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When a Central Bank Becomes a Market Player

An Examination of the Swiss National Bank's

Equity Holdings in the U.S. Market

스위스 국립은행의 미국 주식 투자에 관한 연구

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When a Central Bank Becomes a Market Player: An Examination of the Swiss National Bank's Equity Holdings in the U.S. Market

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Abstract

In this study, I examine the investment performance of the Swiss National Bank (SNB), the central bank of Switzerland. SNB holds $87 billion of the U.S. equities, which makes it the world's eighth largest public investor. Using the 13F filings by SNB for the period of 2013-2019, I find evidence that SNB engages in informed trading in the U.S. equity market, as opposed to SNB's claim that it is a passive investor. I show that changes in SNB ownership are positively related with returns in the following quarter and with the earnings announcement returns in the subsequent quarter. I further provide evidence that this positive relationship is more pronounced for firms with an opaque information environment. Last, I find that SNB investee firms have stronger fundamentals than other firms, implying SNB's stock picking strategy.

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I. Introduction

The Swiss National Bank (hereafter, SNB), the central bank of Switzerland, has invested in foreign currency investments reaching the amount of $764 billion,[1] which is 93.5% of its total assets as of end of 2018 (Swiss National Bank 2018, Annual Report). Out of $764 billion, SNB invests $153 billion in the foreign equity market. This massive investment in the equity market makes some investors call SNB 'the largest hedge fund in the world'. SNB is not the first central bank to invest massively in financial assets. The European Central Bank and the Bank of Japan have also invested in securities to meet their targeted inflation. However, unlike those banks that focus on bond denominated with their own currencies, SNB invests in foreign equity assets. Moreover, its performance generally outperforms the market, notwithstanding some fluctuations. For example, returns on foreign stock investments by SNB in 2017 was 18.4%. The market also seems to appreciate SNB's aggressive investments. The share price of SNB more than tripled in about 2 years since 2017.[2]

This unusual player in the equity market provides a novel opportunity to shed light on the debate surrounding institutional investors' investment

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[1] Exchange rate of 1.00 CHF for 1.00 USD is applied.
[2] SNB is listed at the Swiss stock Exchange for public trading. Refer to section 2.1 for details.

decisions in the literature. The literature on institutional investors has investigated issues such as their performance (Jensen 1968; Grinblatt and Titman 1989; Malkiel 1995; Gruber 1996; Carhart 1997; Daniel et al. 1997; Wermers 2000), informational advantage (Chakravarty 2001; Gompers and Metrick 2001; Sias et al. 2006; Yan and Zhang 2007; Schnatterly et al. 2008), and financing constraints (Shleifer and Vishny 1997; Brunnermeier and Nagel 2004; Shleifer and Vishny 2011; Hanson and Sunderam 2013; Hu et al. 2013). As a quasi-governmental institution, SNB benefits from abundant resources. Institutions with abundant resources enjoy economies of scale in acquiring and processing information (Schnatterly et al. 2008; Maffett 2012). Tracking SNB's informational advantage over the market would offer a better understanding of the resource argument. Moreover, SNB is a central bank, thus a money-printing authority. Unlike sovereign funds of other nations, SNB does not make investments with other assets such as gas or oil. Instead, SNB prints out Swiss francs and purchases foreign stocks with the Swiss francs. This strategy has been possible because SNB is pursuing an expansionary monetary policy and aims to weaken the Swiss franc by buying euros and dollars with it.[3] As a money-issuing authority with an expansionary

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[3] Swiss francs in circulation increased from CHF 41 trillion in 2008 to 78 trillion in 2018.

monetary policy, SNB faces unusually loose financing constraints. Investigating investment strategy and performance of SNB would provide an opportunity to analyze the extent to which loose financing constraint influences investments. Last, SNB is the one and only active institutional investor controlling a monetary policy in the world. SNB offers a unique setting to examine how monetary policies and investment behaviors affect each other.

In this study, I explore empirical evidence on informed trading by SNB. To do so, I narrow down the scope of analysis to the U.S. equity market because SNB's U.S. stock holdings are publicly disclosed in the SEC 13F filings. SNB officially claims to be a passive investor, mirroring the market index and avoiding stock-selections. However, there is some circumstantial evidence showing that is not the case. First, the financial press points out outstanding performance of SNB, implying that SNB might be engaging in informed trading and stock selections of sorts. Furthermore, according to the 13F filings, the percentage of SNB ownership varies substantially for each stock. If SNB simply follows the market as a whole, the percentage of ownership should be similar for each stock. Third, SNB buys and sells only a fraction of its portfolio. If SNB were to invest in the market index, an increase (a decrease) in the investment should result in an increase (a decrease) of all

stocks simultaneously. Last, the order of some top holding stocks in the SNB

portfolio in terms of market value does not match that of the market. For

example, at the end of 2018, SNB decreased the portion of stocks in Facebook

in its portfolio to push Facebook away from its top 5 list, while in the market,

Facebook continued to be the 5th largest firm in terms of market capitalization.

To investigate whether SNB engages in informed trading and stock selections,

I conduct three tests. First, I examine whether the quarterly changes in SNB

ownership of stocks are positively related with future returns. Using the

Fama-Macbeth quarterly regression, I find a positive relation between

changes in SNB equity holdings and subsequent quarterly and annual returns.

I further find that this relationship is asymmetric between the increase and

decrease of ownership, with a focus on the increase. I attribute this asymmetry

to contents of 13F filings, which only reports long positions of the portfolio.

Second, I expect and find that the quarterly changes in SNB ownership of

stocks are positively related with the earnings announcement returns in the

following quarter. Moreover, I find predictive abilities of SNB ownership

change for future returns and earnings announcement returns are more

pronounced for firms with high information asymmetry. Last, I also examine

whether firms that SNB holds have better firm fundamentals compared to the

control sample. As predicted, I find that SNB portfolio firms are less

leveraged, more matured, more profitable, less volatile, grow faster, and have better earnings quality, even after controlling for official stock exclusion criteria of SNB. Overall, the findings are consistent with SNB's informed trading

I believe that this study contributes to extant literatures in several ways. This study adds to the literature on institutions' performance by providing the presence of a central bank's equity holdings in the U.S. market. To my knowledge, this is the first study that demonstrates equity investment activity by a central bank. Second, I provide evidence consistent with SNB engaging in informed trading, in stark contrast to what SNB officially claims. Thus, this study expands a growing literature on the informational advantage and informed trading of an institutional investor in the equity market (Yan and Zhang 2007; Baik et al. 2010; Maffett 2012). This finding will also set the groundwork for further investigations into SNB's equity investments, which could potentially answer various questions about accounting and finance practices by institutional investors.

The remainder of this paper proceeds as follows: Section 2 discusses the background and develops the hypotheses; Section 3 delineates the data and research design; Section 4 reports the descriptive statistics and test results; Section 5 concludes the study.

II. Background and Hypothesis Development

2.1. Institutional Background

The Swiss National Bank is the central bank of Switzerland. Therefore, it is responsible for the country's monetary policy and issuance of Swiss franc (CHF), its currency. SNB is unusual for a central bank in the following two aspects. First, SNB has been listed in the Domestic Standard segment of the Swiss stock exchange (SIX) since its foundation in 1907. As of the end of 2017, 51% of the shares were held by cantons, cantonal banks and other public authorities and institutions.[4] The remaining shares are in the hands of private individuals and legal entities inside and outside of Switzerland. Anyone can access SIX to acquire SNB stock (Ticker: SNBN). However, private shareholders' voting rights are limited. Shareholders can vote only if they are in the share register, and private shareholders' registration is limited to a maximum of 100 shares. Accordingly, 65% of the registered shares are held by public sector shareholders.

Second, SNB owns an unusually large amount of foreign currency investments, especially equities. Its foreign currency investment has been

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[4] Swiss National Bank official website. *Swiss National Bank (SNB) - Questions and answers on the SNB as a company*.
https://www.snb.ch/en/ifor/public/qas/id/qas_unternehmen#

steadily increasing over the past decades, particularly after the financial and debt crisis in 2008. As of the end of 2018, SNB owns 763.7 billion in CHF under foreign currency investments, which is about 93% of its total assets (Swiss National Bank 2018, Annual Report). SNB officially states that the primary purpose of foreign currency investments is to support its monetary policy. Accordingly, the increase in foreign currency investments is related to SNB's attempt to curb the CHF exchange rate. The financial crisis in 2008 attracted global investors to Swiss franc, which is regarded as a safe asset. Resultant demand pressure appreciated CHF across the board. For example, when SNB removed the CHF peg to the EUR at the exchange rate of 1.2 CHF per 1 EUR, the exchange rate immediately changed to 0.94 CHF per 1 EUR. Although not admitted officially, financial press including *Reuters*, the *Wall Street Journal*, and *Bloomberg* states that SNB buys foreign currencies to weaken Swiss franc.

Investment portfolio of SNB's foreign currency investment consists of EUR (39%) and USD (36%). The proportion of investments in USD has been steadily increasing over the past decade. In terms of asset classes, governmental bonds make 69% and equities 19% (Swiss National Bank 2018, Annual Report). Its investment in foreign equity is notable, because this is uncommon for central banks. There are few central banks investing in an

equity market, such as Bank of Japan, but their investments are mostly limited to the domestic market. Massive investment of a central bank in foreign equity is unprecedented. For SNB, such investment has been possible since 2005, when Switzerland's banking law changed to allow it to buy assets other than short-dated bonds. SNB officially states that security and liquidity are of the first and second importance in foreign currency investments, and profitability the third.[5] The first and second criteria are taken into account by investing a bulk of assets in liquid governmental bonds. The third criterion is fulfilled by supplementing the portfolio with other investment categories such as equities. In fact, return of foreign currency investment in local currency has never been negative except for 2018 (-0.7%) over the past 15 years, with an average return of 3.5%. Specifically, during the past 15 years, earnings on bonds of foreign exchange reserves amounted to CHF 11.3 billion, while those on equities amounted to CHF 51.7 billion, making equities a significant factor in the increase in the SNB's capital base (Swiss National Bank 2018, Annual Report).

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[5] Swiss National Bank official website. *Swiss National Bank (SNB) - Questions and answers on asset management*. https://www.snb.ch/en/iabout/assets/id/qas_assets_1#.

SNB does not disclose its specific trading strategy in the equity market, but it mentions a few principles on its official website.[6] First, it argues that its equity investment represents the international equity market as a whole, replicating indices instead of pursuing positive or negative equity selection. As a passive investor avoiding to affect the market, SNB allegedly refrains from making strategic participations in companies and remains a financial investor. Second, it does not invest in equities of mid-cap and large-cap banks and bank-like institutions from advanced economies, to avoid possible conflicts of interest. Third, SNB avoids sin stocks. It does not purchase shares of companies that seriously violates fundamental human rights, systematically cause severe environmental damage or are involved in the production of internationally condemned weapons.

2.2. Prior Literature

Two streams of literature are closely related to my research. The first stream of literature is studies on institutional investors' informational advantage. Prior studies show that certain institutional investors benefit from informational advantage (Grinblatt and Titman 1989; Daniel et al. 1997;

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[6] Swiss National Bank official website. *Swiss National Bank (SNB) - Questions and answers on asset management*. https://www.snb.ch/en/iabout/assets/id/qas_assets_1#.

