing the change in the holdings between the two quarters. We adjust the holdings for corporate events such as splits, reverse splits etc. so that the direction of trade reflects only the insiders' trade decision and is not based merely on corporate actions (our data do not allow us to identify the exact trade date within the quarter). We then partition trades in our aforementioned holdings-based portfolios further into buy and sell portfolios to obtain a total of 12 portfolios. In this analysis, we use buy and sell portfolios within each category to examine the insider trade profitability in a long-short strategy. With the 3 x 2 sorting scheme, we compute and compare the average raw returns, market-adjusted returns, and Fama-French and Carhart four-factor alphas in our 3 rows of insider trade type and 2 columns of short vs. long-horizon insider trade portfolios. In additional analysis, we also apply a calendar-time

portfolio approach by averaging the returns on purchases and sales each quarter. We find that the main results are generally driven by short-horizon insiders' purchases, not their sales.

This paper makes several contributions to the literature. First, while it is well documented that individuals tilt their portfolios towards familiar stocks such as stocks of their employers, industry peers, or local companies (Lindblom et al., 2018; Seasholes & Zhu, 2010), the performance of familiarity-based investments receives mixed evidence (Barber & Odean, 2013). Massa & Simonov (2006) find that Swedish investors concentrate holdings in stocks that are most closely related to them, either professionally or geographically, and earn higher returns than being diversified. Despite consistent and strong evidence of local bias, Seasholes & Zhu (2010) show that US individuals do not earn superior returns on their local investments. Døskeland & Hvide (2011) document that investors in Norway overweigh firms from the industry in which they are employed but underperform on expertise stocks.

Ben-David et al. (2019) examine insiders' own portfolios and find that insiders trade firms from their own industry (expertise stocks) more often and earn abnormal returns on their own-industry trades. Their results also reveal that abnormal returns earned on industry of expertise stocks and on non-expertise stocks significantly differ, suggesting that insider trading in expertise stocks is not information driven but rather based on familiarity to the industry. Insiders seem to have an advantage in processing public information on industry of expertise stocks. Our study adds new insights to this literature by examining the relationship between insiders' investment horizon and familiarity-based investments in their own portfolios. We show that the results in Ben-David et al. (2019) are mainly driven by long-horizon insiders. We also find some evidence that short-horizon insiders trade on information in their own company stock. Their trades in own stock are more profitable and more informative than long-horizon insiders' trades in their own stock.

Second, short-horizon insiders and their firms tend to display characteristics that are associated with a greater focus on short-termism (Akbas et al., 2020). Our paper contributes to this knowledge by relating insiders' investment horizon to their portfolio choices. Since future returns of investments in closely related stocks are likely to be correlated with future returns on human capital, rational investors are expected to hedge by ignoring familiar stocks unless they have an informational advantage that outweighs the diversification disadvantage (Baxter & Jermann, 1997; Cocco et al., 2005; Døskeland & Hvide, 2011; Massa & Simonov, 2006). Insiders are more likely to be considered as more informed and sophisticated among retail

investors. By examining whether insiders' own portfolios contain familiarity-based investments and how these portfolios perform we also provide more evidence on whether insiders hedge against their human capital.

Third, we study insider's personal portfolios using a rich dataset. We obtain daily insider trades between 2006 and 2019 from the Swedish Financial Supervisory Authority. We then match insiders (CEOs) to our detailed quarterly Euroclear investor data through given id numbers and obtain a clean dataset that provides CEOs' own investment portfolios. Thus, our dataset provides direct measures of expertise and non-expertise stocks of CEOs, unlike other studies that match insider data to investor data based on the name of the firm, the transaction dates, the direction of the trade, and the number of shares traded (Ben-David et al., 2019). Taken together, our final dataset contains insider's portfolios including all individual stocks held by the insider during the period and constructed based on quarterly ownership data. This dataset allows us to directly measure the proportion of capital invested in familiar stocks and consequently the degree of portfolio diversification.[7]

In previous research, the widely used retail investor data which come from a large discount brokerage firm include the trading records of 78,000 US investors during 1991-1996.[8] The comprehensive dataset of asset holdings by Swedish households used in Calvet et al. (2007, 2009) dates back to the 1999-2002 period. Our detailed analysis on insiders' own portfolios based on a more recent period also allows us to revisit whether the documented effects in Ben-David et al. (2019) are smaller or larger than that in their sample period of 1991-1996.

Finally, our findings have implications for outside investors and informativeness in efficient markets. Informational asymmetries enlarge the bid-ask spread and reduce liquidity (Amihud & Mendelson, 1991). The insider trades in their own firm stock, when disclosed, may signal to outsiders to follow suit, reduce informational asymmetries, and thus improve liquidity. Akbas et al. (2020) suggest that the trades of short-horizon insiders are more unexpected and more

[7] Our study focuses on direct stockholdings which we expect to represent a significant proportion of risky assets held by insiders. Calvet et al. (2007) show that the composition of the financial portfolio varies with gross wealth; though mutual funds dominate stocks in most Swedish household portfolios, the fraction of direct stockholdings quickly increases in the top percentile of wealth and is more than half of the richest households' financial wealth.

[8] See Barber and Odean (2000, 2001), Barber, Odean and Zhu (2009), Dhar and Zhu (2006), Goetzmann and Kumar (2008), Graham and Kumar (2006), Ivkovic, Poterba, and Weisbenner (2005), Ivkovic and Weisbenner (2005), Kumar (2009), Kumar and Lim (2008), Seasholes and Zhu (2010), and Ben-David et al. (2019). A detailed description of the data can be found in Barber and Odean (2000).

informative than the trades of long-horizon insiders.[9] This means that trades of short-horizon insiders can help identifying unexpected insider trades, which in turn, contributes to establishing a benchmark for expected patterns in insider trading.

The remainder of this paper proceeds as follows. In section 2, we derive our research hypotheses. Section 3 describes the dataset and the methodology. Section 4 presents the analysis and results, and section 5 provides our robustness and additional analysis. Finally, section 6 provides concluding remarks.

2. Research hypotheses

In an efficient market, the informativeness of insider trades is likely to depend on the degree to which the trades are unexpected (Cohen et al., 2012). As the trades of short-horizon insiders are more unexpected and more informed than those of long-horizon insiders (Akbas et al., 2020), the information provided by the (unexpected) trades of short-horizon insiders is valuable for outside investors. Some, if not all, of these unexpected trades are opportunistic (Bhattacharya, 2014; Cohen et al., 2012), they may eliminate the confidence of outside investors in financial markets, in an extreme case, they may even lead to market crashes. To this end, observing the short-horizon insiders' trades (arguably opportunistic trades) may serve as complement for or even alternative to the impact of regulatory mechanisms designed to discourage insider trading, since empirical evidence on the effectiveness of regulatory mechanisms has been mixed (see Adhikari et al., 2022; Seyhun, 1992). In this paper, we elaborate on the link between insider horizon, stock liquidity, and portfolio performance and develop two hypotheses based on insider-investment horizon.

2.1. Insider horizon, liquidity, and stock trades

The literature shows that investors are heterogeneous regarding their characteristics and investment behavior when they evaluate stocks. Their investment horizon, i.e., the period for which they hold the stock, is a crucial trait that may affect investors' preferences and tends to influence stock liquidity. Short-horizon investors would acquire more liquid assets while long-horizon investors hold less liquid assets (Amihud & Mendelson, 1991). Thus, the fraction of short-horizon investors should be positively related to the price of liquidity, implying that short-

[9] Akbas et al. (2020) defines an unexpected trade as the deviation between the current month's trading and the average annual net insider order flow across past 10 years of trading.

horizon investors have a higher reservation value of a more liquid stock. This makes short-horizon investors become marginal investors and bid up the stock price (see Amihud et al., 2006).

Unlike outside investors, CEOs naturally have access to privileged information and thus may act to exploit the information asymmetry to extract abnormal returns. These insiders hold substantial shareholding whose trades can potentially affect the overall liquidity of the stock. Insiders driven by the profit motive in the immediate future prey to short-termism, capitalize on the firm internal material information and trade more actively. If short-horizon insiders trade on information we should observe that their trades are in general more frequent than long-horizon insiders. This should particularly hold for own-firm stocks as private information on own-firm stocks is likely to be more than expertise or other stocks. Moreover, short-horizon insiders should also trade more own-firm stocks than expertise stocks. Thus, our first set of hypotheses is as follows:

H1: Short-horizon insiders trade more than long-horizon insiders do.
H1a: Short-horizon insiders trade their own-firm stocks more than long-horizon insiders.
H1b: Short-horizon insiders trade more own-firm stocks than expertise stocks.

Next, to further examine the information explanation of short-horizon insiders' trades, we study the performance of insiders' trades.

2.2. Insider horizon and information vs. familiarity-based trading

Insiders' personal investments can be information driven or familiarity based. The information hypothesis assumes a case of information asymmetry where insiders receive value-relevant (positive or negative) information about firms to which they are professionally connected (such as their own employers or industry peers) before outside investors (see for example, Coval & Moskowitz, 2001; Korniotis & Kumar, 2013; Seyhun, 1986). Under the familiarity hypothesis, industry insiders may have a comparative advantage in processing and interpreting information about firms in the same industry where they work (Massa & Simonov, 2006).

