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# Bridging Risk Perception and the Business Cycle

*A study of Norwegian and Swedish stock market volatility and their relationships to economic fluctuations between 2000 and 2023.*

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# Abstract

This thesis examines the relationships between volatile stocks, risk perceptions, and the business cycle. We retrieve financial data on 572 firms listed on either the Oslo Stock Exchange or Nasdaq Stockholm. Additionally, we derive measures of risk perception and the real risk-free rate. The data collection and subsequent analysis cover the time period from January 2000 to December 2023. We use a novel measure of risk perception, the Price of Volatile Stocks, that explores the connection between financial markets and economic fluctuations. Moreover, we review empirical evidence for the Price of Volatile Stocks and evaluate its validity for the Norwegian and Swedish economies through three hypotheses. In our analysis, we find inconclusive evidence that the Price of Volatile Stocks can serve as a metric that bridges risk perceptions and the business cycles in scope. We find statistically significant correlations between this novel measure and business outlook indices. However, due to varying results and limited robustness in the statistically significant findings, we do not observe strong evidence to support the hypotheses. In our research, we closely follow the methodology of a corresponding study for the US economy. We compare our findings against this study and evaluate the deviations accordingly. Our thesis is meant to add to the large body of literature on the risk-centric view of business cycles and encourages further research in this field.

***Keywords*** – Volatility, Asset Pricing, Financial Markets, Business Cycles, Macroeconomics, Risk Perceptions

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# 1 Introduction

Understanding volatility in financial markets could provide valuable insight into predicting fluctuations in the business cycle. Based on the evidence found in empirical studies, it is concluded that financial markets and the macroeconomy are deeply interrelated[1]. Existing literature emphasizes that financial markets can be causal in driving economic fluctuations (Keynes, 1937; Kindleberger, 1978; Minsky, 1977). Consequently, a key to understanding financial markets lies in examining risk perceptions. The inherent relationship between risk perceptions and financial markets is especially visible following uncertainty shocks, as explored by Bloom (2009), where uncertainty shocks are shown to result in shifts in investor behavior. Recent empirical evidence has contributed to the formalization of the *risk-centric view of the business cycle*, encompassing the view that risk perceptions shape economic fluctuations (Cochrane, 2017; Caballero & Fahri, 2018). Following an increase in risk perceptions, the implications of the risk-centric view of business cycles include that risky firms are charged a higher cost of capital. During periods of enhanced risk perception, investors then look to the safety of government securities and stable, less volatile stocks. For the government securities, this will drive the prices of bonds up, decreasing the nominal yield and real risk-free rate. The perspective suggests that risk perceptions influence investment and financial market behavior, which in turn catalyze shifts in the business cycle.

However, the risk-centric view of business cycles has been questioned. Specifically, it has been pointed to a lack of empirical evidence that there is a strong correlation between proxies of financial market conditions and the real economy (Pflueger et al., 2020, p. 1444). This questioning of evidence was recently addressed in the paper *Financial Market Risk Perceptions and the Macroeconomy* by Pflueger et al. (2020). In this paper, fundamental to our own research, a novel measure that attempts to bridge the relationship between financial market conditions and the macroeconomy was introduced. Pflueger et al. examine this through the difference in book-to-market ratios for the most and least volatile stocks in their scope. The measure, named the *Price of Volatile Stocks* ("PVS"), tracked stocks traded on American stock exchanges between 1970 and 2016. Moreover, the intuition behind tracking the book-to-market of the most volatile stocks is that these should be particularly affected by investor risk perceptions (Pflueger et al., 2020, p. 1444).

The findings of Pflueger et al. were significant; there is clear evidence of a relationship between PVS and investor perceptions of risk. Furthermore, PVS could also be tied to the real economy in the form of an evident relationship between PVS and the real risk-free rate. So, to what degree are the found correlations between PVS and the economy

[1] See Bloom (2009) and Bloom et al. (2018).

universal? And how can the potential correlations and validity of PVS be applied? Given the measure's novelty, this is something we seek to explore further. Thus, our research question is:

*Do the assumptions and implications of the Price of Volatile Stocks measure hold in the economies of Norway and Sweden?*

A clear objective for this thesis is to analyze whether PVS can link financial markets, risk perception, and economic fluctuations outside the US. Given our focus on two economic areas that are significantly different than the US, we study the role of regional dynamics in affecting the validity of PVS. Our method follows that of Pflueger et al. (2020), with relevant adjustments tailored to the economic contexts of Norway and Sweden where necessary. We develop three hypotheses that are subsequently tested through our analysis. The three hypotheses explore: (1) The correlation between PVS and different investor risk perceptions, (2) the relationship between PVS and the real rate, and (3) if PVS and the real rate possess predictive power for two different asset classes, distinguished by volatility. Our research focuses on available financial market data for Norway and Sweden, along with measures of risk perceptions and the real rate. Moreover, we retrieve various financial information on 572 companies combined, all of which are listed on either the Oslo Stock Exchange or the Nasdaq Stockholm. We run various Ordinary Least Squares (OLS) regressions on the data that span the timeline from January 2000 to December 2023. The OLS regressions, which primarily explore the dependent variable on single independent variables, are run using country-specific measures for Norway and Sweden. Through this approach, we aim to isolate the relationship between two variables for each economic area.

In essence, this thesis explores the applicability and validity of the Price of Volatile Stocks as a measure of risk perception for the Norwegian and Swedish economies. In Section 2, we outline the theoretical framework for our thesis and review relevant literature on asset pricing, the risk-centric view of business cycles, and the novel measure Price of Volatile Stocks. Section 3 presents our methodology and hypotheses. Here, we address our rationale for the selected methodology and present three hypotheses tied to the primary variable of interest in our study. In Section 4, we review the process of data collection and data processing. This section outlines the sources of data and explains the steps taken to prepare the data for analysis. Section 5 displays our results and empirical analysis. Moreover, we analyze the results with respect to our three hypotheses, existing empirical evidence from the US, and address the deviations. Next, we discuss potential limitations connected to data quality and variable selection in Section 6. Lastly, Section 7 presents our conclusion and thoughts regarding future research on the topic.

# 2 Literature Review

*In this section, we will review the theoretical framework of our thesis. We begin by examining fundamental theories of asset pricing. Next, we conduct a review of literature that explores the intersection of macroeconomics and risk perception. Lastly, we look at the Price of Volatile Stocks introduced by Pflueger et al. (2020).*

## 2.1 Asset Pricing

In this thesis, assets are valued using their market share price. Market share prices reflect the cost of capital for each individual firm, as viewed by investors (Pflueger et al., 2020, p. 1444).

### 2.1.1 Present Value

The most basic of valuation methods builds on the intuition that investors will commit funds if they expect to receive a value greater than their initial investment. More specifically, investors will invest if the sum of all future payments exceeds the investment amount, accounting for the time value of money. This can be summarized as: "Value of an asset is equal to the sum of the present values of the expected future benefits of owning that asset" (Hitchner, 2017, p. 122). The discounted-cash-flow method displays this intuition:

$$PV = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} \tag{1}$$

Where:

$$\begin{aligned} PV &= \text{Present Value} \\ CF_t &= \text{Cash Flow at time } t \\ r &= \text{Discount rate (required rate of return)} \\ n &= \text{Total number of periods} \end{aligned}$$

Equation 1 indicates that the present value of any asset changes in response to the discount rate or future cash flows.

### 2.1.2 Cost of Capital

There are multiple ways to determine the cost of capital for a firm. The Capital Asset Pricing Model (CAPM) is among the most recognized models for asset pricing. The model considers the risk-free rate, the market portfolio return, and the individual assets' co-movement with the market, denoted $\beta_i$ (Sharpe, 1964, p. 441). Using these factors, a required rate of return is produced, which in an equilibrium should be a point on the capital market line[2].

$$E(R_i) = R_f + \beta_i \left(E(R_m) - R_f\right) \tag{2}$$

Where:

$$\begin{aligned} E(R_i) &= \text{Expected return of asset } i \\ R_f &= \text{Risk-free rate} \\ \beta_i &= \text{Beta of asset } i \text{ (market co-movement)} \\ E(R_m) &= \text{Expected return of the market portfolio} \end{aligned}$$

The critique directed towards the model has emphasized its overly simplistic approach. Nevertheless, it has become the standard for evaluating the cost of capital (Damodaran, 2012, p. 65).

The model, despite its flaws, outlines a key concept within financial economics, namely that the cost of capital is dependent on the asset's co-movement with factors of risk (the market portfolio in the case of CAPM). An increase in co-movement between the asset and risk factors (higher risk factor exposure) should, assuming investors behave rationally, result in investors charging a higher cost of capital. If the present value of the asset is defined as in Section 2.1.1, then the increased cost of capital should lead to, all else equal, a decrease in the present value.

## 2.2 Risk-Centric View of Business Cycles

A risk-centric view of business cycles proposes that financial markets are integral to driving economic fluctuations. Recent literature has contributed to the development of a formal

[2] Conceptual line connecting the risk-free rate and the market portfolio in a risk-return diagram. Outlined together with CAPM in Sharpe (1964).

framework for this risk-centric view of economic fluctuations (Cochrane, 2017; Caballero & Fahri, 2018; Caballero & Simsek, 2020).

### 2.2.1 Uncertainty and Business Cycles

Business cycles, generally divided into the four stages of expansion, peak, recession, and through, are driven by economic shocks. In fact, it is suggested that the economic fluctuations would not occur if not for the shocks, that can be either positive or negative (Wolla, 2023). These economic shocks often stem from financial market disruptions, energy price shocks, or significant monetary policy changes, among other factors. Empirical research[3] suggests that business cycles are strongly linked to uncertainty. There are multiple historical economic and political shocks that demonstrate this claim. Bloom (2009) specifically looks at the relationship between historical events[4] and different forms of uncertainty. Uncertainty is documented in the form of stock market volatility spikes after major shocks (Bloom, 2009, p. 623). Moreover, it is argued that the volatility linked to major economic events can have significant long-term effects; uncertainty will cause firms to halt production and hiring. Estimates show that this hesitation for further expansion can cause a drop and subsequent rebound in employment and output in the six months following the event (Bloom, 2009, p. 623). In other words, Bloom (2009) finds that uncertainty, displayed by stock market volatility, is a key driver of economic output levels.

### 2.2.2 Macro-Finance

"Macro-finance" has been defined as the study of the relationship between asset prices and economic fluctuations (Cochrane, 2017, p. 945). Clearly articulated in the article by Cochrane, asset prices and their returns are correlated with business cycles. To better understand this relationship, one can look at the standard power-utility consumption-based model:

[3] See, for example, Bloom (2009).

[4] The historical events covered by Bloom (2009) span the timeline of 1960 to approximately 2009, covering major events arising from wars, terror events, and economic crises.

$$E(R^e_{t+1}) = \gamma \operatorname{cov}(\Delta c_{t+1}, R^e_{t+1}) \tag{3}$$

Where:

$$\begin{aligned}
E(R^e_{t+1}) &= \text{Expected excess return of an asset} \\
\gamma &= \text{Risk aversion coefficient} \\
\operatorname{cov}(\Delta c_{t+1}, R^e_{t+1}) &= \text{Covariance between consumption growth and the excess return}
\end{aligned}$$

Equation 3 looks at the relationship between the variables one period ahead (*t+1*). Excess return is generally defined as the additional return compared to a benchmark; an example is the additional return of a risky asset compared to the risk-free rate. This model bridges the relationship between the macroeconomy (consumption growth) and asset returns (excess asset returns). The interpretation is that the compensation an investor requires, symbolized by $E(R^e_{t+1})$, changes based on the performance of an asset during recessions (or expansions). Although it is argued by Cochrane (2017) that consumption itself is not volatile enough to account for the observed equity premium, the model remains foundational in connecting macroeconomic dynamics and asset pricing.

Tying it back to the risk-centric view of business cycles, an increase in perceived risk perception caused by, for example, an economic policy change could lead to an economic downturn. An increase in perceptions of risk would lead to investors valuing "the safety of bonds and charge risky firms a high cost of capital" (Pflueger et al., 2020, p. 1444). Consequently, the stock prices of risky firms could be the most sensitive to shifts in risk perception. The risk-centric view of business cycles then argues that in the case of increased risk perception, the cost of capital for risky firms increases, and the demand for less risky investments such as government bonds increases, leading to a decrease in the real risk-free rate ("real rate")[5]. Risky firms are faced with higher borrowing costs due to the elevated risk premiums, they invest less causing a drop in aggregate demand, and ultimately a recession is formed (Pflueger et al., 2020, p. 1444).