Wermers 2000; Baker et al. 2010). On the other hand, some early evidence suggests mutual funds rather underperform the benchmarks (Jensen 1968; Malkiel 1995; Gruber 1996; Carhart 1997). More similar to my analysis, a stream of literature examines institutional investor's ownership and future returns in the market. Gompers and Metrick (2001) investigate whether institutional investors' ownership predicts future returns. They find a significant and positive relationship between current aggregate institutional ownership and future returns, but not with change of institutional ownership. They conclude that the forecasting power of institutional ownership comes from demand shock, rather than informational advantages. Yan and Zhang (2007) extend this setting by distinguishing between short-term and long-term institutional investors. They find the return predictability of institutional holding documented by Gompers and Metrick (2001) is mainly from short-term institutional investors. They add that the changes of short-term institutional investor holdings predict future returns, concluding that the predictive power is derived from informed trading instead of demand shock. Baik et al. (2010) distinguish between local and non-local institutional investors and find that local institutional investors benefit from better informational advantage. To confirm that their results are consistent with informed trading, they also find that changes in local institutional investor

ownership predict subsequent earnings announcement returns. A positive relationship between changes of institutional investors' ownership and earnings announcement returns is also documented in other studies (Ali et al. 2004; Baker et al. 2010). Maffett (2012) finds that private informed trading of international institutional investors is more pronounced for firms with more opaque information environments because high information asymmetry opens up more potential gain from informed trading.

My study is also related to studies investigating trading strategies of institutional investors. Institutions are sophisticated in information acquisition and processing and prior studies provide consistent evidence. For example, Ke and Ramalingegowda (2005) provide evidence that transient institutions exploit the post-earnings announcement drift (PEAD). Bowen et al. (2014) examine whether Berkshire Hathaway indeed employs trading strategies consistent with Warren Buffett's public statement. They categorize Buffett's comments into three: accounting, governance, and investing practices. Comparing firms owned by Berkshire Hathaway with a control sample, they find that overall Berkshire Hathaway trades consistently with Warren Buffett's commentary.

2.3. Hypothesis Development

I limit the scope of the analysis to SNB's investment in the U.S. equity market because through SEC filings, SNB's portfolio composition can be observed for the U.S. investments. In contrast, information about SNB's portfolio is not available for the European equity market. SNB officially claims not to be picking stocks to avoid influencing the market. Public disclosure in SEC filings allows me to test whether SNB engages in active investment. This unprecedented setting would enhance the understanding of institutional investors' investment decisions. I therefore test whether SNB possesses stock picking ability and what characteristics its portfolio exhibits.

Changes in SNB ownership and future returns

My underlying premise is that SNB will engage in informed trading. I therefore test whether changes in SNB ownership predict future returns. Previous studies have provided evidence that institutional investors are sophisticated informed traders (Arbel and Strebel 1983; Bhushan 1989; Lo and MacKinlay 1990; Cornell and Sirri 1992; Lee 1992; Meulbroek 1992; Sias and Starks 1997; Walther 1997; Chakravarty and McConnell 1999). Chakravarty (2001) and Sias et al. (2006) also show that the superior information of institutional investors is reflected in the prices when they trade.

In previous studies, the return predictability of changes in institutional ownership is used as a proxy for informed trading by institutions (Gompers and Metrick 2001; Yan and Zhang 2007; Maffett 2012). More directly, Yan and Zhang (2007) and Baik et al. (2010) report that ownership changes of certain types of institutional investors are positively correlated with the quarterly returns of the following quarter. Second, to the extent that SNB has resources and expertise as a national bank, SNB is likely to be involved in informed trading, benefiting from informational advantages. Consistently, Schnatterly et al. (2008) find that large institutions have a greater information advantage compared to other institutions because of economies of scale in information acquisitions. Maffett (2012) posits that sophisticated investors with significant resources and expertise can execute profitable trades based on information advantages. The size of SNB's resources as a pseudo-national institute implies that economies of scale in information acquisition exist at SNB. It would also have an informational advantage in the macro economy and foreign exchange developments as a central bank. The possibility that SNB could exploit special knowledge for its investment is also raised on its official website.[7] To the extent that SNB has an information advantage and

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[7] Swiss National Bank official website. Swiss National Bank (SNB) - Questions and answers on asset management. https://www.snb.ch/en/iabout/assets/id/qas_assets_1#.

employs it in investment decisions, there would be a positive relationship between the changes in SNB ownership and future returns.

However, it is possible that changes in SNB ownership do not predict future returns. There are some reasons to believe that SNB might not have an informational advantage. Several studies suggest that institutional investors underperform the bench mark (Jensen 1968; Malkiel 1995; Gruber 1996; Carhart 1997). Moreover, Baik et al. (2010) find that non-local institutional investors have no information advantage compared to local institutional investors. Considering that SNB is a non-local institution in the U.S. equity market, SNB might not have an information advantage. Also, as a central bank, which is one of the most conservative institutions, SNB might not utilize its information advantage despite its advantages. In fact, while SNB stays mute about its informational advantage, it officially denies its use of potential information advantages in investment activities. SNB claims to mirror the market index as a whole to avoid market distortion or unintended signaling to the market. It also declines to engage in either positive or negative stock-selection. While some circumstantial evidence in the financial press and descriptive statistics from SNB's portfolio suggests that it may engage in informed trading, it is an empirical question. This discussion leads to the following hypothesis in the alternative form:

H1: Changes in SNB ownership of a stock are positively related with its future returns.

Changes in SNB ownership and future earnings announcement return

To provide corroborating evidence, I also investigate the relation between changes in SNB ownership and subsequent earnings announcement returns. Prior literature also uses abnormal stock returns around earnings announcements to examine stock-selection skills of investors (Ke et al. 2003; Ali et al. 2004; Christophe et al. 2004; Baker et al. 2010). Specifically, Baker et al. (2010) indicate that the test for earnings announcement returns is advantageous because returns at the earnings announcement date contain the most concentrated information about a firm's earnings. Prior research examines the relationship of institutional ownership change and the three-day benchmark-adjusted return around the earnings announcement date to find a subset of funds showing a positive correlation. If SNB holds an information advantage and engages in informed trading and stock-selection, it would trade in advance of the earnings announcement date. In other words, SNB would increase (decrease) its stock ownership in advance if it expects positive (negative) earnings surprises at the subsequent earnings date. Therefore, I posit the next hypothesis as follows, in the alternative form:

H2: Changes in SNB ownership of a stock are positively related with subsequent earnings announcement returns.

SNB ownership and firm fundamentals

While SNB claims to mirror the index, except for a few exclusion criteria, the number of firms it holds is only about one-third of the total firm listed in NYSE, AMEX, and NASDAQ. Bowen et al. (2014) examines how Berkshire Hathaway's investment choice is related with the portfolio firm's fundamental, governance and accounting principles. In a similar vein, I examine firm characteristics of portfolio stocks held by SNB. Specifically, I test whether SNB's choice of firms is related to firm fundamentals. To do so, I generate the following hypothesis:

H3: SNB selects portfolio firms with strong firm fundamentals.

III. Data and Research Design

3.1. Data

I begin with portfolio firms of Swiss National Bank every calendar quarter during the period from 2013:Q2 to 2019:Q1 from SEC Form 13F filings. Institutional investors are required to file a 13F if their total investment at the end of a calendar quarter exceeds $100 million. The filing

discloses securities in long positions with more than 10,000 shares or market value of $200,000, put and call options, ADRs (American Depositary Receipts) and convertible notes. Thus, the filing fails to capture securities in short positions, any securities invested under 10,000 shares and $200,000, and non-U.S. securities.[8] Another limitation of 13F data is its frequency. The filing is on a quarterly basis and the data observed is snapshots at the end of every quarter. Thus, it is difficult to identify exactly when the trading of securities happened within the quarter. The Swiss National Bank began disclosing its 13F filings since its second calendar quarter of 2013. I obtain 56,406 observations of securities held by SNB between 2013:Q2 and 2019:Q1. For the main analysis, 2013:Q2 is deleted from the sample because data of 2013:Q1 is unobservable, and assuming zero investment for unreported portfolio could be misleading.

My control sample is comprised of all available securities traded in NYSE, AMEX, or NASDAQ in the Compustat and CRSP universe during the same period on a quarterly basis. While Bowen et al. (2014) include all stocks regardless of the exchange market they are listed in, I limit the sample to be traded in NYSE, AMEX, or NASDAQ because SNB has not traded any

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stocks from exchange markets other than those three in the United States. I also require firms to be included in the intersection of CRSP and Compustat, because I utilize stock returns and financial information. This yields 10,029 observations for the final sample. For the variable of analyst earnings estimates, I obtain information from I/B/E/S. To identify environment hazard firms and weapon related firms, I use MSCI KLD.

3.2. Research Design

To investigate whether changes in SNB ownership predict future stock returns, I regress future returns on changes in SNB ownership. Following prior research (Yan and Zhang 2007), each quarter, I run the following cross-sectional regression of one-quarter-ahead (or one-year-ahead) stock returns on changes in SNB ownership and various control variables:

$$
\begin{aligned}
Ret_{i,q,q+1}&\left(Ret_{i,q,q+4}\right) \\
&= \beta_0 + \beta_1 D\_SNB_{i,q} + \beta_2 SNB_{i,q-1} + \beta_3 BM_{i,q} + \beta_4 ME_{i,q} \\
&\quad + \beta_5 Vol_{i,q} + \beta_6 Turn_{i,q} + \beta_7 Prc_{i,q} + \beta_8 S\&P500_{i,q} \\
&\quad + \beta_9 Ret_{i,q-1,q} + \beta_{10} Ret_{i,q-4,q-1} + \beta_{11} Age_{i,q} + \beta_{12} DP_{i,q} \\
&\quad + e_{i,q}
\end{aligned}
$$

$$(1)$$

where $Ret_{q,q+1}$ is one-quarter-ahead stock return in percent compounded quarterly. $Ret_{q,q+4}$ is one-year-ahead stock return in percent compounded yearly. D_SNB_q is the changes in SNB ownership from q-1 to q in per mille. SNB_{q-1} is SNB ownership in q-1 in per mille. *BM* is the book-to-market ratio. *ME* is market capitalization. *Vol* is the monthly volatility over the past two years. *Turn* is the average monthly turnover over the previous quarter. *Prc* is share price. *S&P500* is an indicator variable that takes the value of 1 if the firm is a member of S&P500 index. $Ret_{q-1,q}$ is the contemporary quarter return. $Ret_{q-4,q-1}$ is the lagged three quarter return preceding the beginning of the quarter. *Age* is firm age measured as the number of months since first return appears in CRSP database. *DP* is dividend yield. *DP* is winsorized at the 99th percentile. All other variables except stock returns and DP are winsorized at the 1st and the 99th percentiles. All variables except stock returns and SNB ownerships are expressed in natural logarithms. Timeline of main variables used in equation (1) are illustrated in Figure 1.

I also replace the changes of ownership with dummy variables for changes in SNB ownership and estimate the following regression:

$$Ret_{i,q,q+1}\left(Ret_{i,q,q+4}\right)$$

$$= \beta_0 + \beta_1 I\_Increase_{i,q} + \beta_2 I\_Decrease_{i,q} + \beta_3 SNB_{i,q-1}$$

$$+ \beta_4 BM_{i,q} + \beta_5 ME_{i,q} + \beta_6 Vol_{i,q} + \beta_7 Turn_{i,q} + \beta_8 Prc_{i,q}$$

$$+ \beta_9 S\&P500_{i,q} + \beta_{10} Ret_{i,q-1,q} + \beta_{11} Ret_{i,q-4,q-1}$$

$$+ \beta_{12} Age_{i,q} + \beta_{13} DP_{i,q} + e_{i,q}$$

$$(2)$$

where $I\_Increase_q$ is an indicator variable that takes the value of 1 if D_SNB_q is positive and 0 otherwise. $I\_Decrease_q$ is an indicator variable that takes the value of 1 if D_SNB_q is negative and 0 otherwise. All other variables are as defined in equation (1).