The literature documents that insiders are able to trade on private information and earn abnormal returns (Cziraki et al., 2014; Fidrmuc et al., 2006; Finnerty, 1976; Jaffe, 1974; Jeng et al., 2003; Mavruk & Seyhun, 2016; Seyhun, 1986), although transaction costs may deter insider trading's profitability (Eckbo & Smith, 1998; Lin & Howe, 1990). In a recent study, Ben-David et al. (2019) explore the trading patterns of industry insiders in their own personal portfolios and find

that industry familiarity is an advantage in stock trading. We add to this literature by exploring the heterogeneity of insiders in their investment horizon. We examine the composition of short- and long-horizon insiders' personal portfolios, and their respective performance.

If short-horizon insiders trade based on the superior information that they privately have access to, we expect to observe larger trading volume in own-company stocks than in other stocks as in H1. Furthermore, short-horizon insiders' trades in own-firm stocks should outperform their trades in both expertise stocks and non-expertise stocks. Finally, short-horizon insiders are also expected to outperform their long-horizon counterparts in own stock trades. Thus, our second set of hypotheses refers to the portfolio performance of insiders.

H2: Short-horizon insiders' trades in own-firm stocks outperform their trades in expertise stocks.
H2a: Short-horizon insiders' trades in own-firm stocks outperform their trades in non-expertise stocks.
H2b: Short-horizon insiders outperform their long-horizon counterparts in own stock trades.

The alternative hypothesis would be the familiarity based explanations of insiders' trades. If industry familiarity is an advantage to stock trading, we conjecture that insiders trade more expertise stocks than non-expertise stocks, and such decisions pay off. Moreover, if expertise investments are familiarity-based but not information driven, we do not expect short-horizon insiders to earn superior returns than long-horizon insiders in expertise trades. Finally, if long-horizon insiders do not trade on information in own stocks, the potential abnormal profits on their trades on expertise stocks can be explained by industry familiarity hypothesis. This is intuitive because it is unlikely for long-horizon insiders to have private information on expertise stocks but not own company stock.

3. Data and Method

To examine the effect of insider investment horizon on their personal portfolios, we focus on CEOs as they are expected to be the most informed insiders. We obtain information on CEOs' own-firm trades from the Swedish Financial Supervisory Authority's database, including publication date, transaction date, position within the firm, nature of the transaction, transaction

amount, the company's ISIN number, and other relevant details.[10] Using this comprehensive dataset, we calculate the investment horizon for 826 CEOs throughout our study period.

Next, we obtain information on the CEOs' personal portfolios from Euroclear Sweden for 55 quarters, spanning from the first quarter of 2006 to the third quarter of 2019. Euroclear Sweden provides quarterly stock holdings for all shareholders of firms listed on Swedish stock markets. Our sample firms are primarily listed on the Nasdaq OMX (large, middle, and small-cap) exchange. We merge horizon data with portfolio data using the CEOs' IDs (personnumbers) and the ISIN codes of the companies where they are employed. We then obtain stock prices as well as firm and stock characteristics from Capital IQ, and factor returns from Andrea Frazzini's website.[11] To proxy for the risk-free rate, we use the Swedish 3-month treasury bill rate, which is collected from Sweden's Central Bank database and converted from an annual rate to a quarterly rate.[12] Our final sample consists of 645 CEOs and 909 stocks.

3.1 CEOs' investment horizon

The investment horizon is an important characteristic of investors that usually remains constant over time (Cella et al., 2013), and thus helps us to understand the investors' trading style. While it is not directly observable, we can measure investment horizon from the insider's past trading behavior. Following Akbas et al. (2020), we measure the CEO's investment horizon as the average annual net order flows in the CEO's firm's stock over the past 10 years (40 quarters).[13] This measure tells us the CEOs' trading behavior towards the round-trip transactions: the higher tendency towards round-trip transactions, the shorter the investment horizon shorter.

To calculate horizon, we first calculate the CEO's annual order flow (COF) by scaling the net (four quarters including current quarter) trades (purchases minus sales) with the total trades (purchases plus sales) accumulated during the year (four quarters), as shown in equation (1).

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[10] https://marknadssok.fi.se/publiceringsklient/en-GB/Search/Start/Insyn database accessed on June 6, 2024.

[11] The factor returns are available at https://pages.stern.nyu.edu/~afrazzin/data_library.htm Data accessed on April 10, 2023.

[12] https://www.riksbank.se/en-gb/statistics/interest-rates-and-exchange-rates/search-interest-rates-and-exchange-rates/ data retrieved on April 05, 2021.

[13] We calculate CEO's quarterly HOR, as the Euroclear Sweden database contains investors' quarterly holdings data, although Akbas et al. (2020) calculate insider's monthly HOR. We do not multiply by -1 hence HOR value range in our study becomes 0 to 1, where Akbas et al. (2020) multiply by -1 that makes the HOR value range from -1 to 0 in their study. This deviation does not affect the result as I use HOR to classify insiders into short- and long-horizon insider groups in this study.

$$\mathrm{COF_{i,j,t}} = \frac{\sum_{t}^{t-3}(P_{i,j,t} - S_{i,j,t})}{\sum_{t}^{t-3}(P_{i,j,t} + S_{i,j,t})}, \quad (1)$$

where $COF_{i,j,t}$ is the annual net order flow of CEO i at firm j in quarter t. $P_{i,j,t}$ and $S_{i,j,t}$ are the purchase and sale of stocks respectively by CEO i at firm j in quarter t. According to equation (1), for only purchases, the COF value is P/P = +1, for only sales the COF value is –S/S = -1, and the COF value is 0 for the purchase and sell the same amount. This makes the range for COF value from -1 to +1.

Next, we compute the investment horizon (HOR) as the average of COF over the 10 years (40 quarters) preceding the current quarter. The equation for HOR is as follows.

$$HOR_{i,j,t} = \left|\frac{\sum_{t-1}^{t-40} COF_{i,j,t}}{N}\right|, \quad (2)$$

where $HOR_{i,j,t}$ is the investment horizon of CEO i at firm j in quarter t. N is the number of quarters CEOs traded over the last 10 years (40 quarters). HOR is the absolute value of the average COF over the last 40 quarters. This makes the value range for HOR from 0 to 1. This standardization makes the horizon measure equally applicable for both purchases only (that generate +1 for COF) and sales only (that generate -1 value for COF).

Following equation (2), we can see that when CEOs' purchases and sales do not offset each other over time, there would be a larger average absolute net order imbalance per year, which generates a longer investment horizon (HOR closer to 1). In contrast, CEOs who quickly offset purchases and sales have a shorter investment horizon (HOR closer to 0). We classify CEOs into short- and long-horizon categories using the median value of HOR, which is equal to one. Thus, CEOs with HOR values below one are considered short-horizon insiders, whereas those with HOR equal to one are long-horizon insiders.

3.2 Expertise vs. non-expertise stocks

We define expertise and non-expertise stocks based on industry in our main analysis, and use locality-based classification as an alternative. in the robustness analysis.

3.2.1 Industry based classification

We analyze CEOs' trading activities and profitability across their own-firm, expertise, and non-expertise stocks. In the baseline analysis, we use industry-based classification to define the expertise and non-expertise stocks following the study of Ben-David et al. (2019) and Døskeland & Hvide (2011). Stocks within the same industry where the CEO works (excluding the stocks of his or her own company) are considered expertise stocks, whereas stocks outside the industry are considered non-expertise stocks. We obtain industry classification from Capital IQ, which follows the Global Industry Classification Standard (GICS) and contains 11 sectors, 24 industry groups, 68 industries, and 157 sub-industries. In our analysis, we use the "24 industry groups" classification, following Ben-David et al. (2019) and Døskeland & Hvide (2011).

3.2.2 Locality based classification

In the robustness section, we use the locality-based familiarity to classify expertise and non-expertise, following other studies (see Coval & Moskowitz, 1999, 2001; Massa & Simonov, 2006; Lindblom et al., 2018; Seasholes & Zhu, 2010; Døskeland & Hvide, 2011). A stock is local, and hence classified as expertise, if the firm's headquarters is located in the municipality where the CEO lives.

3.3 Descriptive statistics

Panel A of Table 1 reports the average investment horizon, stock holding and investment values for both short- and long-horizon CEOs across different stock categories. The number of observations in the short-horizon group is almost half that of the long-horizon group across all categories of stocks. For example, under expertise stocks, the number of observations for short-horizon CEOs is 4,468, whereas the long-horizon group contains 9,254 observations. The mean horizon value for short-horizon CEOs ranges from 0.4560 to 0.4949 across various categories, such as expertise, non-expertise, and other stocks. In the full sample, the average horizon is 0.83.