[5]A decrease in the real risk-free rate is caused by lower yields on bonds and safe assets as their prices rise.

## 2.3 The Price of Volatile Stocks:

The central measure in our study is the Price of Volatile Stocks ("PVS"). Introduced in the journal article *Financial Market Risk Perceptions and the Macroeconomy* by Pflueger, Siriwardane, and Sunderam (2020), PVS is a novel measure of risk perception. PVS is defined as "the book-to-market ratio of low-volatility stocks minus the book-to-market ratio of high-volatility stocks" (Pflueger et al., 2020, p. 1443). By its definition, PVS serves as a proxy for how volatile and stable firms are viewed in the market. For time periods when PVS is high, it reflects that the market value of volatile stocks is relatively high, compared to the firms' disclosed book value. Conversely, whenever PVS is low, it indicates that the most volatile stocks are priced relatively low in the market.

In their research, Pflueger et al. (2020) explore if their measure of risk perception provides empirical evidence for the risk-centric view of the business cycle. They examine this by looking at various U.S. financial- and macroeconomic data in the time frame 1970 to 2016. Furthermore, the empirical analysis finds that PVS is tied to investor perceptions of risk: "Our measure is based on the idea that when investors perceive risk to be high, they are only willing to pay low prices for volatile assets" (Pflueger et al., 2020, p. 1487). This conclusion is supported by PVS' statistically significant correlation with, among others, option prices, equity analyst forecasts, and a newspaper-based risk perception index by Baker et al. (2016)[6]. In the same analysis, PVS is also found to be positively correlated with the real rate, bridging the novel risk perception measure with an indicator of economic fluctuations (the real rate). It is emphasized that this correlation holds in both expansions and recessions and in high- and low-inflation environments (Pflueger et al., 2020, p. 1445).

As addressed above, Pflueger et al. (2020) explore the relationships between PVS and multiple different variables. They categorize the variables into four segments: (1) Perceptions of risk, (2) the real rate, (3) other measures of financial conditions, and (4) volatility-sorted returns and monetary policy surprises. The first two segments explore the equilibrium relationships[7] between PVS and key variables of interest, while segment three and segment four test the robustness of PVS.

[6]See Economic Policy Uncertainty in the Data section.

[7]An equilibrium relationship refers to a stable, long-term linkage between the variables of interest where they evolve together over time to maintain balance.

# 3 Methodology and Hypothesis Development

*In this section, we present the methodology and hypothesis development of our study. We begin by detailing the methodological framework, which focuses on evaluating the correlation between a novel measure of risk perception, the Price of Volatile Stocks, and key variables of interest. Next, we introduce our hypotheses connected to the Price of Volatile Stocks.*

## 3.1 The PVS Framework

PVS was found to be significantly correlated to both risk perception and macroeconomic indicators in the empirical analysis by Pflueger et al. (2020). Consequently, we aim to determine its applicability to the Norwegian and Swedish economies. Below, we formally define PVS to provide clarity on its calculation and interpretation.

$PVS_{\mathrm{t}}$ at time $t$ is defined as the difference between the average book-to-market ratio of the least volatile stocks (denoted as "*Low* $\sigma$") and that of the most volatile stocks (denoted as "*High* $\sigma$"). This definition is visualized in equation (4). The classification of low- and high-volatility stocks is outlined in the Data section.

$$\mathrm{PVS}_t \equiv \overline{\left(\frac{\text{Book Value}_t}{\text{Market Value}_t}\right)}_{\text{Low } \sigma} - \overline{\left(\frac{\text{Book Value}_t}{\text{Market Value}_t}\right)}_{\text{High } \sigma} \tag{4}$$

The above definition is based on equal-weighted averages of book-to-market ratios and serves as the central methodology for constructing PVS, as outlined by Pflueger et al. (2020). PVS, with its focus on volatility disparities, aims to evaluate cross-sections[8] in financial markets. Given the novelty of this measure, Pflueger et al. (2020) explore several alternative construction methods to test whether this emphasis on cross-sections is meaningful.

For these alternative PVS constructions, a similar framework is applied with certain modifications. In addition to the main methodology, which relies on the book-to-market structure, a variant using market-to-book ratios is also considered. This variant calculates PVS by subtracting the market-to-book ratio of the least volatile stocks from that of the

[8] Cross-sections in this context refer to different assets categorized by their volatility.

most volatile stocks (see Equation 5). Up to this point, all steps align with the approach detailed in Pflueger et al. (2020) for constructing PVS. However, a deviation is made by additionally examining market-value-weighted versions of both the book-to-market and market-to-book PVS constructions. In these calculations, each company's book-to-market (or market-to-book) ratio is weighted by its individual market value. As "small firms' risk and expected returns are most strongly affected by a recession state," an effort was made to examine if deviating from the equal-weighted approach would impact the results (Perez-Quirós & Timmermann, 2000, p. 1259). To summarize, the four different constructions of PVS we consider are the book-to-market equal-weighted, book-to-market value-weighted, market-to-book equal-weighted, and market-to-book value-weighted approaches.

$$\mathrm{PVS}_{\text{t, Market-to-Book}} \equiv \overline{\left(\frac{\text{Market Value}_t}{\text{Book Value}_t}\right)}_{\text{High } \sigma} - \overline{\left(\frac{\text{Market Value}_t}{\text{Book Value}_t}\right)}_{\text{Low } \sigma} \tag{5}$$

In order to calculate PVS across the relevant timeline, we separate the stocks and the associated firms based on volatility. Rather than evaluating what factors affect investor risk perception, the volatility of previous returns is used as a proxy for all risk factors (Pflueger et al., 2020, p. 1447). Furthermore, we look at PVS through three geographical scopes: $PVS_{Oslo}$, $PVS_{Stockholm}$, and $PVS_{Total}$[9]. The explanation of the different datasets and applicable timeline is covered in the Data section. As far as variable selection and robustness tests are concerned, we closely follow the categorization and structure of Pflueger et al. (2020) in this thesis; some variables are omitted, and this is covered in the Limitations section.

## 3.2 Three Hypotheses

In our study, we focus on how PVS is related to different measures of risk perception and the business cycle. In connection with this focus, we look at three hypotheses that also align with the equilibrium relationships explored in *Financial Market Risk Perceptions and the Macroeconomy*.

[9] "Total" refers to merging the applicable data of Oslo and Stockholm.

**I.** ***PVS is low when investor risk perceptions are high.***

The implication is that there is an inverse relationship between PVS and investor risk perceptions. Following the work of Pflueger et al. (2020), we apply several different measures as proxies for subjective risk perception. We run regressions tied to the two countries in scope, namely Norway and Sweden, along with looking at the datasets combined. The different measures of risk perception include analyst forecasts of EPS[10], a statistical risk measure, and employment- and production outlooks; these variables are described in greater detail in the Data section.

**II.** ***There is a positive correlation between PVS and the real risk-free rate.***

This can be tied to both the pricing of volatile stocks, but also to the pricing of safe, risk-free financial securities: "We find that when $PVS_t$ is high, the price of safe bonds is low, so the real rate is high" (Pflueger et al., 2020, p. 1463). In periods where volatile stocks are priced relatively high, there should be a high real rate and lower priced government-issued (safe) bonds. Similar to the approach in Hypothesis I, we explore the relationship and potential correlation of PVS and the real rate through single-variable regressions. Additionally, we control for the aggregate book-to-market for all firms in scope and explore the relationships between the real rate and the individual components[11] of PVS in multivariate regressions.

**III.** ***Both low values of PVS and the real rate forecast greater returns for high-volatility stocks relative to low-volatility stocks.***

This third and last hypothesis suggests that PVS, as well as the real rate, provides return predictability for high- and low-volatility stocks. Moreover, when PVS is low, implying that high-volatility stocks are relatively cheap compared to accounting (book) values, a portfolio that is long high-volatility stocks and short low-volatility stocks should provide a substantial return. This, of course, also applies to the inverse scenario; with a high PVS, our hypothesis predicts that low-volatility stocks will generate greater returns compared to high-volatility stocks. To test the hypothesis, we regress future returns on PVS and the real rate for a portfolio that is short high-volatility stocks and long low-volatility stocks. Specifically, we run forecasting regressions where we regress the realized return between time $t$ and $t + h$. A high return for this portfolio between $t$ and $t + h$, all else equal, implies a heightened cost-of-capital for high-volatility stocks, relative to low-volatility stocks.

[10]Earnings Per Share

[11]Specifically, the book-to-market ratio (market-to-book) of high- and low-volatility stocks.

# 4 Data

*In this section, we will review the processes of data collection and data processing. We begin by outlining the data collection process, detailing the sources utilized and the rationale for their selection. Next, we provide an overview of the data processing steps, including methods for constructing key metrics and preparing data for analysis.*

## 4.1 Data Collection

For our analysis, we select the time scope of January 2000 to December 2023. Data is collected for this entire period, and any gaps or limitations encountered are addressed accordingly. The data used in our analysis pertains to (1) Norwegian and Swedish financial markets, (2) various measures of risk perception, and (3) the real risk-free rate.

### 4.1.1 Norwegian and Swedish Financial Market Data

We begin our data collection process by compiling all companies listed on the primary stock exchanges in Norway and Sweden: the *Oslo Stock Exchange* and *Nasdaq Stockholm*. The Oslo Stock Exchange ("Oslo") is Norway's premier stock exchange with a market capitalization of $295.55 billion as of May 2022 (Downey, 2024). The exchange was founded in 1819, privatized in 2001, and later acquired by the stock exchange group Euronext in 2019. Founded in 1863, Nasdaq Stockholm ("Stockholm") is the trading exchange for the Swedish securities market. The market capitalization of the exchange equaled approximately $1,055 billion as of September 2, 2024 (Nasdaq Nordic, 2024). We select firms exclusively listed on the main exchanges, intentionally excluding small- and medium-sized enterprises (SMEs)[12]. Additionally, in the case of multiple stock listings per firm, common equity stocks are retained[13]. This approach results in datasets composed of larger, well-established companies with greater market capitalization and liquidity. The official websites for *Euronext* and *Nasdaq Nordic* provided the foundational data, with an up-to-date overview of applicable companies and their tickers for the Norwegian and Swedish exchanges. In total, the datasets consist of 208 companies from Oslo and 364 companies from Stockholm.

[12] These SMEs are typically listed on MTFs (Multilateral Trading Facilities), such as *Euronext Growth* in Norway.

[13] Duplicate stock listings are only present on the Stockholm exchange. Equity listed as "B-shares" is preferred, as this is the most common listed equity for Stockholm.

For data extraction, we collect various financial market data from the *Bloomberg Terminal* ("Bloomberg"), *Yahoo Finance* ("Yahoo"), and *Wharton Research Data Services* ("WRDS"). From Bloomberg, we extract two financial metrics for each Norwegian and Swedish firm in scope: (1) Book value of equity and (2) market value of equity. Book value of equity, as implied by the name, is the accounting value of equity reported quarterly for each firm. In Bloomberg, book value of equity is defined as "Total Common Equity". Market value of equity is the market capitalization of each firm, defined in Bloomberg as "Current Market Cap"; this metric is reported monthly. From Yahoo, we retrieve the stock prices of all the 208 Norwegian and 364 Swedish companies in scope. Specifically, we collect the daily adjusted close price[14] from January 2000 to December 2023.

### 4.1.2 Measures of Risk Perception

We collect data on different measures of risk perception, specifically analyst EPS forecasts, domestic production- and employment outlooks, the OECD[15] Business Confidence Index, and the Economic Policy Uncertainty ("EPU") Index.

**Analyst EPS forecasts**: We begin by compiling the data on forecasted earnings per share from the Institutional Brokers' Estimate System ("IBES"). The EPS forecasts from IBES, sourced via the WRDS platform, are reported annually and cover the same time period as the financial market data (2000–2023).

**Domestic production and employment outlooks:** For data on aggregated production- and employment outlooks in Norway, our source is the reports from the Central Bank of Norway named *Regional Network* ("Regionalt nettverk" in Norwegian). The Regional Network dataset consists of outlooks for production and employment from March 2005 to September 2024. For the domestic outlooks of aggregate Swedish production- and employment, we utilize data from the European Commission; the dataset is called *Main Indicators (ESI, EEI, sectoral CIs).* Specifically, we look at ESI and EEI, acronyms for the Economic Sentiment Indicator and Employment Expectation Indicator, respectively. ESI and EEI are also gathered for the euro area[16] for their comparison to the merged dataset. The structures of these datasets are also monthly and cover the period from January 2000 to December 2023.