Following prior literature (Gompers and Metrick 2001; Yan and Zhang 2007), I estimate regression equations (1) and (2) using weighted-least-squares, with each firm weighted by its log market value of equity. I estimate equations (1) and (2) quarter by quarter using the Fama and MacBeth (1973) method and report t-statistics on the basis of Newey and West (1987) standard errors with 2 quarter lags to account for autocorrelation of dependent variable.

To provide further evidence on informed trading, I focus on the earnings announcement date as my setting for examination because it represents an important information-sensitive event in which SNB is likely to exploit its information advantage. I estimate regressions of cumulative abnormal returns

around subsequent earnings announcements on changes in SNB ownership. Specifically, I run the following regression:

$$CAR_{i,q+1} = \beta_0 + \beta_1 D\_SNB_{i,q} + \beta_2 SNB_{i,q-1} + \beta_3 BM_{i,q} + \beta_4 ME_{i,q}$$

$$+ \beta_5 Ret_{i,q-2,q-1} + \beta_6 Turn_{i,q} + \beta_7 EP_{i,q} + \beta_8 EV_{i,q-1,q}$$

$$+ \beta_9 Analyst\#_{i,q} + \beta_{10} EARank_{i,q} + e_{i,q}$$

$$(3)$$

where CAR_{q+1} is three-day cumulative abnormal return around the earnings announcement date ([-1,+1]) in the subsequent quarter using Fama-French three factor model (Fama and French 1993). Following Baker et al. (2010), I use abnormal return which incorporates both size and book-to-market because La Porta et al. (1997) find that such firm characteristics are related to earnings announcement return. D_SNB_q is the changes in SNB ownership from q-1 to q in per mille. SNB_{q-1} is SNB ownership at q-1 in per mille. BM is the book-to-market ratio. ME is market capitalization. $Ret_{q-2,q-1}$ is lagged quarterly return. It is included to control for potential confounding effect from momentum trading of SNB, following Ali et al. (2004). $Turn$ is the average monthly turnover over the previous quarter. EP is quarterly earnings persistence over the past four years (i.e. coefficient of rolling regression) defined as in Chi and Shanthikumar (2017). EV is standard deviation of quarterly earnings over the past four years in thousands as defined in Chi and

Shanthikumar (2017). *Analyst#* is the natural logarithm of 1 plus the number of analysts reported earnings forecast in I/B/E/S. *EA_rank* is the quarterly decile rank of the number of earnings announcement of other firms on the same day as the given firm's earnings announcement. *EP, EV, Analyst#, and EA_rank* are controlled because they are known to affect earnings forecast accuracy (Chi and Shanthikumar 2017). All variables except stock returns are winsorized at the 1st and the 99th percentiles. The timeline of main variables used in equation (3) is illustrated in Figure 1.

Similar to equation (1), I reestimate equation (3) after replacing continuous variables with dummy variables as follows:

$$CAR_{i,q+1} = \beta_0 + \beta_1 I\_Increase_{i,q} + \beta_2 I\_Decrease_{i,q} + \beta_3 SNB_{i,q-1}$$
$$+ \beta_4 BM_{i,q} + \beta_5 ME_{i,q} + \beta_6 Ret_{i,q-2,q-1} + \beta_7 Turn_{i,q}$$
$$+ \beta_8 EP_{i,q} + \beta_9 EV_{i,q-1,q} + \beta_{10} Analyst\#_{i,q}$$
$$+ \beta_{11} EA\_Rank_{i,q} + e_{i,q}$$

$$(4)$$

where $I\_Increase_q$ is an indicator variable that takes the value of 1 if D_SNB_q is positive and 0 otherwise. $I\_Decrease_q$ is an indicator variable that takes the value of 1 if D_SNB_q is negative and 0 otherwise. All other variables are as defined in equation (3).

Similar to equations (1) and (2), I estimate regression equations (3) and (4) using weighted-least-squares, with each firm weighted by its log market value of equity. I estimate equations (1) and (2) using the Fama and MacBeth (1973) method and report t-statistics on the basis of Newey and West (1987) standard errors with 2 quarter lags to account for autocorrelations in the dependent variable.

Last, to gain insight into SNB's stock picking ability, I test whether fundamental accounting information is associated with SNB's investment decision. To do so, I run a logit regression similar to that of Bowen et al. (2014). As fundamental data are mostly available annually, I run a regression for this analysis by year. Specifically, I run the following logit regression with fixed effects:

$$
\begin{aligned}
I\_SNB_{i,t+1} = \beta_0 &+ \beta_1 MLEV_{i,t} + \beta_2 Age\_year_{i,t} + \beta_3 Owner\_ret_{i,t} \\
&+ \beta_4 Owner\_ret\_vol_{i,t} + \beta_5 Run\_owner\_ret\_growth_{i,t} \\
&+ \beta_6 Run\_ib\_growth_{i,t} + \beta_7 ZScore_{i,t} + \beta_8 DD_{i,t} \\
&+ \beta_9 Divpay_{i,t} + \beta_{10} Auop_{i,t} + Year \\
&- fixed\ effect_{i,t} + Industry - fixed\ effect_{i,t} + e_{i,t}
\end{aligned}
$$

$$(5)$$

where $SNB_{i,t+1}$ is an indicator that takes the value of 1 if SNB holds stock i at least one quarter during year t+1 and 0 otherwise. In other words, stocks with

$SNB_{i,t+1}$ that takes the value of 0 are all publicly traded stocks in NYSE/AMEX/NASDAQ in Compustat and CRSP database that are not owned by SNB during year t+1. *Mlev* is the ratio of book value of short-term debt and long-term debt to market value of assets. *Age_year* is firm age measured as the number of years since first return appears in CRSP database. *Owner_ret* is owners' earnings defined by Warren Buffett computed as reported earnings plus depreciation, depletion, and amortization minus the average annual amount of capital expenditures over three past years as in Bowen et al. (2014). *Owner_ret_vol* is the volatility in *Owner_ret* over the past five years. *Run_ib_growth* is the consecutive number of years for which a firm has achieved an annual operating income growth rate above the median annual growth rate relative to firms in the same two-digit SIC code. *ZScore* is the measure of the likelihood of bankruptcy defined as in Altman (1968). *DD* is a proxy for quality of earnings defined as Bowen et al. (2014). *Divpay* is an indicator variable that takes the value of 1 if the firm is paying dividend and 0 otherwise. *Auop* is an indicator variable that takes the value of 1 if the firm received unqualified audit opinion and 0 otherwise. Following prior literature (Bowen et al. 2014),) I do not include control variables such as *ME*, *BM*, *Lev*, *ROA* and *ROE* because they are highly correlated with many of my

independent variables in the regression. However, the inclusion of the controls does not change my inferences.

[Insert Figure 1 Here]

IV. Results

4.1. Descriptive Statistics and Correlations

Table 1 presents descriptive statistics for the variables used in my main analysis. The number of firm observations included in the Compustat and CRSP universe for the period of 2013:Q3 - 2018:Q3[9] is 105,165 with 10,029 unique firms.[10] Among those, observations with SNB holdings are 49,039 with 3,350 unique firms. This constitutes 46.6% (33.4%) in terms of firm-quarters (unique firms). The mean percentage held by SNB for its investee stocks is 0.16024%. The mean (median) changes in SNB holdings for SNB held stocks is 0.0057% (0.00061%). Although more than half of the changes are positive, the negative value of the first quartile indicates that more than a quarter of the changes are decreases in holdings. In terms of the

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[9] Although Table 3 covers from 2013:Q2 to 2019:Q1, sample period for Table 1 and Table 2 is restricted for consistency with the main analysis (Table 4, Table 5).

[10] There are about 7,300 unique firms per each quarter.

intersection of Compustat and CRSP, 27.4% of the observations show an increase in SNB ownership, and 17.9% a decrease.

[Insert Table 1 Here]

Table 2 reports Pearson (lower diagonal) and Spearman (upper diagonal) correlations among the variables used in my analysis. The change of SNB ownership (*D_SNB*) is positively correlated with subsequent quarterly returns. The univariate results shows that an increase in ownership, instead of a decrease, drives the results. Increases in SNB ownership (*I_Increase*) are positively correlated with abnormal returns in the following quarter and the three-day cumulative abnormal return around the subsequent earnings announcement date. On the other hand, decreases in SNB ownership (*I_Decrease*) are not significantly correlated with future returns. Last, the correlation matrix shows that SNB tends to hold large and low book-to-market firms.

[Insert Table 2 Here]

4.2. Quarterly Trends of SNB Portfolio

Table 3 reports SNB's U.S. equity investment portfolio across time during the sample period. Panel A, Table 3 exhibits the number of firms held by SNB and the aggregated market value of the portfolio at the end of each quarter. The first two columns show the overall portfolio, the middle two show the portfolio from NYSE, and the last two from NASDAQ. Although SNB invests in AMEX as well, the portion of its investment from AMEX is negligibly small in the portfolio (about 2% in terms of number of firms and about 1% in terms of market value). Thus, I do not report AMEX investments separately for parsimony. Panel A, Table 3 shows that SNB has been steadily increasing its investment in U.S. equities since 2013. As of 2019:Q1, SNB holds 86,978 million dollars of the U.S. stocks, which is about one eighth of the national GDP of Switzerland. Figure 2 illustrates the trends of SNB's equity holdings and SNB stock price. As noted in section 2.1, the Swiss National Bank itself is listed on the Swiss Stock Exchange. The bar (left axis) of Figure 2 charts column (2) of Panel A, Table 3. The line (right axis) displays the relative stock price of SNB at a log scale, where its price in April 2013 is 1. Figure 2 shows that SNB's increasing trend of U.S. equity investment is largely aligned with its appreciation of stock price. The

financial press indicates an increase of foreign currency investment as one of the causes of the rise of SNB price.[11]

Another notable trend is its diverse portfolio. SNB has consistently invested in more than 2,000 firms. Nevertheless, it is far less than the market as a whole. Unlike its official statement that it covers the overall market except for some exclusions, SNB holds only about one-third of stocks in the U.S. equity market.[12] Meanwhile, the results by exchange markets show that the same is true in both exchange markets. The SNB portfolio covers about 45% of NYSE listed firms, and about 30% of NASDAQ listed firms.

Panel B, Table 3 demonstrates the number of firms purchased or sold by SNB every quarter. Following prior literature (Sias 2004), a specific stock is defined as bought (sold) if SNB ownership of a stock in percentage (shares owned by SNB/total shares issued) increases (decreases) and the number of shares does not decrease (does not increase). Interestingly, the number of firms purchased or sold by SNB varies every quarter. If SNB mechanically follows the index, there should be an increase in ownership for all firms when

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[11] Atkins, R. 2017. The mysterious rise in shares of the Swiss National Bank. *Financial Times*, August 30.