Table 1: Descriptive Statistics

This table shows the descriptive statistics of CEOs' horizons, Holdings, Values (in the Swedish kronor), and control variables. Panel A presents CEOs' HOR, Holdings, and Values (in the Swedish kronor) across own, expertise, Non expertise, Local, and Non local stocks, and also shows the mean difference (t-statistics in the parentheses) between short- and long-horizon CEOs' investment in these stocks. Horizon (HOR) is the average annual net order flow in the CEO's firm's stock over the past 10 years. The range for the CEOs' horizon is 0 to 1. Holdings is the number of stocks held by the CEO of different firms in each quarter. Value is the total investment in the Swedish kronor of different firms each quarter. Panel B displays the detailed descriptive statistics of the variables used in the holdings regressions. We use Market capitalization, Book to market ratio, Debt to equity ratio, Return on assets, and Beta as control variables. In panel B, Holdings and Value are presented in thousands, whereas Market capitalization is presented in million Swedish kronor. The beta in this table is the 5-year beta of the stocks.

Panel A: Descriptive statistics of CEOs' Horizon (HOR), Holdings in stocks and Value of investment in Swedish Kronor

		Own stock		Expertise		Non expertise		Local		Non local	
Variables	Horizon	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
HOR	Short	3,509	0.4949	4,468	0.4574	19,135	0.4694	4,165	0.4802	14,853	0.4560
	Long	7,176	1	9,254	1	37,646	1	6,393	1	33,417	1
	All	10,685	0.8341	13,722	0.8233	56,781	0.8212	10,558	0.7950	48,270	0.8326
	Short - Long		-0.5051***		-0.5425***		-0.5306***		-0.5198***		0.5439***
			(-144.9269)		(187.0204)		(-367.4747)		(-147.9261)		(365.9293)
Holdings	Short	3,509	602,793	4,468	77,336	19,135	53,888	4,165	33,167	14,853	62,906
	Long	7,176	314,836	9,254	27,663	37,646	29,667	6,393	22,128	33,417	27,794
	All	10,685	409,402	13,722	43,837	56,781	37,829	10,558	26,483	48,270	38,598
	Short - Long		287,957***		49,673***		24,221***		11,039***		35,112***
			(19.3328)		(10.1206)		(12.7770)		(2.9452)		(15.8513)
Value (in thousands)	Short	2,657	28,717	3,785	3,058	14,902	3,921	3,480	677	12,387	5,021
	Long	6,106	12,180	8,119	762	30,601	1,280	5,340	589	28,976	858
	All	8,763	17,194	11,904	1,492	45,503	2,145	8,820	624	41,363	2,105
	Short - Long		16,537***		2,296***		2,641***		88		4,162***
			(12.0625)		(10.2189)		(10.6770)		(1.0996)		(17.2680)

Panel B: Control Variables								
Variables	N	Min	p25	Mean	SD	Median	p75	Max
HOR	53,742	0	0.7255	0.8300	0.2950	1	1	1
Holdings (thousand)	53,742	0.0010	0.5000	72	335	2	10	2,489
Value (thousand SEK)	53,742	0.0170	24	2,004	8,108	95	407	56,027
Market capitalization (million SEK)	53,742	0.0038	3,301	66,578	89,265	24,476	90,570	438,579
Book to market ratio	53,742	-0.1598	0.2965	0.5997	0.5065	0.4707	0.7720	4.2119
Debt to equity ratio	53,742	-6.4907	0.2522	1.2210	2.6314	0.5831	1.0667	21.4099
Return on assets	53,742	-0.9832	0.0197	0.0340	0.0904	0.0420	0.0674	0.2596
Beta (5 years)	53,742	-1.425	0.5046	0.7676	0.4847	0.7260	0.9819	3.1640

Panel A of Table 1 also displays the mean differences in investments between short- and long-horizon CEOs, along with the t-statistics for these differences across the different categories of stocks. Short-horizon CEOs invest significantly more in their own, expertise, and non-expertise stocks, in terms of both stock holdings and value in Swedish kronor, than their long-horizon counterparts. On average, short-horizon CEOs hold more than 77 thousand shares of expertise stocks (equivalent to SEK 3.06 million), which substantially exceeds the long-horizon CEO' investments of 28 thousand (SEK 0.72 million). In non-expertise stocks, short-horizon CEOs hold, on average, 24,221 shares of various firms, equivalent to 2.64 million Swedish kronor more than their long-horizon counterparts. Similarly, short-horizon CEOs, on average, hold 603 thousand shares of their own-company stocks, equivalent to 29 million Swedish kronor, whereas their long-horizon counterparts hold 315 thousand shares, equivalent to 12 million Swedish kronor. These results indicate that short-horizon CEOs engage in more trading activities than long-horizon CEOs in both expertise and non-expertise stocks.

The locality-based classification produces results largely consistent with those obtained from the industry-based classification. We find that short-horizon CEOs invest more in both local and non-local stocks than their long-horizon counterparts. However, the mean difference in investment value in Swedish kronor between short- and long-horizon CEOs is not statistically significant, although this difference is significant in stock holdings. This insignificance may arise from missing prices or price volatility. We lose a few observations after incorporating the stock price. In the local stocks, on average, the short-horizon CEOs hold 33.17 thousand stocks of different firms, equivalent to 677 thousand Swedish kronor, whereas their long-horizon counterparts hold 22.13 thousand stocks of different firms equivalent to 589 thousand Swedish kronor. In the non-local stocks, the short-horizon CEOs hold 35.11 thousand more stocks of different firms equivalent to 4.16 million Swedish kronor than the long-horizon CEOs. These results signify that short-horizon CEOs have more trading activities than their long-horizon counterparts in both local and non-local firms.

Panel B of Table 1 presents the CEO-stock level summary statistics of the variables used in the trading activity analysis. These variables include HOR, Holdings, Value, Market capitalization, Book to market ratio, Debt to equity ratio, Return on assets, and Beta. HOR is the CEOs' investment horizon calculated from their own stock trading activities defined in the previous section and it has a value range from 0 to 1 with a mean value of 0.83. Both the Holdings and Value indicate CEOs' holdings in stocks and in the Swedish kronor respectively. On average,

a CEO holds 72 thousand stocks equivalent to 2 million Swedish kronor and this value ranges from 1 stock equivalent to 17 Swedish kronor to 2.49 million stocks equivalent to 56.03 million Swedish kronor.

The remaining variables are used as control variables, following the previous literature on insider trading (Akbas et al., 2020; Ben-David et al., 2019; Seyhun, 1992). The average Market capitalization of stocks in our final sample is 66.58 billion Swedish kronor. The average Book to market and Debt to equity ratio, Return on assets, and Beta are 0.5997, 1.2210, 0.0340, and 0.7676 respectively in our final sample. We use the 5-year stock beta calculated at the end of each quarter for each stock. All the continuous variables are winsorized at the 1% and 99% levels except Holdings, Value, and Market capitalization for those we use the natural logarithmic transformations.

3.4 Trading Activity Regression Model

We first examine the role of expertise investments and insiders' horizon in their individual portfolios. In this analysis, we test our first hypothesis on trading activities (liquidity). For each CEO, we measure their quarterly holdings in both the number of stocks and market value in their own-company (*Own stock*) stocks, in the same industry stocks where the CEO is working (*Expertise stock*), and in other stocks (*Non-expertise stock*). More formally, our model for analyzing CEO's trading activities is given by Equation (4).

$$Ln(Holdings)_{ijt} = \alpha + \beta_1 HOR_{it} + \beta_2 Own\ stock_{ijt} + \beta_3 HOR \times Own\ stock_{ijt} + \beta_4 Expertise\ stock_{ijt} + \beta_5 HOR \times Expertise\ stock_{ijt} + \delta Stock\ characteristics_{jt} + \gamma Year\ dummy_t + \varepsilon_{it,} \quad (4)$$

where *i* denotes CEO, *j* specifies stock, and *t* denotes quarter. We regress the logarithm of the quarterly holdings on the horizon, own-stock dummy ($Own\ stock$), expertise stock dummy ($Expertise\ stock$), and the interactions between CEOs' horizon (HOR) and the two stock types. Here, $Holdings$ indicates both the holdings in stocks and the value in the Swedish kronor. The unit of analysis in the regressions is CEO–stock–quarter. We control for firm and stock characteristics including size (measured as the natural logarithm of the stock's market capitalization), book-to-market ratio, debt-to-equity ratio, return on assets, systematic risk (proxied by 5-year beta), and year fixed effects (Akbas et al., 2020; Ben-David et al., 2019; Seyhun, 1992). We use heteroscedasticity consistent robust standard errors.

3.5 Regression models for performance analysis

Next, we explore whether short-horizon insiders' trades in their individual portfolios are driven by private information or industry familiarity of expertise by analyzing the profitability of insider trades by trade type and insider horizon. These analyses allow us to test our second hypothesis. If short-horizon industry insiders are informed traders, they should earn higher superior returns in the trades of their own and expertise stocks than in the trades of non-expertise stocks. In addition, their trades on their own stocks should also outperform trades in expertise stocks as they are expected to know their own stocks better than other stocks in the same industry. If short-horizon insiders' trade in expertise stocks is based on industry familiarity, we expect higher abnormal performance on their expertise stocks than their non-expertise stocks, as explained in (Ben-David et al., 2019). We use the holdings-based and calendar time portfolios to answer this question. Furthermore, in the robustness analysis, we redefine expertise vs. non-expertise stocks based on the CEOs' locality and use the transaction-based portfolio approach (Ref & if possible, brief motivation?).