[14] Adjusted close is the closing price after adjustments for all applicable splits and dividend distributions (Yahoo, n.d.-a).

[15] The Organisation for Economic Co-operation and Development

[16] The euro area consists of the European countries that have adopted the euro as their currency (European Commission, n.d.-b).

**OECD Business Confidence Index:** The OECD Business Confidence Index ("OECD BCI") is a sentiment indicator that displays near-future business outlook. Moreover, it is "a standardized confidence indicator [...] based upon opinion surveys on developments in production, orders and stocks of finished goods in the manufacturing sector" (OECD, n.d.). Data collection was carried out directly from the OECD website and consists of gathering indicators for Norway, Sweden, and the euro area. The euro area indicator is used in our analysis to compare its relationship to the merged PVS measure of Norway and Sweden ($PVS_{Total}$). OECD BCI consists of monthly observations, and we retrieve data for the period from January 2000 to December 2023.

**Economic Policy Uncertainty:** The EPU index is an indicator of policy-related economic uncertainty. Baker et al. (2016) were the first to introduce this measure, looking at the frequency of articles in U.S. newspapers that contain terms such as "economic," "uncertain," and "legislation" (Baker et al., 2016, p. 1594). Our source for the EPU varies for the different economic areas. We retrieved the index for Sweden and Europe from *Economic Policy Uncertainty* (Economic Policy Uncertainty, n.d.-a). The developers of the Europe EPU followed the same methodology as Baker et. al (2016), using data from France, Germany, Spain, Italy, and the UK. Similarly, the Swedish EPU was created using the same methodology but was first published by Armelius et al. (2017). These indices are monthly time series covering the entire time period between January 2000 to December 2023. For Norway, the EPU index was sourced from the homepage of Vegard Høghaug Larsen, Associate Professor of Data Science and Economics at BI Norwegian Business School[17]. This index is also a monthly time series and covers the time period of January 2000 to March 2023.

### 4.1.3 Real Risk-Free Rates

We also collect data to construct real risk-free rates. To derive the real rates, we retrieve historical nominal interest rates and inflation forecasts.

**Nominal interest rate:** For the nominal interest rates of Norway and Sweden, we collect data from the Central Bank of Norway, the Swedish National Debt Office ("Riksgjälden" in Swedish), and the European Central Bank ("ECB"). Specifically, the forward-looking nominal interest rate is defined as the yield spot rate (one-year maturity) of government bonds. The zero-coupon Norwegian bonds are reported monthly covering the time period 2015 to 2023. Similarly, the yields on Swedish bonds are also monthly in frequency, with data available from 2014 to 2023. Lastly, yields for government bonds for the euro area, derived from the ECB, include monthly data from 2004 to 2023.

[17]See the online appendix of Larsen (2021) for in-depth information.

**Inflation forecast:** For inflation forecasts, we look at the inflation outlook one year ahead from the reference quarter. Our source for inflation forecasts stems from the ECB Survey of Professional Forecasters[18]. These forecasts are, specifically, HICP (Harmonised Index of Consumer Prices), with a one-year outlook for the time period January 2000 to December 2023.

## 4.2 Data Processing

### 4.2.1 Combined Datasets

The combined data is created by merging the Oslo and Stockholm datasets with respect to book values, market values, and stock prices.

### 4.2.2 Construction of PVS

The Price of Volatile Stocks (PVS) time series is constructed through a series of methodological steps. Our construction of PVS, covered below, mirrors the approach from Pflueger et al. (2020), with the only exception being the additional market-value-weighted approach.

For the inclusion of a firm in the PVS calculation, it must fulfill six criteria, each applied sequentially. Consequently, the number of valid observations decreases progressively from Criterion 1 to Criterion 6. To be included at time $t$, the firm must have (1) a book value, (2) market value, and (3) stock price. (4) Since Yahoo assigns the adjusted close price for $t$ as the adjusted close price for $t + 1$ if no transactions occur, we only consider prices that differ from one day to the next. Quarterly book-to-market ratios are calculated from a trailing six-month rolling average of market values and the latest available (quarterly) book value for each company. We assume the book value is known with a one quarter lag[19]. Two-month rolling standard deviations of daily returns[20] are then computed, and the firms are subsequently placed in one of five volatility quintiles. (5) Only firms with at least 20 observations within this two-month window are considered. (6) Furthermore, a stock is only considered if it has at least two years of data to avoid survival bias, in accordance with Pflueger et al. (2020). Table 4.1 displays how many observations are dropped at each step in the construction. The percentage of valid observations relative to the initial number of book values is reported in the "%" column.

[18]The ECB Survey of Professional Forecasters began in 1999 and and collects information on the expected rates of inflation, real GDP growth, and unemployment in the euro area.

[19]Book value at time $t$ is shifted one quarter ahead, ensuring a known book value is always used.

[20]Daily return is the percentage daily change in adjusted close price.

**Table 4.1:** Valid Observations at Each Step in the PVS Construction

| | Oslo | | Stockholm | | Merged | |
|---|---|---|---|---|---|---|
| Criteria | Valid | % | Valid | % | Valid | % |
| (1) Book Value | 11 164 | 100,00 | 23 813 | 100,00 | 34 977 | 100,00 |
| (2) B/M Value | 10 470 | 93,78 | 22 408 | 94,10 | 32 878 | 94,00 |
| (3) Stock Price | 10 073 | 90,23 | 21 926 | 92,08 | 31 999 | 91,49 |
| (4) $\text{Price}_{t+1} \neq \text{Price}_t$ | 10 032 | 89,86 | 21 915 | 92,03 | 31 946 | 91,33 |
| (5) Min. 20 Returns in 2 Months | 9 475 | 84,87 | 21 556 | 90,52 | 31 017 | 88,68 |
| (6) First 2 Years Filter | 8 408 | 75,31 | 19 269 | 80,92 | 27 665 | 79,09 |

Determined by the standard deviation of daily returns, a stock is defined as low-volatility if placed in the least volatile quintile. Similarly, a stock is defined as high-volatility if it is placed in the most volatile quintile. Next, the average book-to-market ratio for each quintile is calculated for every quarter from January 2000 to December 2023, generating five time series. The final PVS time series is then constructed by subtracting the average book-to-market of the high-volatility stocks from the average of low-volatility stocks. Additionally, the market-to-book calculations require an additional filtering step. These constructions exhibit a small number of extreme values due to book values that are close to or equal to zero, resulting in extreme or infinite values. To address this issue, the market-to-book time series are therefore winsorized at the 5th and 95th percentiles. In Appendix A.1, the choice of the 10% winsorization level is outlined.

### 4.2.3 Analyst EPS Forecast Dispersion

The annual earnings per share forecasts are obtained from the IBES database, accessed from the Wharton Research Data Services (WRDS) website. As with the PVS construction, we follow the method and steps of Pflueger et al. (2020) in obtaining the analyst EPS forecast dispersion. WRDS defines *statistical period* as the date the EPS forecasts are calculated, and the *forecast period end date* as the end of the specific time window for which the EPS estimate applies[21] (Wharton Research Data Services, n.d.). For each firm ($i$) and forecast period ($p$), we select the most recent available forecast date for $i$ prior to $p$. Additionally, the selected forecast date must include at least two unique analyst forecasts. The forecast range is defined as the difference in values between the maximum and minimum EPS forecasts. The dispersion is then defined as the forecast range divided by the absolute value of the forecasts' median. This calculation is visualized in Equation 6:

[21] The forecast period (time window) is on an annual basis.

$$\text{Dispersion}_{\text{EPS}} \equiv \frac{\text{Range}_{\text{EPS forecast}}}{|\text{Median}_{\text{EPS forecast}}|} \tag{6}$$

In line with the approach of Pflueger et al. (2020), $\text{Dispersion}_{\text{EPS}}$ is used as a proxy for perceived earnings volatility. The interpretation is that an increase in the dispersion value implies more disagreement on earnings (elevated risk perception). When calculating the dispersion values, observations with a median EPS forecast of zero are excluded. The resulting time series is subsequently winsorized at the 5th and 95th percentiles to minimize the influence of extreme values where the median EPS forecast is close to zero.

Finally, the variable *Analyst EPS forecast dispersion* ("Analyst Dispersion") is defined as the difference in median dispersions between low-volatility and high-volatility firms[22] (see Equation 7). The raw IBES data contains approximately 18,993 forecasts for the Oslo stocks and 16,414 forecasts for the Stockholm stocks. After applying the above steps, there are 1,596 dispersion values for Oslo and 1,327 dispersion values for Stockholm. Valid Analyst Dispersion observations for Oslo and Stockholm are 56 and 47, respectively. For the merged dataset, the number of Analyst Dispersion observations totals 59. Again, the construction of this variable follows the methodology outlined by Pflueger et al. (2020).

$$\text{Analyst Dispersion} \equiv \text{Median}(\text{Dispersion}_{\text{EPS},\textit{High } \sigma}) - \text{Median}(\text{Dispersion}_{\text{EPS},\textit{Low } \sigma}) \tag{7}$$

### 4.2.4 Statistical Risk Measure

To derive the statistical risk measure, we begin by calculating the rolling standard deviations of daily returns on a quarterly basis. Stocks are subsequently grouped into volatility quintiles based on their standard deviations. The difference in volatility (average standard deviation) between the least and most volatile quintiles is then calculated. Lastly, we fit an AR(1) model[23] to this time series. From this model, a prediction of the difference in the volatility of returns between the two extreme quintiles at *t+1* emerges for all *t*. Here, an increase in the predicted difference implies a growing disparity between the most and least volatile stocks. We use this predicted time series as our statistical risk measure. The construction of this risk perception measure also follows the methodology outlined by Pflueger et al. (2020).

[22] Low-volatility stocks are denoted "Low $\sigma$" and high-volatility stocks are denoted "High $\sigma$".
[23] First-order autoregression model.

$$\text{Statistical Measure}_t \equiv \mathrm{E}_{AR(1),\ t+1}(\overline{\sigma}_{\text{High }\sigma} - \overline{\sigma}_{\text{Low }\sigma}) \tag{8}$$

### 4.2.5 Derivation of Real Rates

We compute the real risk-free rate by taking the one-year government security yield net of the one-year expected inflation rate. The construction is generalized in Equation 9. In the subsequent analysis, we display the relationship between *Real Rate SPF* and PVS. Moreover, the two other real rates constructed are listed in Appendix A.2. We discuss the rationale for the emphasis on Real Rate SPF in Section 6.2.1.

$$\text{Real risk-free rate} = \text{Government security yield} - \text{Inflation forecast} \tag{9}$$

**Real Rate SPF** is the one-year ECB government bond yield net of the one-year Survey of Professional Forecasters inflation forecast.

### 4.2.6 Volatility-Sorted Portfolio Return

First, the average returns between time $t$ and horizon $t + h$ are calculated for high- and low-volatility stocks separately. Next, the return of high-volatility stocks is subtracted from the return of low-volatility stocks. This results in a new time series representing the return between $t$ and $t + h$ for a portfolio that is long low-volatility stocks and short high-volatility stocks[24]. Both $t$ and $t + h$ need to be within the time frame of January 2000 to December 2023. These steps of constructing the volatility-sorted portfolio return mirror the method of Pflueger et al. (2020).

### 4.2.7 Data Scaling

For easier interpretation of the results, PVS and the other risk perception variables (listed in Table 5.1) are scaled to have a mean of 0, as well as a standard deviation of 1. This makes it so that the relationships are to be interpreted as: *"An increase equal to $\sigma_X$ in $X$ is correlated with a $\beta_X \times \sigma_Y$ change in $Y$".*

[24]The portfolio is fixed, not introducing or removing stocks between time $t$ and $t + h$.

The rest of the variables are expressed in annualized percentage points. When PVS is used as an explanatory variable for any of these, for example for the yearly portfolio return, the relationships are to be interpreted as: *"An increase equal to $\sigma_X$ in $X$ is correlated with a $\beta_X$ percent change in $Y$"*.

## 4.3 Descriptive Statistics

**Table 4.2:** Descriptive Statistics

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $\text{PVS}_{\text{Oslo}}$ | 88 | 0.47 | 0.49 | 0.79 | -2.10 | 2.93 |
| $\text{PVS}_{\text{Stockholm}}$ | 88 | -0.04 | 0.01 | 0.25 | -0.87 | 0.43 |
| $\text{PVS}_{\text{Total}}$ | 88 | 0.04 | 0.10 | 0.32 | -1.06 | 0.66 |

Table 4.2 provides PVS summary statistics for the economic areas analyzed in this thesis. The table displays the book-to-market, equal-weighted versions of PVS. Descriptive statistics for alternative PVS constructions are outlined in Appendix A.1.