[12] There is a possibility that SNB does hold more stocks than it appears in 13F. 13F filings require to list only stocks invested more than 10,000 shares or market value of $200,000. Even withstanding this limit, this argument is still valid, because it is not likely that SNB mirrors the whole market with such minor investments in two-thirds of the total stocks.

it increases total investment, and a decrease when it shrinks down total investment. Nevertheless, except for two quarters (2015:Q3, 2016:Q1), SNB increases only a selected number of firms in its portfolio. Similarly, SNB decreases a selected number of firms in the portfolio instead of decreasing all stocks. Such phenomenon prevails in both markets, negating the possibility that SNB merely follows the market index.

Panel C, Table 3 lists top 5 stocks owned by SNB at the end of each year (first quarter for 2019) in terms of its weight in the portfolio. If SNB follows the index, its ranking should be identical to that of the market at the end of every year. Although the overall trend is similar, I observe substantial variation. For example, at the end of 2018, top 5 firms in terms of market capitalization in the U.S. market is in the order of Microsoft, Apple, Amazon, Google, and Facebook,[13] while ranking of SNB portfolio weight is Apple, Microsoft, Google, Amazon, and Johnson & Johnson. Such anecdotal evidence echoes that SNB does not mechanically follow the market index.[14]

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[13] Berkshire Hathaway is disregarded from the list because SNB does not invest in Berkshire Hathaway.

[14] Newer anecdotal evidence in the discrepancy between SNB portfolio and the market is SNB's increase in Alibaba in the third quarter of 2019. From the second to third quarter of 2019, SNB increased 205 million USD amount of Alibaba shares which is about 27% increase in its portfolio. During the same period, the market capitalization of Alibaba did not change significantly.

Last, untabulated results for statistics of SNB equity ownership also provide evidence that SNB does not simply replicate the market. If SNB's portfolio is a simple reflection of the market, it should hold the same portion for every firm in each quarter. Nevertheless, descriptive statistics indicate substantial variation in SNB ownership for each firm. For example, in 2018:Q4, the standard deviation of SNB ownership is 0.11%, with the mean of 0.201%. Overall, the findings in this section suggest that SNB does not mechanically follow the market index.

[Insert Table 3 Here]

[Insert Figure 2 Here]

4.3. Return Predictability of Changes in SNB Ownership

This section tests *H1* using equations (1) and (2). Panel A, Table 4 reports weighted-least-square Fama-Macbeth regression with $Ret_{q,q+1}$, a buy-and-hold return during the following quarter, as my dependent variable. The sample period is from 2013:Q3 to 2018:Q3. The second quarter of 2013 is excluded because it is the first 13F disclosure of SNB's portfolio but it does not necessarily mean that there was no investment in the U.S. equity market

in the first quarter of 2013 and before.[15] To avoid undue effects, I exclude 2013:Q3. I also exclude 2018:Q4 due to data unavailability of stock returns in 2019. To control for outliers created by extreme increases of ownership in the first buy,[16] I also exclude the first buys which constitute 1.3% (1,243 observations) of the sample. Following Yan and Zhang (2007), DP is winsorized at the 99th percentile and all other variables except return are winsorized at the 1st and the 99th percentiles.

Column (1) shows the results for the full sample, a sample of both all SNB investee stocks and the control sample. Consistent with *H1*, the coefficient on *D_SNB$_q$* is positive and significant (coeff. est=3.439; t-value=2.043), indicating that changes in SNB ownership have strong predictive power of subsequent quarter returns. Results for the control variables are overall comparable to those of Yan and Zhang (2007).

I also partition the sample and perform a subsample analysis. That is, the first subsample (column (2)) includes stocks with weight increase (positive *D_SNB$_q$*), stocks without any change (zero *D_SNB$_q$*), and stocks with weight decrease (zero *SNB$_q$*). The second subsample (column (3)) includes stocks with decreased SNB ownership (negative *D_SNB$_q$*), stocks without any

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[15] Refer to 3.1. Data section for detailed explanation of 13F disclosure requirements.
[16] First buys are defined as increases in ownership when past ownership is zero.

change (zero D_SNB_q), and stocks with no SNB ownership (zero SNB_q).

Column (2) reports regression results for the first subsample which excludes

decreased ownership. I find that the coefficient of D_SNB_q is positive and

more significant than that the one in column (1) (coeff. est=3.394; t-

value=3.050). On the other hand, results for the second subsample that

excludes increases in holdings, show an insignificant coefficient on D_SNB_q

(coeff. est=3.693; t-value=0.429). The results from columns (2) and (3) imply

that the increase of ownership has stronger predictive ability than the decrease.

Next, I conduct another subsample analysis to alleviate the concern that

the results are driven by stocks without SNB ownership. I construct a

subsample that includes stocks with weight increase, weight decrease, and no

change in ownership, but excludes stocks without SNB ownership (i.e.

include all stocks with positive SNB_q). Provided that the predictive power

results from changes in SNB ownership, the coefficient of D_SNB_q should be

significant and positive. As expected, column (4) shows that the coefficient

on D_SNB_q is positive and significant (coeff. est=2.394; t-value=3.006). Thus,

I mean to interpret that return predictive power is driven by the changes in

SNB ownership.

Last, I conduct a similar analysis but with dummy variables to help

gauge the economic effect of changes in SNB ownership. Specifically, for my

full sample, I run the same regression as equation (2). Similar to other results, the coefficient on $I\_Increase_q$, which that takes the value of 1 if D_SNB_q is positive, is positive and significant (coeff. est=2.040; t-value=2.727). On the other hand, the coefficient on $I\_Decrease_q$, which that takes the value of 1 if D_SNB_q is negative, is neither negative nor significant (coeff. est=1.327; t-value=1.550). My findings echo the results in columns (2) and (3), which show that return predictability is driven by increases in ownership. In addition, the results show that stocks purchased by SNB yield 2.078% higher quarterly return on average during the next quarter than other stocks. In sum, SNB's return predictability is both statistically and economically significant.

It is noteworthy to mention the coefficient on SNB_{q-1}, which refers to SNB ownership in the past quarter as shown in Panel A, Table 4. Prior literature (Gompers and Metrick 2001; Yan and Zhang 2007) argues that there are two potential forces driving the positive relationship between institutional ownership and future returns: demand shock and informational advantages. The level, SNB_{q-1} reflects demand shock while the change of ownership, D_SNB_q indicates information advantages. My results are consistent with SNB having information advantages. Throughout the five columns, the coefficients of SNB_{q-1} show no or weaker significant results than that of D_SNB_q.

In an untabulated analysis, I replace SNB ownership with total institutional ownership and repeat the analysis for the sample period. Consistent with Gompers and Metrick (2001), I find that the level of total institutional ownership is significant but the change of total institutional ownership is insignificant. In sum, the evidence supports informed trading, rather than demand shock.

Panel B, Table 4 reports weighted-least-square quarterly Fama-Macbeth regression of equation (1) with $Ret_{q,q+4}$, a buy-and-hold return during the following year, as my dependent variable. The sample period is from 2013:Q3 to 2017:Q4. All other specifications follow the one in Panel A, Table 4.

The results in Panel B, Table 4 mirrors that in Panel A, Table 4. The change of SNB ownership has predictive ability of subsequent year returns. Also, the comparison of the coefficients of D_SNB_q and SNB_{q-1} confirms that the predictive power arises from SNB's informational advantages. While these results echo that of previous analyses, there are few differences. The coefficient on D_SNB_q for the subsample excluding the control sample (Column (4)) is insignificant. Also, the coefficient on $I\_Decrease_q$ is positive and significant (coeff. est=6.274; t-value=4.487), in contrast to Panel A, Table 4. This finding is attributable to the notion that stocks sold at a certain quarter

is likely to be bought again during the following quarter.[17] I alos find that the coefficient on D_SNB_q is insignificant (coeff. est=2.065; t-value=1.380), suggesting that a larger decrease in SNB ownership does not lead to a lower future return.

Overall, I find evidence consistent with *H1*. The change of SNB ownership predicts future returns, consistent with SNB's information advantage.

[Insert Table 4 Here]

4.4. Changes in SNB Ownership and Earnings Announcement Returns

This section tests *H2* with two approaches, regressions and portfolio sorts. First, I estimate equations (3) and (4). To test for SNB's information advantages, I examine whether the change of SNB ownership is positively correlated with future earnings announcement returns. Table 5 reports the results for equations (3) and (4) with CAR_{q+1}, cumulative abnormal returns (-1,1) around the subsequent earnings announcement date. Following Baker et

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[17] Panel A, Table 3 shows SNB rarely sells whole shares of a firm, increasing and decreasing its ownership instead of completely excluding them from the portfolio.

al. (2010), I use the Fama-French three-factor model (Fama and French 1993) that controls size and book-to-market to estimate abnormal returns. Column (1), Table 5 exhibits results for the full sample, a sample that consists of all SNB held stocks and control sample. The coefficient on D_SNB_q is positive and significant (coeff. est=0.945; t-value=2.682), indicating that changes in SNB ownership have predictive power for earnings announcement returns in the subsequent quarter. This effect is robust to the inclusion of control variables from prior literature (Ali et al. 2004; Chi and Shanthikumar 2017) that controls for firm characteristics, potential momentum trading of SNB, and other variables that affect earnings announcement returns.

Columns (2) to (4) report regression results for the three subsamples. Column (2) reports the results for the first subsample that consists of stocks with weight increase, with no change, and with weight decrease. As expected, the coefficient on D_SNB_q is positive and significant (coeff. est=0.830; t-value=1.962). Column (3) reports the results for the second subsample that consists of stocks with decreased SNB ownership, with unchanged ownership, and with no SNB ownership. In contrast to the results in column (2), the coefficient on D_SNB_q is insignificant (coeff. est=2.573; t-value=1.308). The results in columns (2) and (3) are consistent with SNB having asymmetric investment behavior in long positions. Column (4) reports the results for the

subsample that includes only SNB investee stocks (positive SNB_q). In column (4), the coefficient on D_SNB_q is positive and significant (coeff. est=0.922; t-value=2.696), indicating that change in ownership has predictive power.

To gauge the economic magnitude of the effect, the last analysis in column (5) reports the results using dummy variables using equation (4). Consistent with other analyses, $I\_Increase_q$ is positive and significant (coeff. est=0.497; t-value=4.644) while $I\_Decrease_q$ is insignificant (coeff. est=0.219; t-value=0.989). The results indicate that SNB's portfolio generates a 0.497% larger return than other firms. The excess return is both statistically and economically significant.

[Insert Table 5 Here]

To provide corroborating evidence, I also sort portfolios according to changes in ownership and compute portfolio returns. Stocks are sorted into quintiles on the basis of the changes in SNB ownership from the previous report date to the current report date every quarter. For each quintile, I compute three-day cumulative abnormal returns around the earnings announcement date ([-1,+1]) in the following quarter similar to Table 5. Table 6 shows the results. Columns (1) and (5) report the mean of CAR_{q+1} for the

lowest and highest quintiles, respectively. The mean of portfolio Q5 is highest and statistically significant (mean=0.103%; t-value=2.109), while that of portfolio Q1 is lowest (-0.062%). Although not statistically significant, it is noteworthy that the mean CAR_{q+1} is negative for portfolio Q1, which is comprised of stocks with a decrease in SNB ownership. It provides evidence that some, although marginal, predictive power exists in firms with ownership decrease. Column (7) reports the hedge portfolio strategy that takes a long position in portfolio Q5 and a short position in portfolio Q1. The difference, Q5-Q1 (increase-decrease) is positive and significant (mean=0.165%; t-value=1.69). Results for stocks not held by SNB are reported in columns (6) and (8). Column (6) reports that stocks not owned by SNB is negative (-0.282%) but not statistically significant. Column (8) reports the difference of CAR_{q+1} between portfolio Q5 and stocks not held by SNB are positive and statistically significant (mean=0.224%; t-value=3.12). The results in Table 6 echo those in Table 5 and confirm that the changes of SNB ownership are positively related with future earnings announcement return, consistent with *H2*.