3.5.1 Holding-based portfolio

For our holding-based portfolio analysis, we form six portfolios based on CEOs' investment horizon and trade type (2 x 3). The unit of analysis in this holding-based portfolio approach is CEO-portfolio-quarter. The portfolios are constructed by partitioning each CEO's stocks into three trade groups (Own, Expertise, and Non-expertise) portfolios under either short-horizon or long-horizon group depending on the CEO's horizon value in the quarter. The portfolios are held for a quarter and rebalanced at the end of each quarter. The constituents of each of the six portfolios are weighted by their quarter-end market value.

We calculate average raw returns, market-adjusted returns, and Carhart (1997) four-factor alphas for our six portfolios, and further compare the difference in the returns between the short and long-horizon CEO trade portfolios within each type of trade.. The portfolio raw return is given by Equation (5).

$$R_{ipt} = \sum_{j=1}^{N_t} w_{ijt} R_{ijt}, \qquad (5)$$

where *i*, *p*, *t*, and *j* stand for CEO, portfolio, quarter and stock respectively. R_{ipt} is the return of CEO *i* from portfolio *p* at quarter *t*, R_{ijt} is the return of CEO *i* from stock *j* at quarter *t*, and w_{ijt} denotes the weight of stock *j* in CEO *i*'s personal portfolio at quarter *t*.

Next, we estimate market-adjusted returns as in Equation (6):

$$AR_{ipt} = R_{ipt} - R_{mt}\,, \tag{6}$$

where AR_{ipt} is the market-adjusted return of CEO *i* from portfolio *p* at the quarter *t*, R_{ipt} is the return of CEO *i* at the quarter *t* return from portfolio *p*, and R_{mt} is the market return at the quarter *t*.[14]

Finally, the Carhart (1997) alphas are estimated based on Equation (7):

$$R_{ipt} - R_{ft} = \alpha_p + \beta_1\left(R_{mt} - R_{ft}\right) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 UMD_t + \varepsilon_{pt}, \tag{7}$$

where R_{ipt} is the return of CEO *i* from portfolio *p* at quarter *t*. R_{ft} and R_{mt} are the Swedish risk-free rate and the market return respectively at the quarter *t*. SMB_t is the difference in the returns of value-weighted portfolios of small stocks and large stocks at quarter *t*. HML_t is the difference in the returns of value-weighted portfolios of high book-to-market stocks and low book-to-market stocks at quarter *t*. UMD_t is the difference in the returns of value-weighted portfolios of stocks with high and low recent returns at quarter *t*. All factor returns are obtained from Andrea Frazzini's website.[15] The risk-free rate is the three-month Swedish Treasury bill rate obtained from the Swedish Central Bank (Riksbanken).

3.5.1 Calendar time portfolio

We transform our holding-based portfolios to the calendar time portfolios by taking the average returns of all the participating CEOs in each portfolio in each quarter. This converts our unit of analysis into the portfolio-quarter level. After transforming into the calendar time portfolio, the

[14] We take an average of 90 days to convert daily market return to quarterly market return.
[15] https://pages.stern.nyu.edu/~afrazzin/data_library.htm data retrieved on April 05, 2021. We collect daily factor returns and then convert then to quarterly by taking the average.

dataset contains 54 quarters' portfolio returns for six portfolios.[16] These portfolio returns include the raw returns, market-adjusted returns, and Carhart (1997) four-factor alphas.

3.5.3 Transaction-based portfolio

For the transaction-based calendar time portfolio analysis, since we do not observe the transaction dates directly, we use the change in the stock holdings between the two quarters to identify whether a CEO buys or sells a stock during the quarter. Stock holdings are adjusted for corporate events such as splits and, reverse splits to remove the effect of corporate actions on the changes in stock holdings so that the direction of trade reflects the insiders' trade decision. We further partition trades in both of our holdings-based portfolios and calendar-time portfolios based on transactions (buy and sell) to obtain a total of 12 portfolios for both buy and sale. We examine the CEO trade profitability through a long-short strategy within each horizon-trade type category. More specifically, we compute and compare the average raw returns, market-adjusted returns, and Carhart (1997) four-factor alphas in both of our buy and sell portfolios based on insider trade type (own stock, expertise, and non-expertise) and insider investment horizon (short and long-horizon).

4. Baseline results

4.1. Trading activities, expertise investment and insiders' horizon

Table 2 presents the results of our trading activity analysis based on Equation (4). The regression analyses are at insider stock quarter level. We relate insiders' trade volume, measured as the natural logarithm of i) the quarterly stock holdings (Panel A) and ii) the market value of the quarterly stock holdings (Panel B) to the insider investment horizon. We include indicators for own-firm and for expertise stocks, and the interaction between insider horizon and these two stock types in the regressions. The interaction term is the main variable of interest. We also include firm and stock-level control variables, year fixed effects in the regressions, and use heteroscedasticity-robust standard errors.

[16] We have 55 quarters from the 1st quarter of 2006 to the 3rd quarter of 2019. Therefore, we have portfolio returns for 54 quarters excluding the 1st quarter.

Table 2. Trade regressions

Table 2 shows the regression analysis results of quarterly CEOs' investment in their own, expertise and non-expertise stocks. Panel A presents results for the holdings regressions, where Holdings indicate CEOs' investment in the number of stocks. Panel B displays the holdings regressions results, where Values indicate the CEOs' investment in the Swedish kronor. We use the natural logarithm of the CEOs' investment (both Holdings and Value) as the dependent variable. The main independent variables are the CEO's investment horizon (HOR), Own stock, Expertise stock, and their interactions. Horizon (HOR) is the average annual net order flow in the CEO's firm's stock over the past 10 years. The range for the CEOs' horizon is 0 to 1, where 0 and 1 indicate extreme short-horizon and long-horizon respectively. Own stock and expertise are dummy variables that indicate CEOs have quarterly holdings of their own and expertise stock respectively. Column 1 shows the regression result on the subsample excluding the observations of the CEOs' own stock. Columns 2-4 present the full sample regression results. Control variables include log market capitalization, book-to-market ratio, debt-to-equity ratio, return on assets, and beta. Year-fixed effects are included in all models. We use heteroscedasticity consistent robust standard errors. The symbol ***, **, and * indicates 1%, 5%, and 10% level of significance.

Panel A: Holdings regressions

Variables	Holdings (1)	Holdings (2)	Holdings (3)	Holdings (4)
HOR	-0.1096***	-0.1479***	-0.1554***	-0.1157***
	(-2.9821)	(-3.6553)	(-4.7347)	(-3.1484)
Own stock			4.2178***	4.2996***
			(49.3097)	(49.5359)
HOR × Own stock			-0.9336***	-0.9755***
			(-9.7239)	(-10.0138)
Expertise Stock	0.3766***	-0.2785***		0.3738***
	(5.2725)	(-3.8456)		(5.2246)
HOR × Expertise stock	-0.1937**	-0.0488		-0.1937**
	(-2.3836)	(-0.5930)		(-2.3811)
Market capitalization	-0.0894***	-0.2091***	-0.0771***	-0.0756***
	(-14.8494)	(-35.6871)	(-14.0529)	(-13.7378)
Book-to-market ratio	0.1375***	0.0799***	0.1044***	0.1149***
	(5.1757)	(3.0210)	(4.2749)	(4.7041)
Debt to equity ratio	0.0472***	0.0374***	0.0342***	0.0357***
	(10.2901)	(8.2254)	(7.8857)	(8.2162)
Returns on assets	-1.4495***	-0.6478***	-1.5864***	-1.5991***
	(-9.4024)	(-4.1651)	(-11.4100)	(-11.5073)
Beta	0.1279***	0.0154	0.0930***	0.0903***

	(4.9688)	(0.5893)	(3.9406)	(3.8268)
Constant	8.0346***	9.8551***	8.0667***	7.9681***
	(111.8386)	(136.5084)	(124.2582)	(118.4601)
Observations	46,931	53,742	53,742	53,742
R-squared	0.0361	0.0583	0.2560	0.2571
F-test				
Own – Expertise stock				3.9258***
				(1461.89)

Panel B: Value regressions

	Value	Value	Value	Value
Variables	(1)	(2)	(3)	(4)
HOR	-0.2243***	-0.2131***	-0.2597***	-0.2339***
	(-5.9385)	(-5.2361)	(-7.6382)	(-6.1952)
Own stock			3.8545***	3.9215***
			(43.6213)	(43.7871)
HOR × Own stock			-0.5752***	-0.6031***
			(-5.8380)	(-6.0386)
Expertise Stock	0.3037***	-0.2919***		0.3046***
	(4.0013)	(-3.8244)		(3.9945)
HOR × Expertise stock	-0.1245	-0.0376		-0.1275
	(-1.4503)	(-0.4354)		(-1.4791)
Market capitalization	0.1446***	0.0358***	0.1655***	0.1670***
	(22.9973)	(5.9250)	(29.0154)	(29.2201)
Book-to-market ratio	0.0874***	0.0405	0.0640**	0.0739***
	(3.1894)	(1.5074)	(2.5194)	(2.9053)
Debt to equity ratio	0.0197***	0.0090*	0.0059	0.0073
	(4.1654)	(1.9285)	(1.3288)	(1.6373)
Returns on assets	0.5711***	1.3860***	0.4707***	0.4594***
	(3.4179)	(8.3649)	(3.1263)	(3.0528)