The means of $PVS_{Oslo}$ and the merged dataset ($PVS_{Total}$) are positive values. This suggests that firms in the lowest volatility quintiles generally possess higher book-to-market ratios compared to firms in the highest volatility quintiles. $PVS_{Stockholm}$, on the other hand, is slightly negative on average. Conversely, this indicates that high-volatility firms generally possess slightly higher book-to-market ratios than low-volatility firms. However, given that the standard deviations are significantly larger than the respective means, these averages are not statistically distinguishable from zero. Figures 4.1, 4.2, and 4.3 display PVS over time for the economic areas in scope. Additionally, they display the changes in the highest and lowest volatility quintiles. The highlighted, red areas show significant periods of financial distress.

Furthermore, Figure 4.4 displays how many firms meet the criteria outlined in Section 4.2.2 across the time scope. Note that there are no valid observations prior to 2002, due to the implications of Criterion 6.

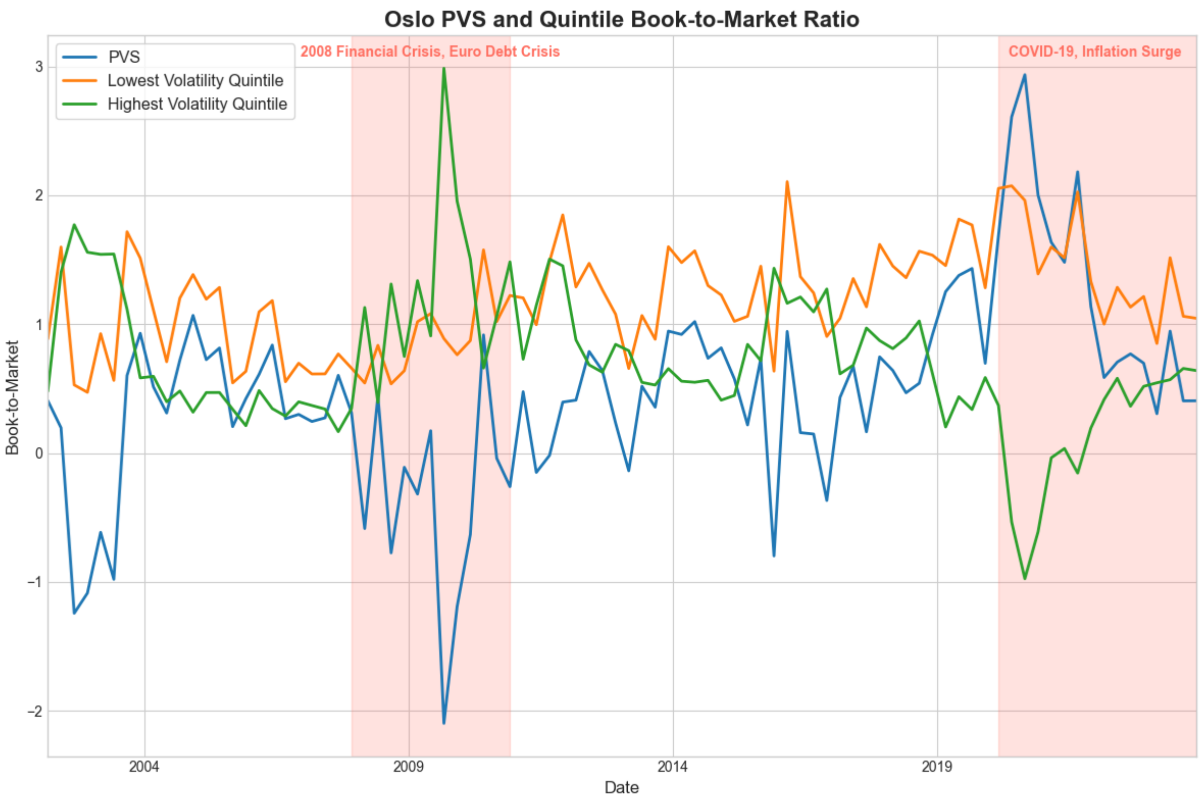


**Figure 4.1:** $\text{PVS}_{Oslo}$ and Periods of Financial Distress

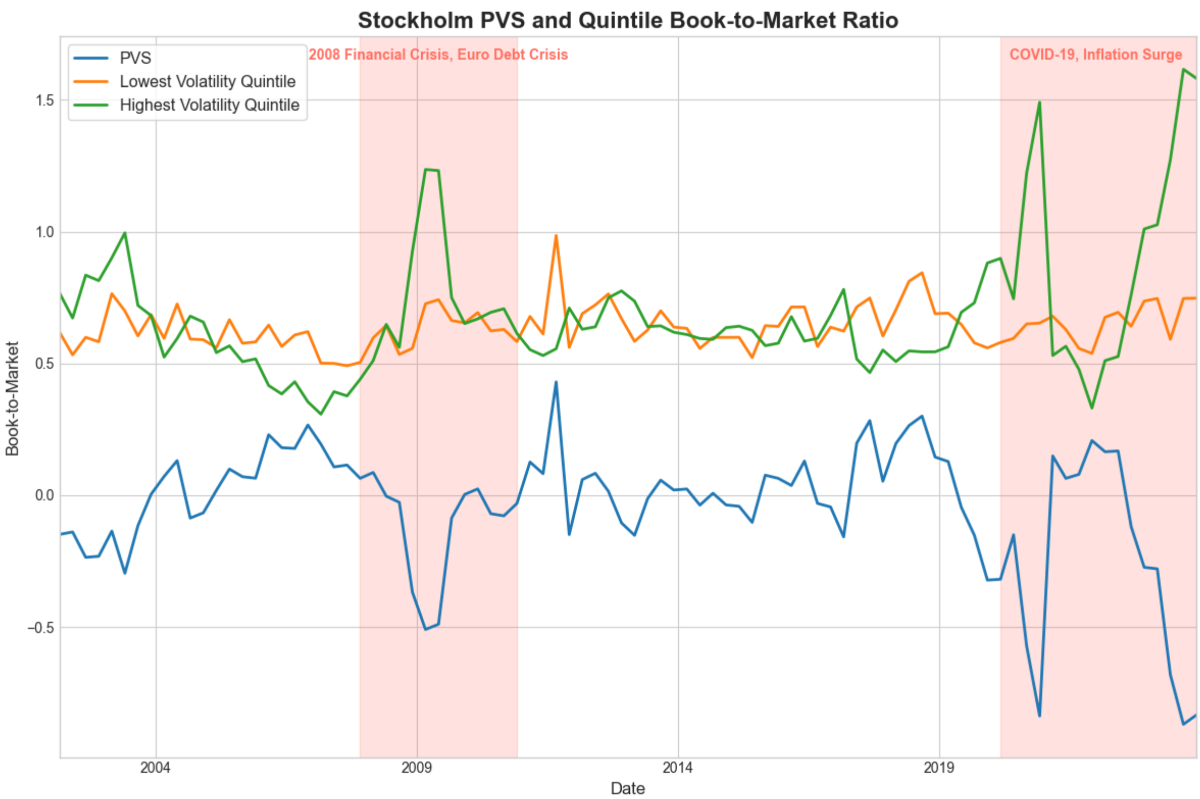


**Figure 4.2:** $\text{PVS}_{Stockholm}$ and Periods of Financial Distress

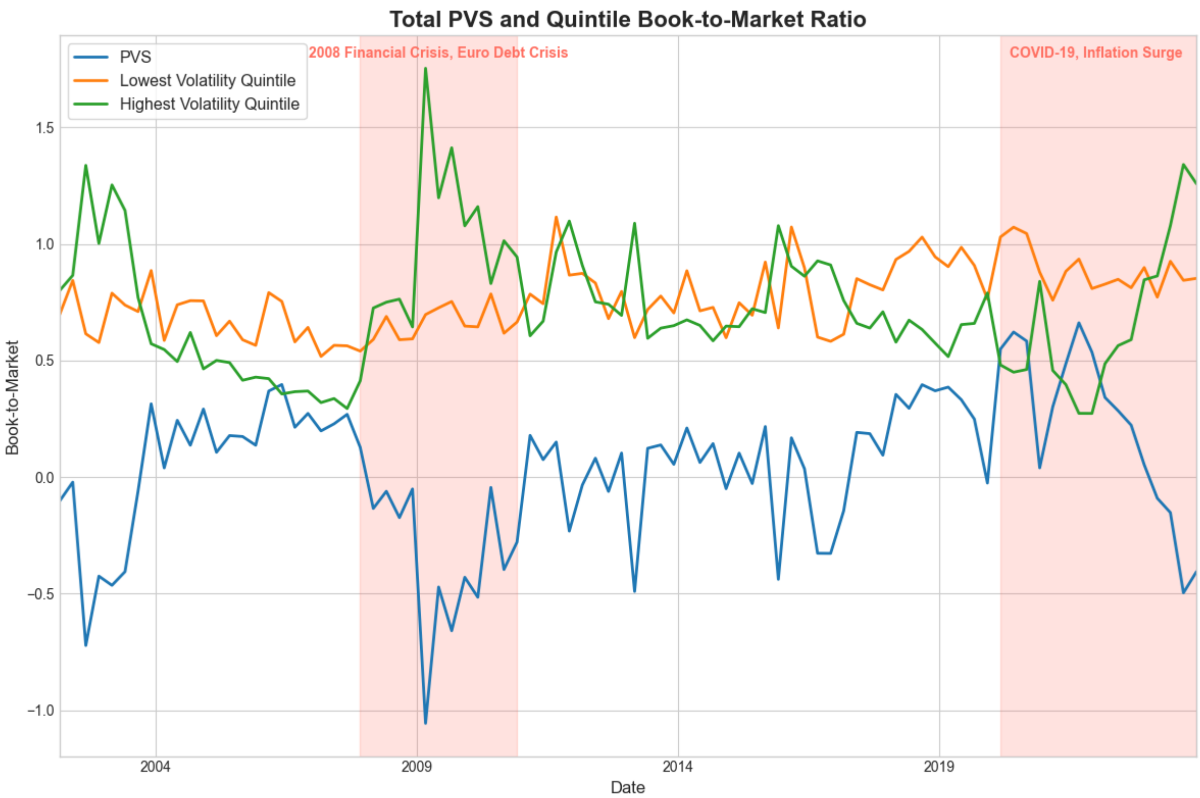


**Figure 4.3:** $\text{PVS}_{Total}$ and Periods of Financial Distress

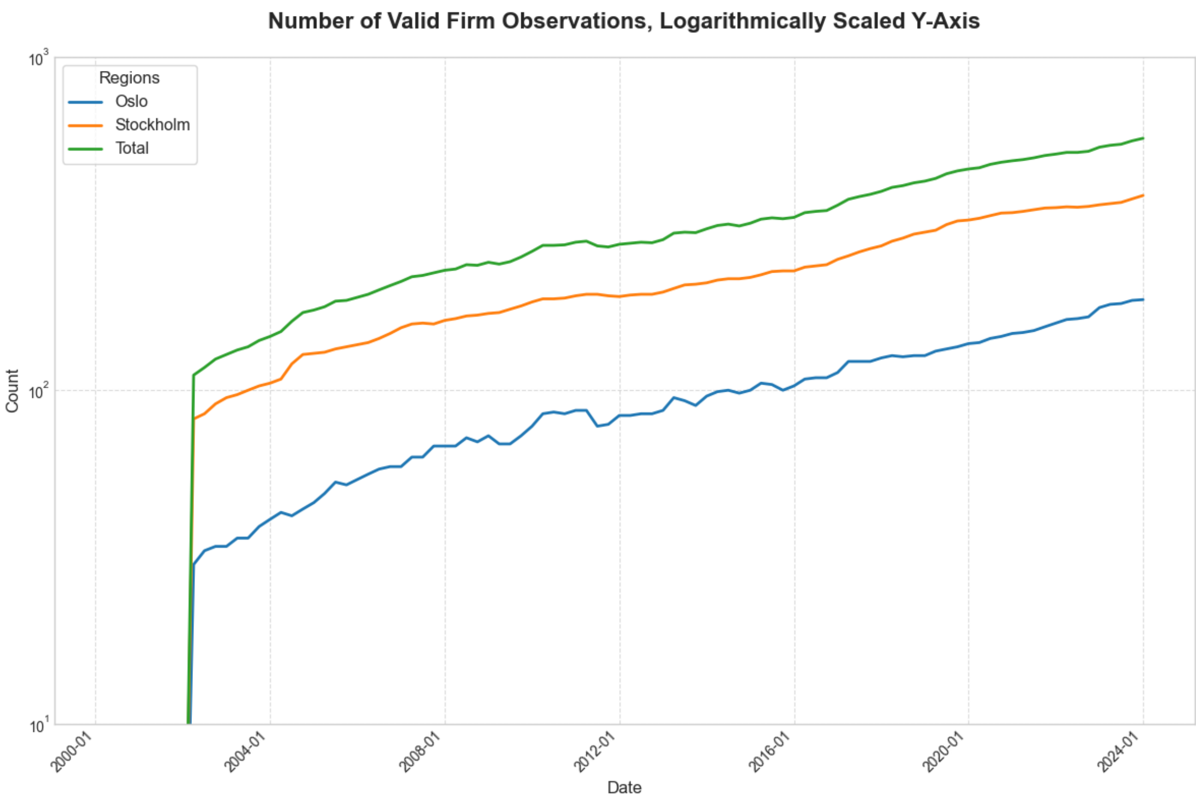


**Figure 4.4:** Firms Considered for Quintile Assignment

# 5 Results and Analysis

*In this section, we will focus on testing our three hypotheses. Specifically, we begin by examining the relationships between PVS and different variables reflecting investor risk perceptions. We also look at the real rate and its potential correlation with PVS. Next, we assess the return predictability of PVS and the real rate and conclude with a discussion of the findings.*