Overall, the results in Tables 5 and 6 support *H2*, reinforcing SNB's informed trading.

[Insert Table 6 Here]

4.5. Cross Sectional Analyses by Extent of Information Asymmetry

Maffett (2012) finds that international institutional investors are more likely to engage in informed trading for firms with opaque information environments. There is a compelling reason to believe that information environments affect informed trading. Opaque information environments increase information asymmetry between informed and non-informed traders, thus create more opportunities to benefit from privately gathered information. Increased potential benefit allows institutional investors to bear incremental cost of more information gathering and processing. To investigate the role of information environments in informed trading of SNB, I follow prior literature and reestimate equations (1) and (3) for the subsamples divided into firms with high and low information asymmetry based on the sample median of each information asymmetry variable. The proxies of information asymmetry are firm size (*ME*), return volatility (*Vol*), and firm age (*Age*).

Panel A, Table 7 reports results of regressions in the subsamples using the model of column (1), Panel A, Table 4. Each subsample is formulated by dividing the sample into high and low information asymmetry every quarter. In columns (1) and (2), the coefficient of D_SNB_q is significantly positive (coeff. est=10.63; t-value=3.410) for smaller firms, while that for larger firms

is insignificant (coeff. est=1.172; t-value=0.0887). The results from return volatility and firm age yield similar inferences.

Panel B, Table 7 reports cross-sectional results using the model of column (1), Table 5. Similar to results in Panel A, Table 7, the predictability of change in ownership is more pronounced for firms with high information asymmetry. The coefficient of D_SNB_q is significantly positive (coeff. est=3.556; t-value=2.339) for smaller firms, while that for larger firms is insignificant (coeff. est=0.380; t-value=1.075). The results from firm age are analogous to those from firm size, while I don't find the same trend for the return volatility.

Overall, the predictability of change in SNB ownership for future quarterly returns and earnings announcement returns tends to be more pronounced for firms with high information asymmetry. This evidence is consistent with SNB engaging in informed trading, and benefits more from information sensitive firms.

[Insert Table 7 Here]

4.6. Stock Selection Criteria of SNB

In this section, I investigate *H3*, the criteria SNB employs in its stock selection, with both univariate and multivariate analyses. As discussed, SNB states that it follows the market as a whole but it only holds about 33.40% of the stocks available in the market. There are two official criteria to exclude firms from the portfolio, mid and large cap banks and firms that harm the environment or human rights. Firms filtered by these two criteria are less than the two-third of the market, and there could be more tacit criteria that SNB uses to filter out firms suitable for investments. Following Bowen et al. (2014), I split the total firms into two groups each quarter: those owned by SNB (i.e, the SNB sample) and those that are not (i.e, the control sample). Bowen et al. (2014) use three categories of potential strategies: accounting, governance, and investing principles. In this analysis, I mostly focus on investing principles they suggested, which covers accounting fundamentals. In addition to fundamental proxies, I add proxies for two exclusion criteria suggested by SNB: banks, and firms harming the environment or human rights. I further require my control firms to be included in CRSP as well, while Bowen et al. (2014) requires their firms to be included only in Compustat. For the multivariate analysis, I estimate equation (5) discussed earlier.

Panel A, Table 8 exhibits univariate comparisons between the SNB sample and the   control sample. Columns (1) and (2) report the descriptives of each variable for the SNB sample and the control sample, respectively. Column (3) is the t-statistic for difference in means of the two groups. Results are largely consistent with the prediction. Firms held by SNB tends to be larger, less leveraged, more matured, more profitable (*ROE, EVA, Owner_ret*) and show more growth (*Run_sale_growth*, *Run_oibdp_growth, Run_ib_growth, Run_owner_ret_ growth*). They are also less financially distressed (*ZScore*), less likely to receive qualified audit opinion (*Auop*), and have better earnings quality (*DD*). Interestingly, SNB tends to invest in firms with less conservative financial statements (*CScore*).

Next, I consider two stock exclusion strategies officially noted by SNB. Contrary to its claims, t-test results for *Env_con* and *Mil_con* are insignificant, suggesting that SNB investee firms do not significantly differ from the control firms in terms of environmental concerns and weapon involvement. Yet, a caveat to this analysis is that the variables from KLD database is not complete. Most of the environmental and weapon related variables from KLD via WRDS ends before 2013, when my sample period starts. Thus, out of 12 environmental concern variables in KLD, *Env_con* is comprised of only the following five variables: toxic spills & releases, climate change, impact of

products & services, biodiversity & land use and operational waste. SNB does not reveal specific guidelines to exclude stocks for environmental reasons, and insufficient coverage of *Env_con* might be leading insignificant results. Similarly, *MIL_con* only covers one variable out of four weapon-related variables provided by KLD. Therefore, it is possible that the insignificant result is due to incomplete proxies. The other exclusion criterion SNB officially mentions, banks with potential conflict of interest, turns out to be significant. *I_Bank*, which is an indicator variable for banks in two-digit SIC code, is significantly small in SNB investee firms. Note that while SNB claimed the exclusion of mid-cap and large-cap banks, *I_Bank* covers all banks.

Panel B, Table 8 presents the results of my multivariate analysis. I run a logistic regression of an indicator variable for the treatment and control firms on various proxies that capture the fundamentals of firms as shown in equation (5). Following Bowen et al. (2014), I do not include the control variables such as size, book-to-market, and ROA because they are correlated with many of the fundamental proxies. I include year and industry fixed effects. It is notable that SNB's tendency to avoid banks is controlled by industry fixed effects. The coefficients are consistent with the prediction, except for *Auop*. The results echo the univariate analysis suggesting that SNB

tends to invest in firms with lower leverage, higher and steadier profit, higher growth, better earnings quality, and higher Z score.

Overall, my findings suggest that SNB selects firms with stronger accounting fundamentals. This evidence supports the view that SNB engages in stock-selection, contrary to its official statement.

[Insert Table 8 Here]

V. Conclusion

SNB's disclosure of the U.S. equity holdings through 13F filings provides a unique setting to investigate a central bank's trading strategy and its performance. Using quarterly 13F filings for the period of 2013-2019, I examine SNB's investment performance and portfolio characteristics. I find evidence consistent with SNB engaging in informed trading and stock-selection. Specifically, the change of SNB ownership in stocks predicts returns in the following quarter and subsequent earnings announcement returns. This positive association is more salient for firms with opaque information environments. I find that SNB portfolio firms exhibit stronger accounting fundamentals than those of other firms.

Overall, this study provides novel evidence on a central bank's equity investment in the U.S. market. I hope that this study will facilitate further examination of SNB's equity investments, which could potentially answer various questions about accounting and finance practices by institutional investors.

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Appendix: Variable Definitions

Variable	Definition
D_SNB_q	the change in SNB ownership from q-1 to q in per mille (refer to the Figure 1)
$I\_Increase_q$	an indicator variable that takes the value of 1 if D_SNB_q is positive and 0 otherwise
$I\_Decrease_q$	an indicator variable that takes the value of 1 if D_SNB_q is negative and 0 otherwise
SNB_{q-1}	SNB ownership in q-1 in per mille (refer to the Figure 1)
$Ret_{q,q+1}$	one-quarter-ahead stock return in percent compounded quarterly (refer to the Figure 1)
$Ret_{q,q+4}$	one-year-ahead stock return in percent compounded yearly
CAR_{q+1}	the thee-day cumulative abnormal return around the earnings announcement date ([-1,+1]) using Fama-French three factor model (refer to the Figure 1)
BM	the book value of equity divided by the market value of equity
ME	the market value of equity
Vol	monthly volatility over the past two years
$Turn$	average monthly turnover over the previous quarter
Prc	share price
$S\&P500$	an indicator variable that takes the value of 1 if the firm is a member of the $S\&P500$ index
$Ret_{q-1,q}$	the contemporary quarter return (refer to the Figure 1)
$Ret_{q-4,q-1}$	the lagged three quarter return preceding the beginning of the quarter (refer to the Figure 1)
$Ret_{q-2,q-1}$	the lagged quarterly return (refer to the Figure 1)
Age	the firm age measured as the number of months since return first appears in CRSP database

DP	dividend yield
EP	the quarterly earnings persistence over the past four years measured by coefficient of rolling regression as defined in Chi and Shanthikumar (2017)
EV	the standard deviation of quarterly earnings over the past four years in thousands as defined in Chi and Shanthikumar (2017)
Analyst#	the natural logarithm of 1 plus the number of analysts reported earnings forecast in I/B/E/S
EA_rank	the quarterly decile rank of the number of earnings announcement of other firms on the same day as the given firm's earnings announcement
Lev	debt over book value of equity
Mlev	the ratio of book value of short-term debt and long-term debt to market value of assets
Age_year	the firm age measured as the number of years since return first appears in CRSP database
ROA	the income before extraordinary items over average book value of assets
ROE	the income before extraordinary items over average book value of equity
EVA	the economic value added computed as per Biddle et al. (1997)
Owner_ret	the owners' earnings computed as reported earnings plus depreciation, depletion, and amortization minus the average annual amount of capital expenditures over three past years
Owner_ret_vol	the volatility in *Owner_ret* over the past five years
Run_sale(oibdp, ib, owner_ret)_growth	the consecutive number of years for which a firm has achieved an annual sale(operating income before depreciation, income before extraordinary items, and owners' returns, respectively)growth rate

	above the median annual growth rate relative to firms in the same two-digit SIC code
ZScore	the measure of the likelihood of bankruptcy as defined in Altman (1968)
CScore	the financial statement conservatism score as defined in Khan and Watts (2009)
GScore	the financial statement score of the timeliness of good news defined in Khan and Watts (2009)
DD	the standard deviation of abnormal accruals, a proxy for quality of earnings as defined in Bowen et al. (2014)
Divpay	an indicator variable that takes the value of 1 if the firm is paying dividend and 0 otherwise
Auop	an indicator variable that takes the value of 1 if the firm received unqualified audit opinion and 0 otherwise
Env_con	the number of environmental concerns from KLD database which is a sum of following indicators: toxic spills & releases, climate change, impact of products & services, biodiversity & land use and operational waste
Mil_con	an indicator variable that takes the value of 1 if the firm involved in weapon industry from KLD database
I_Bank	an indicator variable that takes the value of 1 if two-digit SIC cod is 60

Figure 1

Timeline for Measurement of Variables
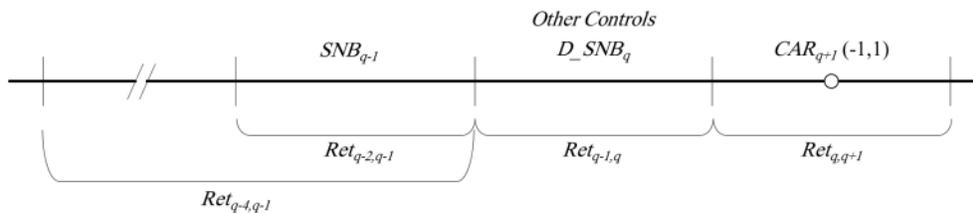
This figure illustrates the timeline for measurement of variables. Each line portrays one quarter, except the line with an omission mark. D_SNB_q is the change in SNB ownership from q-1 to q in per mille. SNB_{q-1} is SNB ownership in q-1 quarter in per mille. $Ret_{q,q+1}$ is one-quarter-ahead stock return in percent compounded quarterly. $Ret_{q-1,q}$ is the contemporary quarter return. $Ret_{q-2,q-1}$is lagged quarterly return. $Ret_{q-4,q-1}$ is the lagged three quarter return preceding the beginning of the quarter. CAR_{q+1} is the thee-day cumulative abnormal return around the earnings announcement date using Fama-French three factor model.