Beta	0.2823***	0.1777***	0.2532***	0.2503***
	(10.6010)	(6.7094)	(10.3869)	(10.2729)
Constant	9.5798***	11.2292***	9.5032***	9.4210***
	(128.6122)	(154.2402)	(140.9107)	(135.2275)
Observations	46,931	53,742	53,742	53,742
R-squared	0.0386	0.0146	0.2072	0.2081
F-test				
Own – Expertise stock				3.6169***
				(1128.73)

In column 1 of Panel A, we examine how investment horizon affects insider trades in expertise and non-expertise stocks, excluding own company stocks. The coefficient of the horizon measure, *HOR*, is negative and significant at the 1% level, indicating that long-horizon insiders trade less than short-horizon in non-expertise stocks. From an economic perspective, one standard deviation increase in insider investment horizon is associated with a 3% decrease in trade volume of non-expertise stocks. The results from the Expertise stocks dummy and our interaction term are consistent. The long-horizon insiders trade more in expertise stocks than short-horizon insiders. The interaction effects suggest that long-horizon insiders trade 19 % less (in ln terms) in expertise stocks than short-horizon insiders do. This effect translates to 6% if we derive the slope of the log-lin model ($\beta * \bar{y}$). In general, this result concurs with those found in Ben-David et al. (2019) that insiders trade firms from their own industry more frequently than other stocks. However, our evidence clearly indicates that the results in Ben-David et al. (2019) are driven by long-horizon insiders.

In column 2, we extend the analysis of expertise trades and horizon to the insider's full portfolio, including own-firm trades. We observe that the interaction effect becomes insignificant. The long-horizon insiders still trade less in non-expertise stocks but expertise stocks dummy now has a negative coefficient because the zeros in this dummy also include the own stocks. The interpretation of this result is such that expertise stocks are traded less compared to non-expertise and own stocks. However, it is difficult to argue with confidence that this relationship holds for short-horizon insiders because the interaction term turns out insignificant. Given that including the own stock together with non-expertise stocks in the zeros

of expertise dummy alters the results significantly, next we examine own stock dummy separately. We shift our trade composition analysis to own-firm vs. other investments in column 3. We observe more own-firm trades compared to other stocks in the short-horizon insider's portfolio indicating that short-horizon insiders might be trading on private information.

In column 3, the result from the interaction effect indicates that long-horizon insiders trade 26% less in own stock, compared to other stocks, than short-horizon insiders do. This is also confirmed by the highly positive and significant coefficient on own stock, suggesting that short-horizon insiders (zeros in our horizon measure) trade more in own stock than long-horizon insiders do.

In column 4, we also include expertise dummy and its interaction with the horizon measure in the regression. Our results seem robust and even the interaction effect between expertise stocks and horizon becomes significant (compared to column 2). Thus, separating the effects of own stock from expertise dummy helps improving the model significantly. Overall, we find that short horizon insiders trade more in own-firm stocks than non-expertise stocks, and less in expertise stocks. We also test for the difference between own-firm trades and expertise trades (for short-horizon insiders with zero horizon values) and report the test result at the bottom of the table. Insider horizon decreases the trade wedge between own-firm and outside-industry stocks, as well influences the relative difference between expertise and non-expertise trades. Regarding the control variables in the holdings regressions, the sign and significance of the coefficients are consistent in all the columns. While market capitalization and return on assets seem to decrease insider holdings in a stock, book-to-market ratio, debt-to-equity ratio and beta increase insider holdings in the stock.

Panel B revises these analyses and shows the results from the market value of the quarterly stock holdings (in ln terms) regressions instead. The results remain robust for own stock but become weaker for expertise stocks. Short-horizon insiders still trade more than long-horizon insiders and they trade more in own stock compared to other stocks. One reason for weaker results from the expertise stocks could be that market value of holdings reflects not only active changes (as in the holdings regressions) but also passive changes since the market value of insider holdings can change based on the stock price changes, although the insider does not trade the stock.

Taken together, these results are suggestive so far and indicate that short-horizon insiders trade on information rather than familiarity and thus trade more in own stocks and to a lesser extent on expertise stocks. These results are in contrast with the idea that insiders hedge against their human capital (Ben-David et al., 2019; Døskeland & Hvide, 2011; Huberman, 2001; Massa & Simonov, 2006). Thus in a sense, our results from insiders, particularly, long-horizon insiders are similar to the previous findings on the behavior of individual investors, suggesting that investors tilt their portfolios towards familiar stocks rather than hedging against their human capital (Grinblatt & Keloharju, 2001). Interestingly, we find that the trade composition difference is influenced by insider investment horizon. Short-horizon insiders generally trade more than long-horizon insiders, which is consistent with the idea that short-horizon investors improve stock liquidity (Amihud et al., 2006; Amihud & Mendelson, 1986b, 1986a). To be able to draw stronger conclusions on whether short-horizon insiders trade on information, next, we examine their portfolio returns on own stock, expertise stocks, and non-expertise stocks and compare these outcomes to those of long-horizon insiders.

4.2. Portfolio performance analysis of short vs. long-horizon insiders

4.2.1. Results from holding-based portfolios

We examine the performance of insider trades based on trade types and horizon to shed light on motivations for their trading behavior. We group stocks into two categories of horizon (short and long) as defined in section 2.1 and three groups of trade types (own-firm, expertise and non-expertise) to construct six portfolios. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. The analyses are at insider portfolio quarter level, meaning that we have three portfolio return observations for each insider in each quarter. Table 3 presents the results. Panel A reports the average raw returns, Panel B shows results from the market adjusted returns, and finally, Panel C presents results from Fama-French four (FF4) factor or Carhart's alpha.

In addition to the portfolio returns, in all the panels we test the difference between the returns for short and long horizon insiders using the Kolmogorov-Smirnov test and show the corresponding D-values. The reason we rely on non-parametric tests for the differences is the fact that the samples have largely uneven number of observations and unequal variances. At the bottom of the panels, we also test the difference in the portfolio returns of own vs. expertise stocks, own vs. non-expertise stocks, and finally, expertise vs. non-expertise stocks.

Table 3. Holding based portfolios

Table 3 presents the results of the quarterly holding-based portfolios of CEOs' investment in their own, expertise, and non-expertise stocks. Panel A, B, and C display the raw returns, market-adjusted returns, and Carhart alphas respectively. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. Portfolio rebalancing happens at the end of the quarter. Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns				
Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0268***	0.0275***	0.0265***	0.0010**
	(13.8660)	(8.3923)	(11.1597)	(0.0361)
Expertise	0.0070***	0.0074***	0.0068***	0.0006***
	(5.9432)	(3.5506)	(4.7653)	(0.0554)
Non expertise	0.0109***	0.0106***	0.0110***	-0.0004
	(9.3416)	(4.7081)	(8.1702)	(0.0264)
Own - Expertise	0.0233***	0.0231***	0.0234***	
	(9.5195)	(6.0858)	(7.5178)	
Own - Non expertise	0.0202***	0.0225***	0.0192***	
	(9.2930)	(5.7923)	(7.3498)	
Expertise - Non expertise	-0.0008	0.0019	-0.0021	
	(-0.5325)	(0.7165)	(-1.1915)	

Panel B: Market adjusted returns				
Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0265***	0.0272***	0.0262***	0.0010**
	(13.7440)	(8.3184)	(11.0620)	(0.0358)
Expertise	0.0067***	0.0071***	0.0065***	0.0006**
	(5.6940)	(3.4073)	(4.5614)	(0.0458)
Non expertise	0.0106***	0.0103***	0.0107***	-0.0004
	(9.0996)	(4.5747)	(7.9674)	(0.0203)
Own - Expertise	0.0233***	0.0231***	0.0234***	
	(9.5195)	(6.0858)	(7.5178)	
Own - Non expertise	0.0202***	0.0225***	0.0192***	
	(9.2930)	(5.7923)	(7.3498)	
Expertise - Non expertise	-0.0008	0.0019	-0.0021	
	(-0.5325)	(0.7165)	(-1.1915)	

Panel C: Carhart Alpha				
Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0120***	0.0132***	0.0115***	0.0017***
	(5.4167)	(3.6295)	(4.1864)	(0.0688)
Expertise	0.0033**	0.0040*	0.0029*	0.0011*
	(2.3730)	(1.6847)	(1.6965)	(0.0484)
Non expertise	0.0053***	0.0064**	0.0045***	0.0019**
	(3.8629)	(2.4796)	(2.8223)	(0.0425)
Own - Expertise	0.0087***	0.0092**	0.0086**	
	(10.39)	(4.32)	(6.59)	
Own - Non expertise	0.0067**	0.0068	0.0070**	
	(6.23)	(2.10)	(4.67)	
Expertise - Non expertise	-0.0020	-0.0024	-0.0016	
	(0.84)	(0.35)	(0.41)	

In all the panels, regardless how we adjust the returns, our results are consistent. Two observations induce us to conclude that short-horizon insiders trade on information. First, short-horizon insiders earn more returns than long-horizon insiders when trading on own stocks (0.1% per quarter, on average) and on expertise stocks (0.06%). Second, short-horizon insiders earn more returns from trading on own-stocks than from trading on expertise stocks (2.3%) and non-expertise stocks (2.3%).