## 5.1 Investor Risk Perceptions

To evaluate whether correlations exist between PVS and investor risk perceptions, consistent with *Hypothesis I*, we employ a range of proxies for risk perception. We utilize analyst EPS forecast dispersions from the IBES database ("Analyst Dispersion"), a statistical forecasting model ("Statistical Measure"), various business sentiment indicators ("Employment Outlook," "Production Outlook," and "OECD BCI"), and the Economic Policy Uncertainty indices ("EPU Index"). Analyst Dispersion and Statistical Measure are variables of perceived risk that match the construction of PVS, focusing on cross-sectional differences in risk perception (Pflueger et al., 2020, p. 1459). The four other variables are broader measures; these aim to capture relationships between PVS and general risk perception. In accordance with Pflueger et al. (2020), high Analyst Dispersion, Statistical Measure, and EPU Index values correspond to high risk perception. Contrary, high values for the three business outlook variables indicate low risk perception. All regressions are performed using the following model:

$$PVS_t = C + \beta \times X_{\mathrm{t}} + \epsilon_t \tag{10}$$

The four different PVS construction methods will hereafter be labeled "BM EW" (book-to-market with equal weights), "BM VW" (book-to-market with market value weights), "MB EW" (market-to-book with equal weights), and "MB VW" (market-to-book with market value weights). Table 5.1 presents the regression results for Oslo, Stockholm, and the merged dataset, using the BM EW method. It is worth noting that the number of observations varies somewhat depending on the explanatory variable included in the regression. This variation arises from differences in data availability as outlined in Section 4.

**Table 5.1:** PVS on Investor Risk Perceptions

*$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$*

| Explanatory | Dependent Variable: $PVS_{\text{Oslo}}$ | | | | | | Dependent Variable: $PVS_{\text{Stockholm}}$ | | | | | | Dependent Variable: $PVS_{\text{Total}}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Analyst Dispersion | −0.244$^{**}$ | | | | | | 0.127 | | | | | | −0.211 | | | | | |
| | (0.117) | | | | | | (0.178) | | | | | | (0.137) | | | | | |
| Statistical Measure | | 0.164 | | | | | | −0.080 | | | | | | 0.131$^{*}$ | | | | |
| | | (0.312) | | | | | | (0.186) | | | | | | (0.072) | | | | |
| Employment Outlook | | | 0.232 | | | | | | 0.474$^{***}$ | | | | | | 0.530$^{***}$ | | | |
| | | | (0.157) | | | | | | (0.094) | | | | | | (0.165) | | | |
| Production Outlook | | | | 0.065 | | | | | | 0.666$^{***}$ | | | | | | 0.537$^{***}$ | | |
| | | | | (0.172) | | | | | | (0.196) | | | | | | (0.172) | | |
| OECD BCI | | | | | 0.193 | | | | | | 0.418$^{***}$ | | | | | | 0.527$^{***}$ | |
| | | | | | (0.169) | | | | | | (0.085) | | | | | | (0.156) | |
| EPU Index | | | | | | 0.340$^{**}$ | | | | | | −0.087 | | | | | | 0.108 |
| | | | | | | (0.156) | | | | | | (0.146) | | | | | | (0.191) |
| Constant | 0.165 | 0.056 | 0.081 | 0.081 | 0.005 | −0.062 | −0.135 | −0.013 | 0.015 | −0.006 | −0.124 | −0.007 | 0.057 | 0.012 | 0.033 | 0.027 | −0.019 | −0.013 |
| | (0.292) | (0.578) | (0.240) | (0.245) | (0.218) | (0.204) | (0.402) | (0.255) | (0.232) | (0.146) | (0.329) | (0.300) | (0.274) | (0.258) | (0.166) | (0.181) | (0.238) | (0.166) |
| Observations | 56 | 88 | 76 | 76 | 88 | 85 | 47 | 88 | 88 | 88 | 88 | 88 | 59 | 88 | 88 | 88 | 88 | 88 |
| $R^2$ | 0.053 | 0.042 | 0.057 | 0.005 | 0.041 | 0.146 | 0.011 | 0.005 | 0.187 | 0.409 | 0.174 | 0.007 | 0.047 | 0.021 | 0.248 | 0.255 | 0.012 | 0.282 |
| Adjusted $R^2$ | 0.035 | 0.026 | 0.044 | −0.009 | 0.030 | 0.136 | −0.011 | −0.011 | 0.178 | 0.402 | 0.165 | −0.004 | 0.030 | 0.007 | 0.239 | 0.246 | 0.001 | 0.274 |
| Residual SE | 1.041 | 1.050 | 0.953 | 0.980 | 0.985 | 0.944 | 1.215 | 1.085 | 0.907 | 0.773 | 0.914 | 1.002 | 0.970 | 1.035 | 0.872 | 0.868 | 1.000 | 0.852 |
| F Statistic | 3.016$^{*}$ | 2.640 | 4.459$^{**}$ | 0.335 | 3.646$^{*}$ | 14.170$^{***}$ | 0.507 | 0.304 | 19.811$^{***}$ | 59.480$^{***}$ | 18.164$^{***}$ | 0.631 | 2.794 | 1.449 | 28.375$^{***}$ | 29.363$^{***}$ | 1.064 | 33.759$^{***}$ |

*Notes:* This table displays the result of regressions with PVS as the dependent variable, and measures of perceived risk as the explanatory variables. PVS is defined as the equal-weighted book-to-market ratio of the highest volatility firms, subtracted from the equal-weighted book-to-market ratio of the lowest volatility firms. Analyst Dispersion utilizes the range divided by the median of EPS forecasts for each firm. The Analyst Dispersion is defined as the difference between the median dispersion of high- and low-volatility firms. Statistical Measure calculates the difference between average rolling standard deviations for high- and low-volatility firms. An AR(1) model is then fitted to this differential time series, and utilized to make a volatility prediction for $t + 1$. The Statistical Measure is defined as this predicted time series. For Oslo, the Employment Outlook and Production Outlook are business indicators for Norway provided by *Regionalt Nettverk*. For Stockholm and the merged dataset, Employment Outlook and Production Outlook are defined as the Employment Expectation Indicator and the Economic Sentiment Indicator for Sweden and the EU, respectively. The OECD BCI is the Business Confidence Index for Norway, Sweden, and the euro area. The EPU Index is the Economic Policy Uncertainty Index for Norway, Sweden, and large European economies, respectively. Newey-West Standard errors are in parentheses. Each column represents a single-variable regression for the indicated dependent variable.

From Table 5.1, we see that there is limited statistical significance for regressions of $PVS_{\text{Oslo}}$ on the different investor risk perceptions. However, we do observe that two out of the six risk perception measures are found significant at conventional thresholds of statistical significance. Firstly, the Analyst Dispersion measure has a negative coefficient of -0.244, significant at the 5% level. Here, the interpretation is that a one standard deviation increase in analyst EPS forecast dispersion is associated with a 0.244 standard deviation decrease for $PVS_{\text{Oslo}}$. The observed inverse relationship supports our first hypothesis, as higher levels of this measure of risk perception are negatively correlated with PVS. In other words, aligning with *Hypothesis I*, when the discrepancy between the perceived risk of stable and volatile stocks is large (increase in Analyst Dispersion), then volatile stocks are relatively cheap. Secondly, we observe a positive correlation between $PVS_{\text{Oslo}}$ and the EPU Index: A one standard deviation increase in the EPU Index is correlated with a 0.340 standard deviation increase in $PVS_{\text{Oslo}}$. The positive coefficient for the EPU Index contradicts the first hypothesis, as higher values of the index signify increased risk perception (Pflueger et al., 2020, p. 1462).

Upon further review of Table 5.1, it is evident that we find more statistical significance for the regressions of $PVS_{\text{Stockholm}}$ and $PVS_{\text{Total}}$ on the different risk perception measures. For both these economic areas, we find positive relationships between PVS and the Employment Outlook, Production Outlook, and OECD BCI variables. The positive coefficients for these three measures align with *Hypothesis I* and the results outlined by Pflueger et al. (2020). All three variables are statistically significant at the 1% level. Additionally, we observe statistical significance at the 10% level for the regression of $PVS_{\text{Total}}$ on the statistical risk measure. This finding contradicts our hypothesis and the result of Pflueger et al. (2020). The finding indicates that high levels of the predicted volatility discrepancy (between high- and low-volatility stocks) for the next quarter are correlated with high levels of PVS. Assuming our first hypothesis is true, high values of the statistical risk measure would be correlated with low PVS values, all else equal.

Given the existence of multiple economic areas and alternative methods to construct the PVS time series, it could be beneficiary to provide a comprehensive overview of the regression coefficients. To achieve this, we extract only the betas for each explanatory variable. Table 5.2 and Table 5.3 display the collection of all coefficients across the economic areas and PVS construction methods. The reasoning behind examining the different PVS constructions is to evaluate if other constructions produce very different results. Additionally, comparing these four construction methods serves as a form of robustness test to determine whether the found correlations in the initial PVS construction (BM EW, Table 5.1) hold with different approaches.

**Table 5.2:** Coefficients, All PVS Constructions on Investor Risk Perceptions - Part 1

| | BM EW | | | BM VW | | |
|---|---|---|---|---|---|---|
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| Analyst Dispersion | -0.244** | 0.127 | -0.211 | -0.347** | 0.036 | -0.039 |
| Statistical Measure | 0.164 | -0.080 | 0.131* | 0.081 | 0.006 | -0.003 |
| Employment Outlook | 0.232 | 0.474*** | 0.530*** | 0.244** | 0.391 | 0.435*** |
| Production Outlook | 0.65 | 0.666*** | 0.537*** | 0.127 | 0.609** | 0.606*** |
| OECD BCI | 0.193 | 0.418*** | 0.527*** | 0.263*** | 0.473*** | 0.566*** |
| EPU Index | 0.340** | -0.087 | 0.108 | 0.010 | -0.032 | -0.171 |

**Table 5.3:** Coefficients, All PVS Constructions on Investor Risk Perceptions - Part 2

| | MB EW | | | MB VW | | |
|---|---|---|---|---|---|---|
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| Analyst Dispersion | 0.222 | -0.147 | -0.075 | 0.232 | -0.020 | 0.099 |
| Statistical Measure | -0.051 | 0.564* | -0.097 | 0.034 | 0.288 | -0.137 |
| Employment Outlook | 0.493*** | 0.383* | 0.172 | 0.292*** | 0.350*** | 0.165 |
| Production Outlook | 0.441*** | 0.314*** | 0.147 | 0.304*** | 0.313*** | 0.163 |
| OECD BCI | 0.370*** | 0.454** | 0.224** | 0.321*** | 0.385*** | 0.251*** |
| EPU Index | -0.138 | 0.140 | 0.035 | -0.062 | 0.176 | -0.028 |

As evident in Tables 5.2 & 5.3, there is varying statistical significance across the different PVS constructions. For both the Statistical Measure and the EPU Index, there is limited statistical evidence of a correlation between the risk perception measures and PVS. However, a key observation across the statistically significant results is the positive relationship between business outlook measures[25] and PVS. With an emphasis on $PVS_{\text{Stockholm}}$, it displays statistically significant positive correlations to all three business outlook measures for three out of the four constructions. This aligns with the implications set forth by our first hypothesis, namely that PVS should be low when investor risk perceptions are high. Oppositely to heightened risk perceptions, PVS is high when the economic environment outlook is optimistic (large values for the business outlook measures), also addressed by Pflueger et al. (2020).