Figure 2

Trends in the U.S. Equity Investment of SNB and SNB Stock Price

(in million dollars)
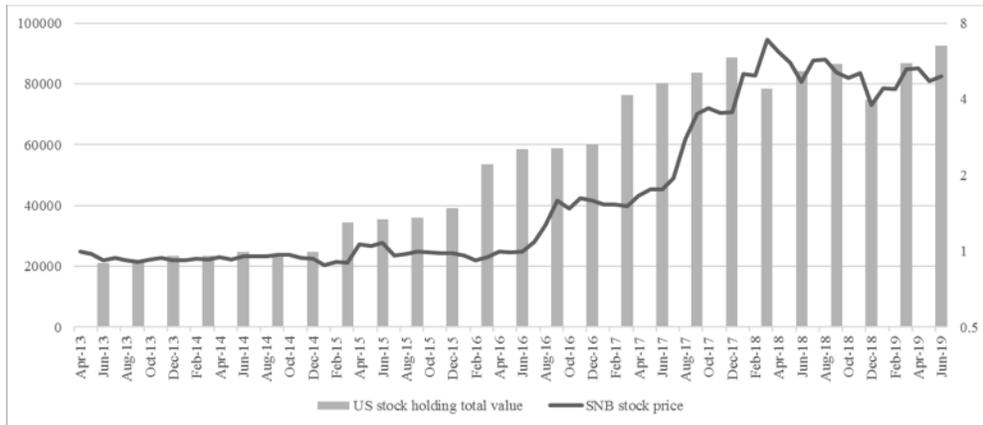
This figure illustrates quarterly trends in the U.S. equity investment of the Swiss National Bank and the stock price of the Swiss National Bank. The bar (left axis) displays total market value in million dollars as of end of each quarter. The line (right axis) displays the relative stock price of Swiss National Bank in a log scale, setting the price on April 2013 as 1.

Table 1
Descriptive Statistics

	n	Mean	Std. Dev.	Q1	Median	Q3
D_SNB	105,165	0.0265	0.1078	0	0	0.0093
D_SNB (holding stocks)	49,039	0.0570	0.1523	-0.0062	0.0061	0.0791
I_Increase	105,165	0.2742	0.4461	0	0	1
I_Decrease	105,165	0.1797	0.3839	0	0	0
SNB	105,165	0.7382	1.0460	0	0	1.2880
SNB (holding stocks)	49,039	1.6024	1.0162	1.0304	1.3895	1.7034
$Ret_{q,q+1}$	105,085	1.6795	27.2250	-9.7226	0.9836	11.2280
CAR_{q+1}	99,968	-0.1262	9.6630	-3.7710	-0.0890	3.5265
BM	105,165	1.2768	0.0041	0.2339	0.4980	0.8926
ME	105,165	5,871	24,600	154	716	2,984
Vol	105,165	0.1164	0.0856	0.0639	0.0930	0.1439
Turn	105,165	6.9180	109.5543	1.8694	3.7280	6.4844
Prc	105,165	81.26	3359.02	6.86	18.48	41.04
Age	105,165	226.92	176.56	77	191	308
DP	105,165	0.0012	0.0027	0	0	0.0017
EP	102,287	0.0976	32.4822	-0.0599	0.1335	0.4373
EV	104,311	0.0859	0.3755	0.0031	0.0104	0.0399
Analyst#	97,983	7.6593	7.0136	3	5	10
EA_rank	97,983	193.63	124.86	90	175	283

This table reports descriptive statistics. Refer to Appendix for variable definitions.

Table 2

Correlations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) D_SNB		0.8446	-0.7267***	0.2075***	0.0293***	0.007	-0.0467***	0.1447***
(2) $I\_Increase_q$	0.6836***		-0.2877***	0.6375***	0.0601***	0.0218***	-0.1378***	0.43***
(3) $I\_Decrease_q$	-0.3506***	-0.2877		0.4371	0.0281	0.0146	-0.088***	0.2713***
(4) SNB_q	0.2576***	0.5254	0.3392		0.0653***	0.0301***	-0.177***	0.6228***
(5) $Ret_{q,q+1}$	0.029***	0.0246***	0.0049	0.0135***		0.3853***	0.0126***	0.0724***
(6) CAR_{q+1}	0.0041	0.01***	0.0068	0.0089	0.3344***		0.0165***	0.0318***
(7) BM	-0.0584***	-0.117***	-0.0869***	-0.1331***	-0.0013	0.0024		-0.1836***
(8) ME	0.0465***	0.1085***	0.0592***	0.2414***	0.0035	0.0024	-0.0424***	

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

This table reports Pearson (Spearman) correlations in lower (upper) diagonal. Refer to Appendix for variable definitions.

Table 3
Trends of SNB Investment in the U.S. Equity Market
Panel A: Quarterly Total Value of the SNB U.S. Equity portfolio

(in million dollars)

Year	(1) Total	(2)	(3) NYSE	(4)	(5) NASDAQ	(6)
	number of firms	market value of portfolio (in million $)	number of firms	market value of portfolio (in million $)	number of firms	market value of portfolio (in million $)
2013:Q2	2,237	20,993	1,218	16,040	923	4,430
2013:Q3	2,223	22,126	1,211	16,768	915	4,795
2013:Q4	2,250	23,525	1,221	17,695	933	5,230
2014:Q1	2,243	23,332	1,222	17,542	927	5,165
2014:Q2	2,285	24,758	1,246	18,597	950	5,504
2014:Q3	2,282	23,999	1,246	17,843	946	5,549
2014:Q4	2,321	24,644	1,268	18,097	962	5,897
2015:Q1	2,312	34,531	1,267	24,939	954	8,698
2015:Q2	2,358	35,615	1,282	25,395	979	9,259
2015:Q3	2,358	36,100	1,286	25,792	975	9,404
2015:Q4	2,444	39,042	1,324	27,202	1,023	11,014
2016:Q1	2,413	53,693	1,306	37,992	1,012	14,825
2016:Q2	2,403	58,455	1,292	41,668	1,014	15,898
2016:Q3	2,368	58,899	1,277	40,913	996	17,138
2016:Q4	2,410	60,107	1,295	41,750	1,019	17,459
2017:Q1	2,394	76,325	1,292	51,403	1,007	23,801
2017:Q2	2,425	80,248	1,299	53,625	1,030	25,443
2017:Q3	2,407	83,834	1,292	55,456	1,025	27,236
2017:Q4	2,398	88,573	1,291	57,435	1,029	30,029
2018:Q1	2,338	78,489	1,286	50,204	1,010	27,887
2018:Q2	2,390	84,174	1,310	52,974	1,039	30,757
2018:Q3	2,371	86,527	1,301	54,147	1,039	32,165
2018:Q4	2,408	74,806	1,306	47,691	1,067	26,907
2019:Q1	2,368	86,978	1,282	54,731	1,037	31,809

Panel B: Quarterly Change in the SNB U.S. Equity portfolio

Year	(1) Total number of firms bought	(2) number of firms sold	(3) NYSE number of firms bought	(4) number of firms sold	(5) NASDAQ number of firms bought	(6) number of firms sold
2013:Q2	2,237	-	1,218	-	923	-
2013:Q3	623	1,298	440	650	161	596
2013:Q4	517	526	275	380	217	133
2014:Q1	1,711	501	836	366	801	118
2014:Q2	807	346	443	226	344	110
2014:Q3	145	1,342	67	866	70	435
2014:Q4	1,193	484	659	356	491	115
2015:Q1	1,394	43	854	25	489	15
2015:Q2	1,690	142	969	87	652	49
2015:Q3	2,309	7	1,259	5	959	1
2015:Q4	783	157	490	103	266	48
2016:Q1	2,392	7	1,292	3	1,006	3
2016:Q2	1,318	275	737	155	530	106
2016:Q3	162	1,626	84	970	68	608
2016:Q4	973	202	547	132	391	61
2017:Q1	1,180	95	708	63	435	26
2017:Q2	1,332	184	776	122	515	54
2017:Q3	725	74	464	49	245	22
2017:Q4	1,138	161	657	105	456	53
2018:Q1	1,273	580	671	414	576	160
2018:Q2	1,004	176	589	106	403	68
2018:Q3	279	545	130	389	145	154
2018:Q4	1,530	245	845	137	666	104
2019:Q1	2,000	34	1,100	21	860	12

Panel C: Top 5 Stocks Owned by Swiss National Bank at the End of Each Year

	(1)		(2)		(3)		(4)		(5)	
Year	Top1		Top2		Top3		Top4		Top5	
2013	Exxon Mobil Corp.		Apple Inc.		Johnson & Johnson		Microsoft Corp		Procter & Gamble Co.	
	581	0.132%	543	0.108%	378	0.147%	339	0.109%	313	0.142%
2014	Apple Inc.		Exxon Mobil Corp.		Johnson & Johnson		Microsoft Corp		Procter & Gamble Co.	
	614	0.095%	462	0.119%	371	0.127%	367	0.096%	322	0.131%
2015	Apple Inc.		Google Inc.		Microsoft Corp.		Exxon Mobil Corp		Johnson & Johnson	
	1,093	0.187%	853	0.177%	789	0.178%	652	0.201%	599	0.211%
2016	Apple Inc.		Google Inc.		Microsoft Corp.		Exxon Mobil Corp		Johnson & Johnson	
	1,743	0.286%	1,328	0.265%	1,286	0.266%	1,116	0.298%	969	0.309%
2017	Apple Inc.		Google Inc.		Microsoft Corp.		Amazon.com Inc.		Facebook Inc.	
	3,240	0.373%	2,385	0.350%	2,329	0.353%	1,761	0.313%	1,576	0.375%
2018	Apple Inc.		Microsoft Corp.		Google Inc.		Amazon.com Inc.		Johnson & Johnson	
	2,487	0.333%	2,431	0.312%	2,075	0.308%	2,013	0.276%	1,246	0.360%
2019:Q1	Apple Inc.		Microsoft Corp.		Amazon.com Inc.		Google Inc.		Johnson & Johnson	
	3,026	0.338%	2,901	0.321%	2,468	0.281%	2,406	0.316%	1,385	0.372%

Table 3 reports descriptive statistics of quarterly trends of SNB portfolio in the U.S. equity market. Panel A, Table 3 shows total number of firms in the portfolio and market value of it at the end of each quarter. Columns (1) and (2) provide statistics for total portfolio, columns (3) and (4) provide statistics for NYSE portfolio and columns (5) and (6) provide statistics for NASDAQ portfolio.

Panel B, Table 3 shows number of firms bought and sold during each quarter. Following Sias (2004), buy (sell) is defined as increase (decrease) in SNB ownership percentage with non-decrease (non-increase) in number of shares owned by SNB. Odd number columns report number of firms bought, and even number columns report number of firms sold during the quarter. Columns (1) and (2) provide statistics for total portfolio, columns (3) and (4) provide statistics for NYSE portfolio and columns (5) and (6) provide statistics for NASDAQ portfolio.