4.2.2. Results from calendar time portfolio approach

The main results in Table 3 considers the heterogeneity within the insider groups by providing results from insider portfolio quarter analysis. The current results eliminate this heterogeneity by averaging out returns of insider groups in a quarter, allowing us to obtain three portfolio return observations in each quarter. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. Portfolio rebalancing occurs at the end of the quarter. Similar to the previous analysis, Table 4, Panel A reports the average raw returns, Panel B presents results from the market adjusted returns, and Panel C reports results from Carhart's alpha.

Table 4. Calendar time portfolios

Table 4 presents the results of the quarterly calendar time portfolios' returns of CEOs' investment in their own, expertise, and non-expertise stocks. Panel A, B, and C display the raw returns, market-adjusted returns, and Carhart alphas respectively. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. Portfolio rebalancing happens at the end of the quarter. Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns

Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0247**	0.0264***	0.0242**	0.0021***
	(2.4952)	(2.7146)	(2.3479)	(0.8636)
Expertise	0.0060*	0.0064*	0.0057*	0.0007***
	(1.9428)	(1.7315)	(1.9299)	(0.9703)
Non expertise	0.0085*	0.0094*	0.0077	0.0017***
	(1.7715)	(1.7506)	(1.6271)	(0.9437)
Own - Expertise	0.0187**	.0199***	.0185**	
	(2.6091)	(2.8773)	(2.3468)	
Own - Non expertise	.0161***	.0169***	.0165**	
	(2.8830)	(2.9156)	(2.6318)	
Expertise - Non expertise	-.0025	-.00299	-.0019	
	(-1.1981)	(-0.8893)	(-0.8096)	

Panel B: Market adjusted returns

Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0243**	0.0260***	0.0238**	0.0021***
	(2.5086)	(2.7309)	(2.3567)	(0.8676)

Expertise	0.0056*	0.0060*	0.0053*	0.0007***
	(1.9390)	(1.7054)	(1.9232)	(0.9697)
Non expertise	0.0081*	0.0090*	0.0073	0.0017***
	(1.7638)	(1.7443)	(1.6077)	(0.9459)
Own - Expertise	0.0187**	0.0199***	0.0185**	
	(2.6091)	(2.8773)	(2.3468)	
Own - Non expertise	0.0162***	0.0169***	0.0166**	
	(2.8830)	(2.9156)	(2.6318)	
Expertise - Non expertise	-0.0026	-0.0030	-0.0020	
	(-1.1981)	(-0.8893)	(-0.8096)	

Panel C: Carhart Alpha

Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0122**	0.0129**	0.0124**	0.0005***
	(2.3980)	(2.2437)	(2.1734)	(0.9659)
Expertise	0.0025	0.0035	0.0017	0.0018***
	(1.2365)	(1.2428)	(0.8291)	(1.0021)
Non expertise	0.0034	0.0045	0.0025	0.0020***
	(1.1754)	(1.3748)	(0.7904)	(1.0042)
Own - Expertise	0.0097***	0.0094**	0.0107**	
	(6.93)	(5.11)	(4.93)	
Own - Non expertise	0.0088***	0.0084*	0.0099**	
	(6.72)	(3.81)	(6.28)	
Expertise - Non expertise	-0.0009	-0.0010	-0.0008	
	(0.40)	(0.11)	(0.13)	

We obtain robust and consistent results both across the panels but also compared to the previous analysis in Table 3. Focusing on Panel C, FF4 alpha analysis, we observe that short-horizon insiders earn 0.05% more alpha than long-horizon insiders when trading in own stock. Short-horizon insiders earn 0.9% more alpha on own stocks than on their expertise stocks.

Taken together, short-horizon insiders trade more in own firm stock and they gain more from trading own stock than trading expertise stocks or non-expertise stocks. Short-horizon insiders also earn more abnormal returns than long-horizon insiders. These results indicate that while short-horizon insiders trade on information, the evidence points towards the direction that long-horizon insiders trade on familiarity (to expertise industry stocks). Thus, trades of short-horizon insiders seem to be more informative than those of long-horizon insiders as proposed by Akbas et al. (2020).

The results from long-horizon insiders are in line with Ben-David et al. (2019)'s findings about the profitability of industry insider trades. The superior returns in expertise trades compared to non-expertise trades can be explained by information-based familiarity (Ben-David et al., 2019; Massa & Simonov, 2006). Long-horizon insiders are familiar with industry stocks and when new information comes about these industry stocks long-horizon insiders are better at processing this information since they know more about these stocks.

5. Robustness tests and additional analysis

5.1 Results from local vs. non-local portfolios

In Table 5 we consider a different definition of expertise stocks and use local stocks instead of using the industry to define the expertise stocks. A stock is defined as local if the firm headquarters of the stock is located in the same district (municipality) as the insider lives. The literature on local bias documents that distance to firms seems to influence investors' decision making, although it is unclear whether the reasons for local bias are information based or can simply be explained by familiarity (see Coval & Moskowitz, 1999, 2001; Massa & Simonov, 2006; Lindblom et al., 2018; Seasholes & Zhu, 2010; Døskeland & Hvide, 2011). Examining the local stocks in the personal portfolios of insiders might provide additional insights to this literature as insiders in one firm are likely to be socially linked with the insiders in another firm within a locality. Table 5 revises the previous analysis by using local vs non-local stocks in insiders' personal portfolios.

Table 5. Local vs. non-local portfolios

Table 5 presents the results of the quarterly holding-based portfolios of CEOs' investments in their own, local, and non-local stocks. Panel A, B, and C display the raw returns, market-adjusted returns, and Carhart alphas respectively. We exclude CEOs' own company stocks from both local and non-local portfolios. Portfolio rebalancing happens at the end of the quarter. Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns				
Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0268***	0.0275***	0.0265***	0.0010**
	(13.8660)	(8.3923)	(11.1597)	(0.0361)
Local	0.0119***	0.0072**	0.0058***	0.0014
	(7.4222)	(2.4106)	(3.4139)	(0.0256)
Non local	0.0164***	0.0089***	0.0118***	-.0029***
	(16.4717)	(4.4426)	(8.4477)	(0.0506)
Own - Local	0.0225***	0.0191***	0.0240***	
	(6.3617)	(2.9904)	(5.6540)	
Own - Non local	0.0202***	0.0255***	0.0180***	
	(9.2470)	(6.7529)	(6.7561)	
Local - Non local	-0.0003	0.0007	-0.0062***	
	(-0.1897)	(0.2053)	(-3.0917)	

Panel B: Market adjusted returns				
Portfolio	Without Horizon	SH	LH	SH - LH
	(1)	(2)	(3)	(4)
Own	0.0265***	0.0272***	0.0262***	0.0010**

	(13.7440)	(8.3184)	(11.0620)	(0.0358)
Local	0.0115***	0.0069**	0.0055***	0.0014
	(7.2311)	(2.3261)	(3.2567)	(0.0274)
Non local	0.0160***	0.0085***	0.0115***	-0.0029***
	(16.1604)	(4.2865)	(8.2544)	(0.0484)
Own - Local	0.0225***	0.0191***	0.0240***	
	(6.3617)	(2.9904)	(5.6540)	
Own - Non local	0.0202***	0.0255***	0.0180***	
	(9.2470)	(6.7529)	(6.7561)	
Local - Non local	-0.0003	0.0007	-0.0062***	
	(-0.1897)	(0.2053)	(-3.0917)	

Panel C: Carhart Alpha

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0120***	0.0132***	0.0115***	0.0017***
	(5.4167)	(3.6295)	(4.1864)	(0.0688)
Local	0.0061***	0.0027	0.0032	-0.0005***
	(3.4848)	(0.7816)	(1.5252)	(0.1123)
Non local	0.0068***	0.0055**	0.0054***	0.0001***
	(6.3292)	(2.3995)	(3.2619)	(0.0865)
Own - Local	0.0059**	0.0105*	0.0083**	
	(4.40)	(3.05)	(5.76)	
Own - Non local	0.0052**	0.0077*	0.0061*	
	(4.46)	(3.00)	(3.38)	
Local - Non local	-0.0007	-0.0028	-0.0022	
	(0.10)	(0.26)	(0.66)	

Focusing on Panel C, FF4 alphas, the results from local stocks tend to be weaker than the results from the industry expertise stocks. The difference between the alphas on local trades of short vs. long-horizon insiders is significant only at the 10% level, although more favorable for short-horizon insiders. One reason for this result could be that defining expertise stocks only as local stocks leads to a narrower, subset of expertise stocks, some of which end up with the group of non-expertise stocks. However, short-horizon insiders tend to earn 0.9% more alpha on own

stock than on local stocks, indicating, again, that short-horizon insiders trade on information and they have more information on own firm stock than on local stocks.