For $PVS_{\text{Total}}$, the explanatory variables of statistical significance are also the business outlook measures. The positive coefficients for the OECD BCI measure are significant at either the 1% or 5% level across all four PVS constructions. For the book-to-market constructions of $PVS_{\text{Total}}$, all three business outlook measures are statistically significant at the 1% level. Looking at the beta coefficients tied to $PVS_{\text{Oslo}}$, evidently, there are varying results. For the BM EW approach outlined in Table 5.1, there are two statistically significant results, one in alignment with and one that contradicts our hypothesis. In contrast,

[25]Employment Outlook, Production Outlook, and OECD BCI

$PVS_{\text{Oslo}}$ is found to exhibit a positive relationship to at least two of the business outlook measures in each of the three other PVS constructions. Lastly, we find minimal evidence of correlations between PVS and the Statistical Measure, and PVS and the EPU Index. Pflueger et al. (2020) found an inverse relationship between these two risk perceptions and PVS, in line with our first hypothesis. Overall, the business outlook measures seem to exhibit more robust relationships with PVS across economic areas and construction methods, relative to Analyst Dispersion, Statistical Measure, and the EPU Index. At the 5% level, the three business outlook indices display 26 instances of statistically significant coefficients, while the three other regressors have a combined total of three. In general, the $R^2$ values of the business outlook measures are also much larger than for the other variables. As the analyst dispersion and statistical measure variables assess perceived risk discrepancy, we find PVS to exhibit a more robust relationship to the more generalized measures of risk perception. In Appendix B.2, we also run PVS on volatility indices[26]. We observe similar results as the broader measures of risk perception, although not to the same extent.

## 5.2 The Real Rate

Next, we evaluate the relationship between the real risk-free rate and PVS, applying the methodology of Pflueger et al. (2020). Three types of regressions are performed. Firstly, the real rate is regressed on PVS. Secondly, the real rate is regressed on both PVS and the aggregate book-to-market of all firms in scope. This is done to investigate if the emphasis on cross-sections (high- and low-volatility stocks) of financial markets is of importance. Thirdly, the real rate is regressed on the individual components of PVS, to check if the individual extreme quintiles correlate with the real rate. The explanatory variables are all standardized to have a mean of 0 and a standard deviation of 1, while the real rate is expressed in annual percentage points. Here we aim to test *Hypothesis II*, which states that there is a positive relationship between the real rate and PVS. The regression in Table 5.4 is defined in Equation 11, and the regressions for Tables 5.5 & 5.6 are defined in Equation 12:

$$Real\ Rate_{\text{t}} = C + \beta \times X_{\text{t}} + \epsilon_t \tag{11}$$

$$Real\ Rate_{\text{t}} = C + \beta_1 \times X1_{\text{t}} + \beta_2 \times X2_{\text{t}} + \epsilon_t \tag{12}$$

[26] Volatility indices are the Chicago Board Option Exchange Volatility Index (VIX) and the EURO STOXX 50 Volatility (VSTOXX)

**Table 5.4:** The Real Rate on PVS

| | *Dependent variable: The one-year Real Rate* | | |
|---|---|---|---|
| | Real Rate SPF | | |
| | (1) | (2) | (3) |
| $PVS_{Oslo}$ | −0.189 | | |
| | (0.200) | | |
| $PVS_{Stockholm}$ | | 0.191 | |
| | | (0.296) | |
| $PVS_{Total}$ | | | 0.051 |
| | | | (0.360) |
| Constant | −0.017 | −0.041 | −0.034 |
| | (0.425) | (0.476) | (0.452) |
| Observations | 77 | 77 | 77 |
| $R^2$ | 0.029 | 0.035 | 0.002 |
| Adjusted $R^2$ | 0.016 | 0.022 | −0.011 |
| Residual Std. Error | (df = 75) 1.060 | (df = 75) 1.057 | (df = 75) 1.075 |
| F Statistic | (df = 1; 75) 2.206 | (df = 1; 75) 2.690 | (df = 1; 75) 0.163 |
| *Notes:* | | | $^{*}$p<0.1; $^{**}$p<0.05; $^{***}$p<0.01 |

Regression of the real rate on PVS. The real rate, derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield, is the dependent variable in all regressions. PVS is defined as the equal-weighted book-to-market ratio of the most volatile firms, subtracted from the equal-weighted book-to-market ratio of the least volatile firms. Newey-West standard errors are in parentheses.

### 5.2.1 Real Rate on PVS

As shown in Table 5.4, there are no statistically significant relationships between PVS and the real rate for any of the economic areas in focus. This, combined with a relatively low $R^2$ for the regressions, does not provide evidence of a clear correlation between the real rate and PVS. In Appendix C.1, we show that this result is robust across all four different constructions of PVS. Further examining the regressions in C.1, we find that the sign of the coefficients changes based on what PVS construction method is applied; this further undermines the possibility of validating a clear relationship between the real rate and PVS.

This is a considerable contrast to the results presented by Pflueger et al. (2020). They found the PVS coefficient to be 1.26, indicating that a one standard deviation increase in PVS is associated with a 1.26 percent increase in the real rate. The finding was significant at the 5% level.

### 5.2.2 Real Rate on PVS and Aggregate Book-To-Market

In Table 5.5, the real rate is regressed on PVS and with the aggregate book-to-market ratio for all firms at time $t$, mirroring Pflueger et al. (2020). The central construction of PVS, using equal weights and book-to-market ratios, displays no statistically significant findings. This applies to either explanatory variable in the regressions for Oslo, Stockholm, and the merged dataset. We also run the same regressions for the alternative PVS constructions, displayed in Appendix C.1. In total, we find one instance of a statistically significant PVS coefficient (-0.244 for $PVS_{\text{Stockholm}}$) at the 5% level. As this single coefficient is the only one in 12 regressions, there is limited empirical evidence of a clear relationship. In the same multivariate regression, Pflueger et al. (2020) found the PVS coefficient to be 1.26 (again) and significant at the 5% level.

The estimated coefficients of the aggregate book-to-market values are consistently negative across the economic areas and PVS constructions. Additionally, there are two instances where the coefficients are significantly different from zero at conventional levels of significance. As both of these instances are for Oslo, and only significant at the 10% level, the robustness of these findings is uncertain. Pflueger et al. (2020) did not find the coefficient of aggregate book-to-market to be statistically distinguishable from zero.

**Table 5.5:** The Real Rate on PVS and the Aggregate Book-to-Market Ratio

| | *Dependent variable: The one-year Real Rate* | | |
|---|---|---|---|
| | | Real Rate SPF | |
| | (1) | (2) | (3) |
| $PVS_{Oslo}$ | −0.203 | | |
| | (0.215) | | |
| Aggregate $BM_{Oslo}$ | −0.158 | | |
| | (0.115) | | |
| $PVS_{Stockholm}$ | | 0.133 | |
| | | (0.170) | |
| Aggregate $BM_{Stockholm}$ | | −0.236 | |
| | | (0.261) | |
| $PVS_{Total}$ | | | −0.037 |
| | | | (0.359) |
| Aggregate $BM_{Total}$ | | | −0.224 |
| | | | (0.205) |
| Constant | −0.018 | −0.045 | −0.032 |
| | (0.416) | (0.340) | (0.446) |
| Observations | 77 | 77 | 77 |
| $R^2$ | 0.054 | 0.077 | 0.044 |
| Adjusted $R^2$ | 0.028 | 0.052 | 0.019 |
| Residual Std. Error | (df = 74) 1.054 | (df = 74) 1.041 | (df = 74) 1.059 |
| F Statistic | (df = 2; 74) 2.091 | (df = 2; 74)3.078* | (df = 2; 74) 1.720 |

*Notes:* *p<0.1; **p<0.05; ***p<0.01

Regression of the real rate on PVS and aggregate book-to-market ratios. The real rate, derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond yield, is the dependent variable in all regressions. PVS is defined as the equal-weighted book-to-market ratio of the most volatile firms, subtracted from the equal-weighted book-to-market ratio of the least volatile firms. The Aggregate BM is the aggregate book-to-market ratio of all firms in scope. Newey-West standard errors are in parentheses.

**Table 5.6:** The Real Rate on the Average Book-to-Market Ratio of High- and Low-Volatility Stocks

| | *Dependent variable: The one-year Real Rate* | | |
|---|---|---|---|
| | Real Rate SPF | | |
| | (1) | (2) | (3) |
| High Volatility $BM_{Oslo}$ | −0.230 | | |
| | (0.166) | | |
| Low Volatility $BM_{Oslo}$ | $-0.563^{**}$ | | |
| | (0.240) | | |
| High Volatility $BM_{Stockholm}$ | | −0.211 | |
| | | (0.265) | |
| Low Volatility $BM_{Stockholm}$ | | −0.282 | |
| | | (0.197) | |
| High Volatility $BM_{Total}$ | | | −0.274 |
| | | | (0.305) |
| Low Volatility $BM_{Total}$ | | | $-0.449^{**}$ |
| | | | (0.204) |
| Constant | −0.033 | −0.038 | −0.038 |
| | (0.243) | (0.348) | (0.300) |
| Observations | 77 | 77 | 77 |
| $R^2$ | 0.240 | 0.146 | 0.253 |
| Adjusted $R^2$ | 0.220 | 0.123 | 0.233 |
| Residual Std. Error | (df = 74) 0.944 | (df = 74) 1.001 | (df = 74) 0.936 |
| F Statistic | (df = 2; 74) $11.701^{***}$ | (df = 2; 74) $6.344^{***}$ | (df = 2; 74) $12.536^{***}$ |

*Notes:* $^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

Regression of the real rate on PVS components. The real rate, derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond yield, is the dependent variable in all regressions. The High Volatility BM is the equal-weighted book-to-market ratio of the most volatile firms at time *t*. Conversely, the Low Volatility BM is the equal-weighted book-to-market ratio of the least volatile firms. Newey-West standard errors are in parentheses.

### 5.2.3 Real Rate on PVS Components

The regressions in Table 5.6 show the real rate on the average book-to-market ratios of high- and low-volatility firms, individually. All estimated coefficients are negative, with two coefficients being statistically distinguishable from zero. The statistically significant coefficients are the low-volatility book-to-market (BM) coefficients for Oslo and the merged dataset. For Oslo, the coefficient is estimated to be -0.563. The interpretation is that a one standard deviation increase in the average book-to-market ratio of low-volatility firms is correlated with a 0.563 percentage point decrease in the annual real rate. These results are opposite to that of Pflueger et al. (2020). The finding that only the book-to-market value of low-volatility firms is correlated with the real rate holds true across all PVS construction methods (see Appendix C.1.). Moreover, the statistically significant coefficients are all negative.

Regarding the findings of Pflueger et al. (2020), our analysis of the relationship between the real rate and PVS shares certain similarities but also significant differences. Firstly, we cannot establish a robust link between the real rate and PVS, as no coefficients are statistically significant and signs of the coefficients vary. This diverges from Pflueger et al. (2020), as they estimated a significant positive correlation between the real rate and PVS. When controlling for the average book-to-market ratio, the result is twofold: The estimated PVS coefficients fluctuate with regard to direction, scale, and statistical significance. On the other hand, the estimated coefficients for the aggregate stock market are all consistently negative but not statistically significant at the 5 % level. This result is the same as in Pflueger et al. (2020). When examining the book-to-market values of high- and low-volatility firms independently, they find, contrary to us, that the book-to-market of low-volatility firms is positively correlated with the real rate. Furthermore, this is used to emphasize that the corresponding stocks are similar to bonds; all else equal, the market values of low-volatility stocks decrease (book-to-market goes up) when real interest rates go up (Pflueger et al., 2020, p. 1466). Our results for Oslo and the merged dataset suggest the opposite; when the real interest rate rises, the market values of low-volatility firms increase. However, these results are not robust across the other PVS construction methods. The lack of empirical evidence supporting *Hypothesis II* makes it difficult for us to argue that (1) there is a clear relationship between PVS and the real rate, (2) the emphasis on cross-sections of volatility is crucial to bridge financial data and the real rate, and (3) stocks of low-volatility firms display bond-like attributes.