Panel C, Table 3 reports top 5 stocks owned by Swiss National Bank in terms of market value of holdings at the end of each quarter. Each cell shows the name of the company on the top, market value of SNB holdings on the bottom left, and percentage of the holding out of total shares of the company on the bottom right. For Google Inc., class A stock and class C stock are summed (weighted averaged) for the market value (percentage).

Table 4

Quarterly Changes in SNB Ownership and Future Returns

Panel A: Changes in SNB Ownership and Returns in the Following Quarter

	Full sample	Increase and no change	Decrease and no change	Holding stocks only	Full sample
	(1)	(2)	(3)	(4)	(5)
	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$
Intercept	6.993***	7.180***	8.545***	7.147**	7.692***
	(3.787)	(3.619)	(4.030)	(2.076)	(4.012)
D_SNB_q	3.439**	3.394***	3.693	2.394***	
	(2.043)	(3.050)	(0.429)	(3.006)	
$I\_Increase_q$					2.040***
					(2.727)
$I\_Decrease_q$					1.327
					(1.550)
SNB_{q-1}	0.543*	0.766*	1.105	0.0498	-0.0285
	(1.851)	(1.854)	(1.150)	(0.177)	(-0.091)
BM	-16.50	-3.132	-6.041	-711.9	3.129
	(-0.450)	(-0.093)	(-0.172)	(-1.391)	(0.092)
ME	-0.372**	-0.388**	-0.477***	-0.337	-0.420***
	(-2.557)	(-2.466)	(-2.632)	(-1.627)	(-2.824)
Vol	-14.73**	-14.04**	-17.38**	-3.677	-13.91**
	(-2.123)	(-2.070)	(-2.453)	(-0.403)	(-1.991)
Turn	-0.923***	-1.108***	-1.046***	-0.796**	-1.072***
	(-5.185)	(-5.143)	(-4.872)	(-2.120)	(-5.557)
Prc	0.575	0.658*	0.641*	0.195	0.506
	(1.687)	(1.783)	(1.797)	(0.553)	(1.553)
S&P500	0.431	0.695	0.802	0.651*	0.775
	(0.736)	(1.234)	(1.340)	(1.927)	(1.582)
$Ret_{q-1,q}$	0.0158	0.0165*	0.0173**	0.0194	0.0159
	(1.711)	(1.794)	(2.106)	(1.284)	(1.690)
$Ret_{q-4,q-1}$	0.00505	0.00802	0.00570	-0.00293	0.00530
	(0.992)	(1.466)	(1.182)	(-0.557)	(1.067)
Age	0.0690	0.0399	0.0519	0.187	0.0322
	(0.287)	(0.180)	(0.206)	(0.625)	(0.138)
DP	-148.3	-178.2*	-149.6	35.72	-122.4
	(-1.547)	(-1.860)	(-1.411)	(0.446)	(-1.280)
Quarters (n)	21	21	21	21	21
Observations	92,394	73,318	67,462	45,788	92,394
Adj. R^2	0.0391	0.0402	0.0384	0.0672	0.0401

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Panel B: Changes in SNB Ownership and Returns in the Following Year

	Full sample	Increase and no change	Decrease and no change	Holding stocks only	Full sample
	(1)	(2)	(3)	(4)	(5)
	$Ret_{q,q+4}$	$Ret_{q,q+4}$	$Ret_{q,q+4}$	$Ret_{q,q+4}$	$Ret_{q,q+4}$
Intercept	20.82***	22.30***	23.41***	23.61***	23.38***
	(5.751)	(6.206)	(7.399)	(3.633)	(6.522)
D_SNB$_q$	6.713***	5.329***	2.065	1.088	
	(3.906)	(3.371)	(1.380)	(0.685)	
I_Increase$_q$					6.377***
					(5.449)
I_Decrease$_q$					6.274***
					(4.487)
SNB$_{q-1}$	1.797**	2.187**	4.254**	0.0822	-0.102
	(1.977)	(2.144)	(2.211)	(0.102)	(-0.110)
BM	-32.01	14.54	28.51	-2689.4	39.58
	(-0.363)	(0.182)	(0.305)	(-1.570)	(0.437)
ME	-1.030***	-1.149***	-1.291***	-0.931**	-1.212***
	(-3.026)	(-2.887)	(-3.592)	(-2.201)	(-3.434)
Vol	-49.68***	-52.88***	-48.43***	-19.46	-47.30***
	(-3.491)	(-4.321)	(-3.486)	(-0.577)	(-3.327)
Turn	-3.453***	-4.140***	-4.625***	-1.750	-3.999***
	(-6.223)	(-8.540)	(-6.187)	(-1.574)	(-6.790)
Prc	2.127**	2.354**8	2.612***	0.293	1.875**
	(2.463)	(2.794)	(3.598)	(0.230)	(2.226)
S&P500	0.601	0.841	2.479	1.607	1.824
	(0.275)	(0.387)	(1.632)	(1.369)	(1.023)
Ret$_{q-1,q}$	-0.00549	-0.00710	0.00384	-0.0205	-0.00334
	(-0.164)	(-0.235)	(0.133)	(-0.345)	(-0.099)
Ret$_{q-4,q-1}$	0.00429	0.00453	0.00407	0.00384	0.00440
	(0.254)	(0.259)	(0.234)	(0.200)	(0.256)
Age	0.637	0.690	0.694	0.831	0.542
	(0.721)	(0.800)	(1.002)	(0.747)	(0.624)
DP	-618.6**	-622.8**	-655.5**	-136.4	-524.2*
	(-1.997)	(-1.972)	(-2.057)	(-0.674)	(-1.676)
Quarters (n)	18	18	18	18	18
Observations	75,510	60,400	54,493	37,489	75,510
Adj. R^2	0.039	0.0404	0.0336	0.0667	0.040

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Table 4 reports the quarterly Fama-Macbeth (1973) regression of one-quarter-ahead and one-year-ahead returns on changes in SNB holding. t-values are based on Newey-West standard errors with 2 quarter lags. Each regression is estimated quarter by quarter using weighted-least-squares, with each firm weighted by its log market capitalization. The sample period for Panel A (Panel B) is from 2013:Q3 to 2018:Q3 (2017:Q3). All first buys of each stock are deleted to control for different buying behaviors in first buys. The total sample is comprised of all publicly traded stocks in NYSE/AMEX/NASDAQ that are included in both CRSP and Compustat database. Columns (1) and (5) report results on full sample. Column (2) reports results on subsample of which D_SNB_q is positive or zero (i.e. $I\_Decrease_q$=0). Analogously, column (3) reports results on subsample of which D_SNB_q is negative or zero (i.e. $I\_Increase_q$=0). Column (4) reports results on subsample of which SNB_{q-1} is positive. Refer to Appendix for variable definitions. DP is winsorized at the 99th percentile. All other variables except stock returns and DP are winsorized at the 1st and the 99th percentiles. All variables except stock returns and SNB ownerships are expressed in the natural logarithms.

Table 5

Quarterly Changes in the SNB Ownership and Earnings Announcement Returns

	Full sample	Increase and no change	Decrease and no change	Holding stocks only	Full sample
	(1)	(2)	(3)	(4)	(5)
	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}
Intercept	0.0789*	-0.134	-0.102	2.614***	0.226
	(0.183)	(-0.329)	(-0.243)	(2.812)	(0.487)
D_SNB$_q$	0.945***	0.830**	2.573	0.922***	
	(2.682)	(1.962)	(1.308)	(2.696)	
I_Increase$_q$					0.497***
					(4.644)
I_Decrease$_q$					0.219
					(0.989)
SNB$_{q-1}$	0.0779**	0.158*	0.0942	-0.00744	-0.0416
	(2.496)	(2.034)	(1.045)	(-0.198)	(-1.119)
BM	17.96***	19.70***	16.27**	88.29	21.39***
	(2.601)	(3.100)	(2.175)	(0.735)	(3.202)
ME	0.0191	0.0404	0.0351	-0.162**	0.00470
	(0.500)	(1.092)	(0.924)	(-2.435)	(0.116)
Ret$_{q-2,q-1}$	-0.0087***	-0.0081***	-0.0081***	-0.011***	-0.0089***
	(-4.187)	(-3.087)	(-3.288)	(-4.190)	(-4.186)
Turn	-0.414***	-0.456***	-0.450***	-0.359***	-0.442***
	(-4.905)	(-5.338)	(-5.206)	(-3.879)	(-5.568)
EP	-0.121*	-0.150**	-0.154**	0.000918	-0.128*
	(-1.754)	(-2.001)	(-2.046)	(0.011)	(-1.917)
EV	-0.0521	-0.0512	0.0478	0.0772	-0.000898
	(-1.080)	(-1.123)	(0.659)	(0.580)	(-0.016)
Analyst#	0.113**	0.0632	0.0774	0.233***	0.106**
	(2.231)	(1.052)	(1.687)	(3.326)	(1.983)
EA_rank	-0.00372	-0.00371	-0.00126	-0.00957	-0.00761
	(-0.498)	(-0.438)	(-0.129)	(-0.836)	(-0.997)
Quarters (n)	21	21	21	21	21
Observations	92,580	73,513	67,493	45,917	92,580
Adj. R^2	0.0049	0.0061	0.0058	0.0081	0.0054

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Table 5 reports the quarterly Fama-Macbeth (1973) regression of earnings announcement returns in the subsequent quarter on changes in SNB holding. t-values are based on Newey-West standard errors with 2 quarter lags. Each regression is estimated quarter by quarter using weighted-least-squares, with each firm weighted by its log market capitalization. The sample period is from 2013:Q3 to 2018:Q4. All first buys of each stock are deleted to control for different buying behaviors in first buys. The total sample is comprised of all publicly traded stocks in NYSE/AMEX/NASDAQ that are included in both CRSP and Compustat database. Columns (1) and (5) report results on full sample. Column (2) reports results on subsample of which D_SNB_q is positive or zero (i.e. $I\_Decrease_q$=0). Analogously, column (3) reports results on subsample of which D_SNB_q is negative or zero (i.e. $I\_Increase_q$=0). Column (4) reports results on subsample of which SNB_{q-1} is positive. All variables except stock returns are winsorized at the 1st and the 99th percentiles. Refer to Appendix for variable definitions.

Table 6

Mean CARs at Subsequent Earnings Announcement by Quartiles of Changes in SNB Ownership

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Q1	Q2	Q3	Q4	Q5	No hold	Q5-Q1	Q5-No hold
CAR_{q+1}	-0.062	0.082	0.064	0.076	0.103**	-0.282	0.165*	0.224***
	(-0.689)	(0.745)	(-0.933)	(1.086)	(2.109)	(-1.200)	(1.69)	(3.12)
D_SNB_q	-0.12	0.013	0.042	0.085	0.251	0		

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Table 6 reports mean CARs at subsequent earnings announcement by quartiles of changes in SNB ownership. The total sample is sorted into quintiles in terms of D_SNB_q every quarter. Mean CAR_{q+1} by each quintile and its t-statistics are reported. Column (6) reports mean CAR_{q+1} for stocks with no SNB ownership. Column (7) and (8) reports results of difference in means t-test between highest quintile and lowest quintile, highest quintile and stocks with no SNB ownership, respectively. Mean D_SNB_q of each quintile is reported. No variables are winsorized in this analysis.