5.2 Results from transaction-based portfolios

Our evidence on the portfolio performance of short-horizon insiders clearly indicates information based trading. To examine whether the abnormal performance is driven by purchases or sales, we also study the performance of insiders' transaction portfolios. Our holding data are quarterly and we can only determine whether insider increased or decreased his weight on a stock in their personal portfolio by calculating the change in his position (the number of shares adjusted for splits etc.) in the stock between the two quarters. Although this measure does not exactly reflect the transaction made within the quarters, it provides us with a measure of active change in the weight placed on a stock between the quarters. Our approach is consistent with the previous literature also using quarterly holdings data, for example literature on mutual fund performance.

In Appendix A, we revise our insider portfolio quarter level analysis for purchase portfolios, the table structure is the same as before, Panel A reports the average raw returns, Panel B shows results from the market adjusted returns, and Panel C shows results from FF4 factor or alphas. The results from purchases of own stock remain the same. In raw return and market adjusted return analysis, short-horizon insiders' purchases of own stock outperform those of long-horizon insiders by 1.8%. The results from FF4 alphas are weaker. However, it is consistent with the results from the holdings portfolios that short-horizon insiders' purchases of own stock significantly outperform short-horizon insiders' purchases of expertise stocks by 4.9%.

Appendix B shows the results from insiders' sell portfolios instead. The results are weaker, particularly, we find no difference between the performance of short-horizon and long-horizon insiders' sales of own stock. Similarly, there is no difference in the performance between the sales of own stock and expertise stock for the short-horizon insiders. The results suggest that our main findings are mainly driven by insiders' purchases, which is also consistent with the information story of insider trading. The previous literature documents that insider purchasing is more likely to be based on informed trading but insider sale can be related to other reasons than information such as liquidity needs, tax reasons, and diversification purposes (Lynch & Rothchild, 2000; Degryse et al. 2014).

5.3 Results from transaction-based calendar time portfolio approach

Appendix C revises the analysis for calendar time purchase portfolios by averaging the purchase returns for each purchase portfolio and quarter. The results are persistently robust. Short-horizon insiders' purchases of own stock outperform long-horizon insiders' own stock by 0.2%. Also, consistent that short-horizon insiders' purchases of own stock outperform short-horizon insiders' purchases of expertise stocks by 3.4%. Similar to insider portfolio quarter analysis, Appendix D shows that the results from the sell portfolios are weaker, confirming again that insiders' sales may not be information-based but can be explained by other reasons such as liquidity needs. Taken all together, our additional analyses confirm that short-horizon insiders' trades on own stock information based and this is mainly driven by their purchases. Long-horizon insiders' trades on expertise stocks are familiarity-based, confirming the results of Ben-David et al. (2019). These results suggest that short-horizon insiders' purchases are more informative than long-horizon insiders' purchases.

6. Conclusions

We examine the role of expertise investments, defined as industry familiarity, in individual portfolios of CEOs, in relation to their investment horizon. We observe that the trading volume of short-horizon insiders is significantly greater than that of long-horizon insiders. Short-horizon insiders trade more in own-company stocks than long-horizon insiders do. They also trade more in own stock than in expertise stocks. Next, we explore whether short-horizon insiders' trades in their own portfolios are information-driven. We analyze the performance of own-stock, expertise, and non-expertise trades across insider's horizon using a holding-based portfolio approach, calendar time portfolio approach, and transaction-based calendar time portfolio approach. We find that short-horizon insiders outperform the long-horizon insiders, indicating that trades by short-horizon insiders are information-driven. Short-horizon insiders' trades in own-stocks outperform short-horizon insiders' trades in expertise stocks. Consistent with the information story these results are mainly driven by insiders' purchases not by their sales.

Our results have some implications for investors, stock prices, and firms. The trades by long-horizon insiders do not seem to be (superior) information driven. This result may be in line with the argument that insider trading impairs the functioning of financial markets. However, the trades by short-horizon insiders seem to be unexpected and opportunistic, indicating some misappropriation that may discourage corporate investment and reduce the efficiency of

corporate behavior. The short-horizon insiders tend to trade on superior information, indicating that they gain some part of the returns to corporate investments at the expense of outsider shareholders.

The consistent outperformance of short-horizon insiders over long-horizon insiders seems to suggest that the information used by short-horizon insiders originates within the firm rather than it is generated by followers of the firm, such as financial analysts or other outsider investors. Thus, when short-horizon insiders trade, the purchases by outside investors, who do not have this private information, will be subject to adverse selection. That is, for a given price the shares are available to outsiders when the (expected) value of the firm is low than when it is high. This is because short-horizon insiders will buy up shares when the (expected) firm value is higher than when it is low.

This situation likely eliminates the confidence of outsider investors in financial markets. If outsider investors know that their purchases are subject to adverse selection they will be unwilling to pay for the full expected value of the stock and hence the expected value of firms' future investments. This has also implications for incumbent shareholders who will not be able to obtain the full expected value of the returns to the firm investment. This means that trades by short-horizon investors will cause outsider investors to discourage firm investments. This is bad news if outsider investors, to some extent, control firm behavior. That is, firm investment will decrease to a lower level than what is expected or an economically efficient level.

The degree to which firm investment falls depends on whether and how much outsider investors are sophisticated, whether they are aware of the existence of trades by short-horizon insiders, and to what degree they take account of adverse selection in calculating expected returns on their investments. Thus, a careful examination of this heterogeneity and how outsider investors respond when short-horizon insiders' trade is a fruitful area for further research.

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Appendix

A. Purchase portfolios

Appendix B presents the results of the quarterly purchases portfolios of CEOs' investment in their own, expertise, and non-expertise stocks. Panel A, B, and C display the raw returns, market-adjusted returns,

and Carhart alphas respectively. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. Portfolio rebalancing happens at the end of the quarter. Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0197***	0.0331***	0.0151**	0.0180**
	(3.3290)	(2.9797)	(2.1643)	(0.0971)
Expertise	-0.0062**	-0.0077	-0.0053*	-0.0024**
	(-2.2711)	(-1.4788)	(-1.7354)	(0.1274)
Non expertise	-0.0002	0.0004	-0.0004	0.0008***
	(-0.0804)	(0.0800)	(-0.1907)	(0.0930)
Own - Expertise	0.0149	0.0486**	-0.0053	
	(1.0768)	(2.2976)	(-0.3057)	
Own - Non expertise	0.0085	-0.0165	0.0213	
	(0.6198)	(-0.7333)	(1.2321)	
Expertise - Non expertise	-0.0072	-0.0144	-0.0024	
	(-1.4531)	(-1.2561)	(-0.7737)	

Panel B: Market adjusted returns

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0196***	0.0329***	0.0150**	0.0179**
	(3.3141)	(2.9645)	(2.1559)	(0.1021)
Expertise	-0.0065**	-0.0080	-0.0056*	-0.0024**
	(-2.3898)	(-1.5335)	(-1.8493)	(0.1343)

Non expertise	-0.0004	0.0001	-0.0007	0.0008**
	(-0.1988)	(0.0122)	(-0.2899)	(0.0796)
Own - Expertise	0.0149	0.0486**	-0.0053	
	(1.0768)	(2.2976)	(-0.3057)	
Own - Non expertise	0.0085	-0.0165	0.0213	
	(0.6198)	(-0.7333)	(1.2321)	
Expertise - Non expertise	-0.0072	-0.0144	-0.0024	
	(-1.4531)	(-1.2561)	(-0.7737)	

Panel C: Carhart Alpha

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0118*	0.0253*	0.0073	0.0180
	(1.6771)	(1.8988)	(0.8789)	(0.1351)
Expertise	-0.0106***	-0.0137**	-0.0090***	-0.0047***
	(-3.4507)	(-2.3334)	(-2.6014)	(0.4119)
Non expertise	0.0024	0.0050	0.0003	0.0047***
	(0.9704)	(0.9829)	(0.1083)	(0.2076)
Own - Expertise	0.0224***	0.0390***	0.0163*	
	(7.51)	(7.29)	(2.84)	
Own - Non expertise	0.0094	0.0203	0.0070	
	(1.26)	(1.95)	(0.51)	
Expertise - Non expertise	-0.013***	-0.0187**	-0.0093*	
	(7.63)	(4.40)	(3.29)	