## 5.3 Return Predictability

The final focus of this analysis is to investigate the relationship between the Price of Volatile Stocks, the real rate, and a corresponding portfolio's returns. To assess whether the PVS or the real rate possesses predictive power for the future performance of the portfolio, we perform forecasting regressions. The portfolio is short high-volatility stocks and long low-volatility stocks. Specifically, we calculate the difference in realized returns between the lowest volatility quintile and the highest volatility quintile during the period $t$ to $t + h$. This time series is regressed on the PVS (or real rate) value at time $t$, given by Equations 13 & 14. For calculating realized returns, an equal-weighted portfolio approach is implemented. The methodology mirrors Pflueger et al. (2020).

$$PVS_{\mathrm{t}} = C + \beta \times Return_{\mathrm{t}\rightarrow\mathrm{t+h}} + \epsilon_t \quad (13)$$

$$Real\ Rate_{\mathrm{t}} = C + \beta \times Return_{\mathrm{t}\rightarrow\mathrm{t+h}} + \epsilon_t \quad (14)$$

### 5.3.1 Future Returns on PVS

In the regression tables below, PVS is standardized to have a mean of 0 and a standard deviation of 1, while the Return coefficients are expressed in annual percentage points. The horizon is one year[27]. Tables 5.7 & 5.8 display the results using the four different construction methods for PVS. An initial observation is that all beta coefficients for PVS are positive. This suggests that higher PVS values are associated with greater returns for low-volatility stocks compared to high-volatility stocks in the following year. As an example, a one standard deviation increase in $\mathrm{PVS}_{\mathrm{Stockholm}}$ is correlated with a 7.958 percent increase in the one-year future portfolio return. In alignment with *Hypothesis III*, high PVS values forecast greater returns for low-volatility stocks relative to high-volatility stocks. However, we observe that only a third of all the PVS coefficients are significant at the 5% level. On average, the models exhibit relatively low $R^2$ values. Consequently, based on these results, it is challenging to conclude that PVS has predictive power for future returns.

We note that all coefficients for the constants are negatively significant at the 5% level. As PVS is standardized to have a mean of 0, this implies that when PVS is at its mean, one would expect a negative return for the portfolio. To elaborate, we find that the most volatile stocks generate a greater return than the least volatile stocks when PVS is at its average level. This aligns with basic principles of asset pricing, namely that higher-risk assets should generate higher returns, relative to lower-risk assets (Sharpe, 1964). Appendix D.1 explores additional horizons for the portfolio. As shown in those regression tables, we generally observe positive PVS coefficients, as well as negative constants for all horizons.

[27] The one year horizon aligns with that of Pflueger et al. (2020). In Appendix D, we also consider horizons of 2 years and 6 months.

**Table 5.7:** Yearly Returns of Low Minus High Volatility Portfolios on PVS - Part 1

| | *Dependent variable: Yearly Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | BM EW | | | BM VW | | |
| | $Return_{Oslo}$ | $Return_{Stockholm}$ | $Return_{Total}$ | $Return_{Oslo}$ | $Return_{Stockholm}$ | $Return_{Total}$ |
| $PVS_{Oslo}$ | 3.226 | | | 7.900** | | |
| | (4.300) | | | (3.447) | | |
| $PVS_{Stockholm}$ | | 7.958** | | | 1.483 | |
| | | (3.376) | | | (2.076) | |
| $PVS_{Total}$ | | | 2.593 | | | 3.395 |
| | | | (3.994) | | | (2.093) |
| Constant | −9.282** | −9.710*** | −7.802** | −9.104** | −8.926** | −7.994** |
| | (4.539) | (3.649) | (3.479) | (4.057) | (4.358) | (3.502) |
| Observations | 84 | 84 | 84 | 84 | 84 | 84 |
| $R^2$ | 0.016 | 0.145 | 0.023 | 0.092 | 0.005 | 0.033 |
| Adjusted $R^2$ | 0.004 | 0.134 | 0.011 | 0.081 | −0.007 | 0.022 |
| Residual Std. Error | 26.174 | 16.078 | 16.916 | 25.133 | 17.340 | 16.824 |
| F Statistic | 1.315 | 13.884*** | 1.921 | 8.356*** | 0.433 | 2.838* |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table 5.8:** Yearly Returns of Low Minus High Volatility Portfolios on PVS - Part 2

| | *Dependent variable: Yearly Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | MB EW | | | MB VW | | |
| | $Return_{Oslo}$ | $Return_{Stockholm}$ | $Return_{Total}$ | $Return_{Oslo}$ | $Return_{Stockholm}$ | $Return_{Total}$ |
| $PVS_{Oslo}$ | 4.145 | | | 0.304 | | |
| | (3.484) | | | (3.991) | | |
| $PVS_{Stockholm}$ | | 3.876*** | | | 4.164* | |
| | | (1.326) | | | (2.193) | |
| $PVS_{Total}$ | | | 1.745 | | | 4.068* |
| | | | (2.027) | | | (2.217) |
| Constant | −9.293** | −8.889** | −7.672** | −9.282** | −8.938** | −7.667** |
| | (4.338) | (4.100) | (3.456) | (4.511) | (3.753) | (3.084) |
| Observations | 84 | 84 | 84 | 84 | 84 | 84 |
| $R^2$ | 0.025 | 0.051 | 0.010 | 0.0001 | 0.058 | 0.053 |
| Adjusted $R^2$ | 0.013 | 0.040 | −0.002 | −0.012 | 0.047 | 0.041 |
| Residual Std. Error | 26.056 | 16.934 | 17.027 | 26.381 | 16.872 | 16.655 |
| F Statistic | 2.068 | 4.435** | 0.822 | 0.011 | 5.077** | 4.566** |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

### 5.3.2 Future Returns on the Real Rate

Regressions in Table 5.9 display the results from regressing the annual return of the aforementioned portfolio on the real risk-free rate (Real Rate SPF). Here, the real rate and the portfolio return are described in annual percentage points; the interpretation is that a one percentage point increase in the real rate corresponds to a $\beta$ percentage point change in the yearly (future) portfolio return. In this set of regressions, there are no significant coefficients for the real rate at any conventional level of significance. This lack of consistent significant results, combined with the low $R^2$ values, implies that there is no evident correlation in the data.

**Table 5.9:** Yearly Returns of Low Minus High Volatility Portfolios on Real Rate SPF

| | *Dependent variable: Yearly Portfolio Return* | | |
|---|---|---|---|
| | $Return_{\text{Oslo}}$ | $Return_{\text{Stockholm}}$ | $Return_{\text{Total}}$ |
| | (1) | (2) | (3) |
| Real Rate SPF | 2.800 | −3.383 | −1.481 |
| | (2.441) | (2.494) | (1.023) |
| Constant | −5.436 | −6.760* | −4.548 |
| | (3.883) | (3.898) | (2.786) |
| Observations | 73 | 73 | 73 |
| $R^2$ | 0.016 | 0.052 | 0.012 |
| Adjusted $R^2$ | 0.002 | 0.039 | −0.002 |
| Residual Std. Error (df = 71) | 23.798 | 15.600 | 14.823 |
| F Statistic (df = 1; 71) | 1.155 | 3.923* | 0.833 |

*Notes:* Newey-West standard errors in parenthesis *p<0.1; **p<0.05; ***p<0.01

As observed in Table 5.9, the constant terms are somewhat consistent, as they are all estimated to be negative. The interpretation of the Stockholm constant is that when the real rate is at its mean, this is associated with a negative return of the portfolio, one year ahead. Displayed in Appendix D.1., we do not find noticeable empirical evidence for a relationship between the real rate and the portfolio return for other horizons (six months and two years).

## 5.4 Summary of Findings

The analysis, structured around our three hypotheses, reveals mixed results. It highlights some findings similar to that of Pflueger et al. (2020) but also areas of inconsistency. For investor risk perceptions, we find that the business outlook indicators are the only variables that appear to be of statistical significance for PVS. These indicators display a somewhat robust result, having at least one instance of statistical significance across all different construction methods of PVS. However, we do not find substantial significant correlations for the other risk perception measures. Therefore, we cannot confidently conclude that PVS is low when investor risk perceptions are high. In the second part of the analysis, which examines whether PVS is correlated with the real rate, the results offer limited support for *Hypothesis II*. The few instances of statistical significance are not consistent across different PVS construction methods. For the final part of our analysis, covering the return predictability of a portfolio, the findings are also inconsistent. We note that the observed PVS coefficients are almost exclusively positive, but there are few statistically significant results at conventional significance thresholds. Consequentially, it is difficult to determine if PVS or the real rate has predictive power for the return differential between high-volatility and low-volatility stocks.

# 6 Limitations

*In this section, we will address the limitations of our study, focusing on the challenges and constraints related to variable selection and data quality. We will discuss coherence-related issues as well as excluded variables. This discussion aims to provide transparency regarding our study and to address the potential impact of limitations on the robustness and specificity of our findings.*

## 6.1 Choice of Data and Variables

Data selection and the choice of variables are key elements of our subsequent analysis. Moreover, the selected time scope and variable selection play a significant role in shaping the focus and potential findings of the analysis.

### 6.1.1 Time Scope

Our decision to select the time period of January 2000 to December 2023 stems from the availability of stock- and financial market data for Norwegian and Swedish companies. More specifically, stock prices are not available in our source (Yahoo) before January 1, 2000. Because our time scope is narrower than the one of Pflueger et al. (2020), this arguably limits our study to analyze long-term relationships to the same extent. Furthermore, it is important to be aware of the magnitude and effect of significant global events, such as the 2008 financial crisis and the COVID-19 pandemic. As seen in Figures 4.1, 4.2, and 4.3, these major economic disruptions had significant impacts on PVS and could therefore influence the results. Figure 6.1 displays historical yields for the one-year maturity government bonds that we derive the Real Rate SPF from. We observe that between, approximately, 2012 and 2022 there were negative yields for these euro area bonds. The abnormal yields[28] present during our time scope could also impact the results.

[28]Nominal interest rates (and government bond yields) have been positive throughout most of history (Haksar & Kopp, 2020).


**Figure 6.1:** Yield Government Bonds Euro Area, 1-year Maturity (Source: ECB)

### 6.1.2 Excluded Variables

In this thesis, the included variables are selected to establish potential empirical connections between economic fluctuations and financial markets. There are variables included in the paper by Pflueger et al. (2020) that we have not covered in our analysis. The main reason for this is time constraints. Among these omitted variables is option-implied volatility: "Option-Implied volatility [...] is the median at-the-money one-year implied volatility of high-volatility firms minus the median for low-volatility firms" (Pflueger et al., 2020, p. 1458). Furthermore, in the paper, the authors test the robustness of PVS on different measures of financial conditions and monetary policy surprises. Lastly, given time constraints, we were not able to obtain long-term growth forecasts as a control for changes in cash flow expectations.

## 6.2 Quality of Data

The quality of data is essential when evaluating the results of any analysis. Norway and Sweden, as relatively small developed economies, exhibit fluctuations in the quality of country-specific data.

### 6.2.1 Locality Level of Data

When comparing the real rate with PVS and portfolio returns in Section 5, we rely on data from the ECB Survey of Professional Forecasters rather than the Norwegian Central Bank and the Swedish National Debt Office. This is caused by the inability to obtain reliable historical data for inflation forecasts exclusive to Norway and Sweden. Pflueger et al. (2020) consider the US economy, obtaining both American government bond yields and

American inflation forecasts. They are thereby able to match the historical government bond yield to the inflation forecasts within their economic area. In Appendix C.2, we display the real rates constructed using the yields on Norwegian and Swedish treasury bonds, together with the European inflation forecasts. We emphasize Real Rate SPF in our analysis to ensure correspondence between the bond yield and inflation forecast, both pertaining to the euro area. This focus on correspondence aims to align with the abovementioned methodology.

## 6.3 Additional Implications of PVS

We acknowledge that there are two empirical implications addressed in the paper of Pflueger et al. (2020) that are beyond the scope of this thesis. As a result of time constraints and lack of a clear source for key variables, we are unable to explore these aspects further. The two implications are: (1) *"High values of PVS should be accompanied by an expansion in aggregate investment,"* and (2) *"PVS should rise and investor risk perception should fall following good news about fundamentals. If Investors' risk perceptions are rational, subsequent revision in expected risk should not be forecastable"* (Pflueger et al., 2020, p. 13). Implication 1 is investigated by running different local projection regressions similar to Jordà (2005), with the investment-to-capital ratio, the output gap, and the unemployment change as dependent variables. These regressions aim to examine if PVS possesses predictive power for real outcomes. Implication 2 is mainly investigated regressing the difference between realized and option-implied volatility[29] on PVS. These regressions aim to examine if risk assessment errors are correlated with PVS.