Table 7

Quarterly Changes in SNB Ownership and Future Returns by the Extent of Information Asymmetry

Panel A: Future Quarterly Returns

	Size		Return volatility		Age	
	Small	Large	Low	High	Young	Mature
	(1)	(2)	(3)	(4)	(5)	(6)
	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$	$Ret_{q,q+1}$
Intercept	13.35***	6.502***	6.211***	8.590***	10.33***	7.413**
	(3.027)	(2.695)	(3.090)	(2.782)	(3.608)	(2.496)
D_SNB_q	10.63***	1.172	1.825	6.189**	4.126**	3.167
	(3.410)	(0.887)	(1.292)	(2.278)	(2.397)	(1.366)
SNB_{q-1}	2.429***	0.342	0.153	0.930**	0.635	0.505*
	(3.048)	(1.366)	(0.756)	(2.524)	(1.673)	(1.941)
BM	8.907	-35.35	-58.29**	27.98	9.716	-35.64
	(0.192)	(-1.212)	(-2.166)	(0.381)	(0.126)	(-1.104)
ME	-0.906**	-0.353**	-0.257*	-0.554**	-0.720***	-0.184
	(-2.487)	(-2.017)	(-1.960)	(-2.518)	(-3.181)	(-1.581)
Vol	-13.16**	-12.30	-30.06*	-13.26**	-14.32**	-11.40
	(-2.170)	(-1.250)	(-1.803)	(-2.145)	(-2.173)	(-1.170)
Turn	-1.551***	-0.507*	-0.279	-1.232***	-1.182***	-0.855***
	(-4.864)	(-1.858)	(-1.217)	(-5.077)	(-4.366)	(-3.814)
Prc	0.861	0.355	0.192	0.973*	1.383***	0.155
	(1.459)	(1.312)	(1.540)	(1.794)	(2.958)	(0.549)
S&P500	-0.999	0.498	0.366	0.470	0.359	0.510
	(-0.413)	(1.616)	(1.438)	(0.485)	(0.462)	(0.996)
$Ret_{q-1,q}$	0.0154**	0.0307*	0.0298***	0.0133	0.0177*	0.0116
	(2.153)	(1.704)	(2.742)	(1.546)	(1.835)	(1.092)
$Ret_{q-4,q-1}$	0.00925*	0.00256	-0.00122	0.00507	0.00411	0.00307
	(1.879)	(0.330)	(-0.118)	(1.362)	(0.720)	(0.446)
Age	-0.0392	0.130	0.207	0.0452	-0.108	-0.268
	(-0.130)	(0.463)	(1.046)	(0.139)	(-0.325)	(-0.560)
DP	-158.0	-131.6	-152.4	-207.4	-194.6	-54.37
	(-1.465)	(-1.422)	(-1.541)	(-1.582)	(-1.656)	(-0.677)
Quarters (n)	21	21	21	21	21	21
Observations	46,197	46,193	46,201	46,195	46,197	46,195
Adj. R^2	0.0421	0.0673	0.0657	0.0337	0.0412	0.0455

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Panel B: Future Earnings Announcement Returns

	Size		Return volatility		Age	
	Small	Large	Low	High	Young	Mature
	(1)	(2)	(3)	(4)	(5)	(6)
	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}	CAR_{q+1}
Intercept	-0.0794	1.621***	0.814***	-0.351	-0.506	0.664
	(-0.076)	(2.908)	(3.517)	(-0.555)	(-0.940)	(1.255)
D_SNB_q	3.556**	0.380	0.893*	0.711	1.168**	0.996
	(2.399)	(1.075)	(1.908)	(1.560)	(2.393)	(1.492)
SNB_{q-1}	0.658***	0.0232	0.000271	0.231***	0.0585	0.101***
	(2.589)	(0.885)	(0.011)	(3.806)	(0.985)	(3.843)
BM	15.66	20.10***	8.096	20.30	22.20	12.37
	(1.134)	(3.859)	(0.891)	(1.358)	(1.155)	(1.643)
ME	0.0391	-0.0865**	-0.051***	0.0611	0.0720	-0.0338
	(0.406)	(-2.409)	(-2.621)	(1.048)	(1.458)	(-0.767)
$Ret_{q-2,q-1}$	-0.0064	-0.012***	-0.016***	-0.008***	-0.0065**	-0.013***
	(-1.553)	(-3.841)	(-4.965)	(-3.523)	(-2.814)	(-5.515)
Turn	-0.570***	-0.317***	-0.0917	-0.529***	-0.547***	-0.269**
	(-5.183)	(-4.675)	(-1.547)	(-5.033)	(-6.481)	(-2.423)
EP	-0.277*	-0.0333	-0.000813	-0.209	-0.123	-0.120
	(-1.985)	(-0.599)	(-0.012)	(-1.689)	(-1.106)	(-0.899)
EV	-0.115	0.0451	-0.0200	-0.0348	0.0425	-0.0157
	(-0.189)	(0.668)	(-0.324)	(-0.229)	(0.391)	(-0.233)
Analyst#	0.119	0.107***	0.0970**	0.0829	0.172**	0.0844
	(0.796)	(3.111)	(2.007)	(1.201)	(2.364)	(1.467)
EA_rank	-0.00727	-0.00737	-0.0148	0.0282	-0.0220*	0.00586
	(-0.457)	(-0.716)	(-1.364)	(0.709)	(-1.720)	(0.463)
Quarters (n)	21	21	21	21	21	21
Observations	46,290	46,294	46,288	46,291	46,290	46,290
Adj. R^2	0.0107	0.0055	0.0086	0.0067	0.0072	0.0074

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Panel A (Panel B), Table 7 reports cross-sectional results using model from column (1), Panel A, Table 4 (column (1), Table 5). The sample is divided into high and low size (*ME*), return volatility (*Vol*), and firm age (*Age*) every quarter based on the sample median. Other variables are as defined in Table 4 and Table 5.

Table 8

SNB Ownership and Fundamentals

Panel A: Univariate Analysis on Accounting Fundamental Proxies

Variable	Pred. Sign for Diff.	(1) Mean SNB investee sample	(2) Mean Control sample	(3) t-statistic for Difference in Means	(4) n SNB investee sample	(5) n Control sample
ME	(+)	9,557	5,893	12.82***	12,345	11,847
BM	(?)	0.5062	0.3635	1.13	12,345	11,847
Lev	(-)	0.4989	0.9777	-0.54	12,345	11,847
Mlev	(-)	0.1681	0.1860	-6.86***	12,290	11,793
Age_year	(+)	23.544	17.6637	33.96***	12,282	11,070
ROA	(+)	0.0086	-0.0225	1.5	12,344	11,867
ROE	(+)	0.0704	-0.0713	8.63***	12,344	11,867
EVA	(+)	0.0640	-0.1074	10.38***	7,927	5,936
Owner_ret	(+)	0.0547	-0.1028	9.55***	11,443	11,347
Owner_ret_vol	(-)	0.4005	0.7129	-11.94***	11,437	11,292
Run_sale_growth	(+)	1.7566	1.1277	24.57***	12,235	11,393
Run_oibdp_growth	(+)	1.4856	0.9820	23.62***	11,588	11,682
Run_ib_growth	(+)	1.4093	0.9462	20.68***	12,332	11,832
Run_owner_ret_growth	(+)	1.4267	1.0257	17.5***	11,316	11,181
ZScore	(+)	9.0160	5.7917	7.53***	9,763	8,595
CScore	(+)	0.0597	0.2030	-52.92***	7,210	5,051
GScore	(+)	0.0009	-0.0175	27.4***	7,210	5,051
DD	(-)	0.4663	0.7680	-14.47***	10,033	9,149
Divpay	(+)	0.5939	0.3951	28.89***	12,345	11,847
Auop	(+)	0.9004	0.8036	11.56***	12,340	11,840
Env_con	(-)	0.0866	0.1020	-1.30	12,282	11,070
Mil_con	(-)	0.0402	0.0441	0.62	9,033	1,088
I_Bank	(-)	0.0730	0.1375	-16.50***	12,346	11,875

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Panel B: Multivariate Analysis on Accounting Fundamental Proxies

	Pred. Sign	(1)
		I_SNB_{t+1}
Intercept		0.243***
		(2.683)
Mlev	(-)	-0.0243**
		(-2.360)
Age_year	(+)	0.0636***
		(9.477)
Owner_ret	(+)	0.0167***
		(4.095)
Owner_ret_vol	(-)	-0.0026***
		(-2.849)
Run_owner_ret_growth	(+)	0.0089***
		(4.059)
Run_ib_growth	(+)	0.0260***
		(10.206)
ZScore	(+)	0.0011***
		(4.790)
DD	(-)	-0.0259**
		(-2.737)
Divpay	(+)	0.149***
		(7.919)
Auop	(+)	0.0432
		(1.465)
Year fixed effect		Yes
Industry fixed effect		Yes
Number of total observations		16,346
Adj. R^2		0.1174

*, **, *** represent significance at the 0.1, 0.05, and 0.01 levels (two-tailed), respectively.

Panel A, Table 8 compares firms purchased by Swiss National Bank next year and firms that are not by the mean levels for various proxies for accounting fundamental information from 2012 to 2017. A firm of year t is classified as 'SNB investee sample' if SNB holds the stock at least one quarter during year t+1 and classified as 'Control Sample' otherwise. The control sample is comprised of all firms traded publically in NYSE/AMEX/NASDAQ that are included in both CRSP and Compustat database but not invested by SNB. Column (3) reports t-statistics of test of difference in means using t-test. The number of observations in these analyses varies depending on the availability of data.

Panel B, Table 8 reports logistic regression of an indicator variable for treatment and control firms on various proxies for accounting fundamentals. I_SNB_{t+1} is an indicator variable that takes the value of 1 if SNB hold the stock in at least one quarter during year t+1 and 0 otherwise. Following Bowen et al. (2014) I do not include control variables *ME*, *BM*, *Lev*, *ROA* and *ROE* because they are correlated with many of the independent variables in the regression. Refer to Appendix for variable descriptions.

스위스 국립은행의
미국 주식 투자에 관한 연구

김성효

경영학과 회계학전공

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본 연구에서는 스위스의 중앙은행인 스위스 국립은행이 미국 주식시장에서 정보거래자(informed trader)인지의 여부와 그 결과인 투자 성과를 분석한다. 스위스 국립은행의 미국 주식시장 투자액은 약 870억 달러에 달하며 계속해서 증가하고 있다. 해외 주식에 크게 투자하는 중앙은행은 전례가 없기에 스위스 국립은행의 독특한 투자는 주목할 가치가 있다. 스위스 국립은행은 공식적으로 정보거래자임을 부정한다. 그러나 본 연구에서 미국 증권거래위원회(SEC) 13F를 통해 공시되는 스위스 국립은행의 2013년부터 2019년까지 미국 주식 포트폴리오를 분석한 결과 스위스 국립은행은 미국 주식시장에서 정보거래자인 것으로 나타났다. 구체적으로 스위스 국립은행의 지분율 변화는 다음 분기의 주가수익률과 이익공시 시점의 주가수익률을 예측한다. 또한 이 관계는 정보환경이 불투명한 주식에서 더 뚜렷하게 나타난다. 마지막으로 스위스 국립은행 포트폴리오에 속한 주식들은 비교군에 비해 더 양호한 회계지표를 보인다. 결론적으로 본 연구의 분석 결과는 스위스 국립은행이 미국 주식시장에서 정보거래자임을 시사한다.