Appendix B. Sell portfolios

Appendix B presents the results of the quarterly sell portfolios of CEOs' investment in their own, expertise, and non-expertise stocks. Panel A, B, and C display the raw returns, market-adjusted returns, and Carhart alphas respectively. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. Portfolio rebalancing happens at the end of the quarter. Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio

returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns				
Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0218***	0.0047	0.0334***	-0.0287
	(3.3207)	(0.5297)	(3.6498)	(0.0837)
Expertise	0.0062***	-0.0004	0.0099***	-0.0103*
	(2.6650)	(-0.1290)	(3.1541)	(0.0980)
Non expertise	0.0110***	0.0092***	0.0120***	-0.0028*
	(6.3692)	(2.5930)	(6.3269)	(0.0577)
Own - Expertise	0.0217*	0.0087	0.0342*	
	(1.7885)	(0.5987)	(1.7741)	
Own - Non expertise	0.0076	0.0064	0.0085	
	(0.8804)	(0.5413)	(0.6924)	
Expertise - Non expertise	-0.0013	-0.0001	-0.0020	
	(-0.7000)	(-0.0350)	(-0.8308)	

Panel B: Market adjusted returns				
Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0215***	0.0045	0.0331***	-0.0286
	(3.2838)	(0.5006)	(3.6230)	(0.0837)

Expertise	0.0059**	-0.0007	0.0096***	-0.0103
	(2.5394)	(-0.2026)	(3.0487)	(0.0846)
Non expertise	0.0107***	0.0089**	0.0117***	-0.0028
	(6.1974)	(2.5145)	(6.1643)	(0.0500)
Own - Expertise	0.0217*	0.0087	0.0342*	
	(1.7885)	(0.5987)	(1.7741)	
Own - Non expertise	0.0076	0.0064	0.0085	
	(0.8804)	(0.5413)	(0.6924)	
Expertise - Non expertise	-0.0013	-0.0001	-0.0020	
	(-0.7000)	(-0.0350)	(-0.8308)	

Panel C: Carhart Alpha

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0123	-0.0073	0.0256**	-0.0329
	(1.5448)	(-0.6736)	(2.2888)	(0.2669)
Expertise	0.0051*	-0.0024	0.0106***	-0.0130***
	(1.7926)	(-0.6493)	(2.6290)	(0.3372)
Non expertise	0.0086***	0.0065	0.0100***	-0.0035
	(3.9698)	(1.5189)	(4.1220)	(0.0738)
Own - Expertise	0.0072	-0.0049	0.0150	
	(0.73)	(0.16)	(1.77)	
Own - Non expertise	0.0037	-0.0138	0.0156	
	(0.20)	(1.21)	(2.11)	
Expertise - Non expertise	-0.0035	-0.0089	0.0006	
	(0.91)	(2.57)	(0.02)	

Appendix C. Calendar time purchase portfolios

Appendix C presents the results of the quarterly calendar time purchase portfolios' returns of CEOs' investment in their own, expertise, and non-expertise stocks. Panel A, B, and C display the raw returns, market-adjusted returns, and Carhart alphas respectively. We exclude CEOs' own company stocks from both expertise and non-expertise portfolios. Portfolio rebalancing happens at the end of the quarter.

Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0305**	0.0365**	0.0274**	0.0091***
	(2.4456)	(2.0161)	(2.0812)	(1.0824)
Expertise	-0.0047	-0.0068	-0.0034	-0.0033***
	(-1.3126)	(-1.0333)	(-1.3584)	(0.9967)
Non expertise	-0.0004	-0.0020	-0.0011	-0.0009***
	(-0.1238)	(-0.4648)	(-0.3625)	(0.9941)
Own - Expertise	0.0352***	0.0433**	0.0304**	
	(3.2578)	(2.4860)	(2.4365)	
Own - Non expertise	0.0309***	0.0385**	0.0285**	
	(2.8115)	(2.1834)	(2.4508)	
Expertise - Non expertise	-0.0043	-0.0048	-0.0021	
	(-1.0150)	(-0.6680)	(-0.5776)	

Panel B: Market adjusted returns

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0301**	0.0362**	0.0270**	0.0091***
	(2.4501)	(2.0079)	(2.0793)	(1.0827)

Expertise	-0.0051	-0.0072	-0.0038	-0.0033***
	(-1.4605)	(-1.1069)	(-1.5548)	(0.9980)
Non expertise	-0.0008	-0.0024	-0.0015	-0.0009***
	(-0.2554)	(-0.5729)	(-0.5092)	(0.9958)
Own - Expertise	0.0352***	0.0433**	0.0304**	
	(3.2578)	(2.4860)	(2.4365)	
Own - Non expertise	0.0309***	0.0385**	0.0285**	
	(2.8115)	(2.1834)	(2.4508)	
Expertise - Non expertise	-0.0043	-0.0048	-0.0021	
	(-1.0150)	(-0.6680)	(-0.5776)	

Panel C: Carhart Alpha

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0215**	0.0197	0.0176*	0.0021***
	(2.4482)	(1.0920)	(1.7691)	(0.9853)
Expertise	-0.0093**	-0.0144**	-0.0059**	-0.0085***
	(-2.5001)	(-2.0556)	(-2.1382)	(1.0040)
Non expertise	0.0009	0.0009	-0.0013	0.0022***
	(0.3576)	(0.2530)	(-0.4612)	(0.9931)
Own - Expertise	0.0308***	0.0341**	0.0235**	
	(17.25)	(3.59)	(5.88)	
Own - Non expertise	0.0206**	0.0188	0.0189*	
	(4.99)	(1.04)	(3.36)	
Expertise - Non expertise	-0.0102**	-0.0153**	-0.0046	
	(6.42)	(5.62)	(1.53)	

Appendix D. Calendar time sell portfolios

Appendix D presents the results of the quarterly calendar time sell portfolios' returns of CEOs' investment in their own, expertise, and non-expertise stocks. Panel A, B, and C display the raw returns, market-adjusted returns, and Carhart alphas respectively. We exclude CEOs' own company stocks from

both expertise and non-expertise portfolios. Portfolio rebalancing happens at the end of the quarter. Column 1 shows the portfolio returns of all CEOs regardless of their horizon, and columns 2 and 3 present the same for short- and long-horizon CEOs respectively. Column 4 displays the mean difference of the portfolio returns between short- and long-horizon CEOs. Panel A, B, and C show raw returns, market-adjusted abnormal returns, and Carhart four-factor alphas respectively. For both the raw returns and market-adjusted returns, we use the t-test and for Carhart alpha, we use the chi-square test to compare the mean difference among own, expertise, and non-expertise portfolios. We use the Kolmogorov-Smirnov test to compare the mean difference of portfolios' returns between short- and long-horizon CEOs. D-values of the Kolmogorov-Smirnov test are presented in parentheses. The symbol ***, **, and * indicate 1%, 5%, and 10% significance levels.

Panel A: Raw returns

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0221*	0.0168	0.0370***	-0.0202***
	(1.9754)	(1.0591)	(2.9891)	(0.9658)
Expertise	0.0040	-0.0032	0.0068***	-0.0101***
	(1.6505)	(-0.5721)	(3.3199)	(1.0014)
Non expertise	0.0092***	0.0089*	0.0093***	-0.0003***
	(3.2124)	(1.7303)	(3.5832)	(0.9747)
Own - Expertise	0.0181	0.0158	0.0299**	
	(1.6604)	(1.0504)	(2.4141)	
Own - Non expertise	0.0128	0.0079	0.0276**	
	(1.3091)	(0.5173)	(2.2918)	
Expertise - Non expertise	-0.0052	-0.0122	-0.0024	
	(-1.6688)	(-1.5949)	(-0.8380)	

Panel B: Market adjusted returns

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0217*	0.0164	0.0367***	-0.0203***
	(1.9681)	(1.0446)	(3.0046)	(0.9652)

Expertise	0.0036	-0.0036	0.0065***	-.0101***
	(1.5381)	(-0.6426)	(3.2247)	(1.0008)
Non expertise	0.0088***	0.0086*	0.0089***	-0.0003***
	(3.2152)	(1.6929)	(3.5135)	(0.9770)
Own - Expertise	0.0181	0.0158	0.0299**	
	(1.6604)	(1.0504)	(2.4141)	
Own - Non expertise	0.0128	0.0079	0.0276**	
	(1.3091)	(0.5173)	(2.2918)	
Expertise - Non expertise	-0.0052	-0.0122	-0.0024	
	(-1.6688)	(-1.5949)	(-0.8380)	

Panel C: Carhart Alpha

Portfolio	Without Horizon	SH	LH	SH - LH
Own	0.0122	0.0097	0.0245**	-0.0148***
	(1.2361)	(0.6595)	(2.3048)	(0.9519)
Expertise	0.0030	-0.0040	0.0069***	-0.0109***
	(1.1428)	(-0.6271)	(3.0228)	(0.9963)
Non expertise	0.0058**	0.0028	0.0085***	-0.0057***
	(2.2052)	(0.5629)	(3.0295)	(1.0011)
Own - Expertise	0.0092	0.0137	0.0176*	
	(1.64)	(0.81)	(3.72)	
Own - Non expertise	0.0064	0.0069	0.0160*	
	(0.81)	(0.17)	(3.33)	
Expertise - Non expertise	-0.0028	-0.0068	-0.0016	
	(0.94)	(1.17)	(0.20)	