[29] Realized volatility is the standard deviation at time $t + h$, and option-implied volatility is calculated at time $t$.

# 7 Conclusion

This thesis explores the relationships between Norwegian and Swedish stock market volatility and the business cycle. We focus on the novel measure of risk perception *Price of Volatile Stocks*, and its correlation to investor risk perceptions, the real rate, along with the measure's capacity to forecast asset returns. From the data, we observe some empirical evidence that aligns with our first hypothesis, namely that PVS is correlated with investor perceptions of risk. Among the risk perceptions explored, we see, specifically, that business outlook indices are positively correlated with PVS. These indices exhibit, although to a varying degree, correlations to PVS across four different construction methods. For our other two hypotheses, the results of the performed analysis are inconclusive. The results from investigating the correlation between the real rate and PVS yield few statistically significant findings. Additionally, based on our data, PVS and the real rate also demonstrate limited forecasting power. We closely follow the methodology outlined by Pflueger et al. (2020) in this thesis. This applies to the development of our hypotheses, data collection and processing, and comparing the regression results. Evidently, our results differ from those of Pfluger et al. (2020), who found robust correlations between PVS and the real rate, as well as empirical evidence of the portfolio return predictability.

Our research question pertains to whether PVS and its assumptions hold in the Norwegian and Swedish economies. With this, our objective is to evaluate a measure of risk perception based on financial data (PVS) and further try to connect the financial markets to the business cycle. Through the methodology, we examine the proposition of risk-centric business theories. Given the novelty of PVS, a consequential objective of the thesis is to compare our results to the findings in the US. Based on the discussed assumptions of the risk-centric view of business cycles, understanding stock market volatility could provide insight for predicting economic fluctuations. PVS could be a measure that helps bridge this relationship, as implied by the empirical evidence of Pflueger et al. (2020). Our data and subsequent analysis, however, do not provide further support for this idea.

We acknowledge that not all empirical implications of PVS are outlined by our analysis; there remain clear opportunities for further research within this field. Future studies could also examine how the discussed variables of interest correlate across different economic areas, allowing for a greater understanding of the stability and potential robustness of PVS. To further examine whether or not there could exist similar linkages in other economies could enhance our understanding of global economic dynamics.

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# Declaration on the Use of AI Tools in the Work of This Master's Thesis

Name and version of AI tool: ChatGPT 4o.
Purpose of tool usage: Organizing data, structuring content, spell-checking, and grammar review.

We are aware that we are responsible for all content of this master's thesis, including the parts where AI tools are used. We are responsible for ensuring that the thesis complies with ethical rules for privacy and publication.

# Appendices

## A Supplementary Descriptive Statistics

## B PVS on Measures of Risk Perception: Alternative Constructions

## C Different Real Rates on PVS

## D Portfolio Return Predictability Expansion

# A Supplementary Descriptive Statistics

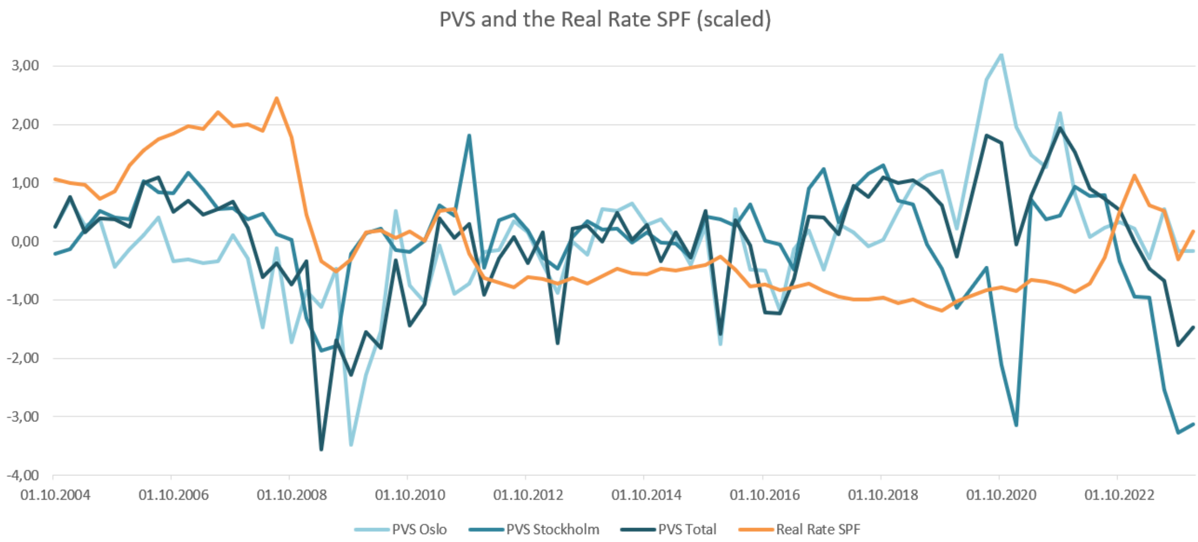


**Figure A.1:** PVS and the Real Rate SPF

## A.1 Descriptive Statistics on PVS, Using Alternative Construction Methods

### Filtered PVS

Tables A.1, A.2 and A.3 display descriptive statistics of PVS, using the BM VW, MB EW, and MB VW methods, respectively. The descriptive statistics for PVS using the BM EW are presented in Section 4. PVS is winsorized at the 5th and 95th percentiles for the MB EW and MB VW methods.

**Table A.1:** Descriptive Statistics of PVS, BM VW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | −0.02 | 0.05 | 0.42 | −1.52 | 0.59 |
| $PVS_{Stockholm}$ | 88 | −0.09 | −0.03 | 0.30 | -1.22 | 0.43 |
| $PVS_{Total}$ | 88 | −0.06 | −0.01 | 0.25 | −1.10 | 0.30 |

**Table A.2:** Descriptive Statistics of PVS, MB EW, 10% Winsorization

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 9.44 | 4.63 | 16.60 | −5.5 | 63.24 |
| $PVS_{Stockholm}$ | 88 | 0.23 | 0.01 | 2.32 | −3.74 | 4.88 |
| $PVS_{Total}$ | 88 | 4.47 | 2.61 | 7.46 | −3.92 | 24.70 |

**Table A.3:** Descriptive Statistics of PVS, MB VW, 10% Winsorization

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 8.40 | 5.07 | 13.61 | −7.74 | 41.31 |
| $PVS_{Stockholm}$ | 88 | −4.75 | −4.5 | 9.71 | −22.04 | 16.51 |
| $PVS_{Total}$ | 88 | −0.12 | −2.08 | 12.47 | −18.30 | 34.67 |

**Winsorization Exploration**

The PVS series based on the MB EW and MB VW are winsorized at the 5% tails (the 10% level). This is due to infinite and large values caused by book values that are either equal to or close to zero. Pflueger et al. (2020) chose this cutoff, however, but this might not be suitable for other data.

**Table A.4:** 2% Winsorization, MB EW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 29.10 | 4.63 | 119.06 | −14.25 | 795.72 |
| $PVS_{Stockholm}$ | 88 | Inf | 0.01 | NA | −15.87 | Inf |
| $PVS_{Total}$ | 88 | Inf | 2.61 | NA | −6.25 | Inf |

Tables A.4, A.5, and A.6 display the descriptive statistics of PVS using the MB EW method, using a winsorization level of 2, 5, and 20%, respectively. When comparing these tables to Table A.2, it becomes apparent that winsorization is required. Initially, we observe that a more strict approach than the 2% or 5% should be preferred. The maximum values display infinite or extremely large values in comparison to the 10% level

**Table A.5:** 5% Winsorization, MB EW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 23.24 | 4.63 | 85.64 | −8.44 | 470.86 |
| $PVS_{Stockholm}$ | 88 | 0.21 | 0.01 | 2.66 | −6.01 | 6.79 |
| $PVS_{Total}$ | 88 | 26.62 | 2.61 | 114.88 | −4.71 | 626.30 |

**Table A.6:** 20% Winsorization, MB EW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 6.64 | 4.63 | 8.25 | −2.97 | 22.26 |
| $PVS_{Stockholm}$ | 88 | 0.22 | 0.01 | 2.00 | −2.74 | 3.49 |
| $PVS_{Total}$ | 88 | 4.23 | 2.61 | 6.33 | −1.89 | 19.20 |

of winsorization. However, when winsorizing at the 20% level, the values do not change dramatically. For both Stockholm and the merged dataset, the standard deviation changes with less than 1, less than a 15% change. This implies that the most extreme values have already been filtered out, which is further supported by the maximum and minimum values of Oslo and the merged dataset. The most extreme positive values decrease from roughly 471 and 626 to 63 and 25 (respectively) between the 5 and 10% level. As we do not want to alter the data more than necessary, winsorizing at the 10% level seems reasonable.

PVS constructed using the MB VW method (Tables A.7, A.8, and A.9) displays similar characteristics, although to a lesser extent. As the maximum and minimum PVS values are not in the triple digits, an argument could be made that the 5% winsorization level would be more appropriate for this construction. However, as some ranges are still quite large, a more strict level seems appropriate. As with the MB EW, winsorization beyond the 10% level has limited impact, while affecting a large part of the data. The 10% winsorization level is therefore retained, as this seems to be a reasonable level, given our dataset.

**Table A.7:** 2% Winsorization, MB VW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 15.58 | 5.07 | 49.46 | −12.12 | 346.69 |
| $PVS_{Stockholm}$ | 88 | Inf | −4.5 | NA | −106.69 | Inf |
| $PVS_{Total}$ | 88 | Inf | −2.08 | NA | −77.98 | Inf |

**Table A.8:** 5% Winsorization, MB VW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 10.52 | 5.07 | 20.89 | −8.74 | 95.98 |
| $PVS_{Stockholm}$ | 88 | −5.21 | −4.5 | 12.97 | −46.67 | 26.67 |
| $PVS_{Total}$ | 88 | 1.96 | −2.08 | 20.52 | −22.77 | 83.09 |

**Table A.9:** 20% Winsorization, MB VW

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| $PVS_{Oslo}$ | 88 | 7.72 | 5.07 | 11.56 | −5.81 | 30.76 |
| $PVS_{Stockholm}$ | 88 | −5.36 | −4.50 | 7.44 | −17.77 | 4.92 |
| $PVS_{Total}$ | 88 | −1.15 | −2.08 | 9.15 | −14.74 | 14.70 |

## A.2 Descriptive Statistics of Other Variables

### Descriptive Statistics for Measures of Risk Perception

Tables A.10, A.11, and A.12 display descriptive statistics for the measures of risk utilized as descriptive variables in Section 5 of this thesis. The number of observations differs due to data availability as well as frequency.

**Table A.10:** Descriptive Statistics of Risk Perception Measures for Oslo

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Analyst Dispersion | 56 | −0.93 | −0.73 | 0.96 | −3.34 | 0.57 |
| Statistical Measure | 96 | 0.04 | 0.04 | 0.01 | 0.03 | 0.09 |
| Employment Outlook | 76 | 0.43 | 0.40 | 0.44 | −0.7 | 1.40 |
| Production Outlook | 76 | 0.52 | 0.60 | 0.44 | −0.60 | 1.40 |
| OECD BCI | 288 | 100.11 | 100.28 | 1.20 | 96.04 | 102.71 |
| EPU Index | 279 | 124.89 | 112.87 | 65.47 | 21.29 | 439.76 |

**Table A.11:** Descriptive Statistics of Risk Perception Measures for Stockholm

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Analyst Dispersion | 47 | −0.31 | −0.15 | 0.51 | −2.06 | 0.19 |
| Statistical Measure | 96 | 0.03 | 0.03 | 0.01 | 0.02 | 0.06 |
| Employment Outlook | 288 | 100.00 | 101.40 | 10.00 | 66.30 | 120.00 |
| Production Outlook | 288 | 100.00 | 101.35 | 10.00 | 63.90 | 121.30 |
| OECD BCI | 288 | 100.13 | 100.04 | 1.69 | 95.12 | 104.39 |
| EPU Index | 288 | 94.24 | 93.56 | 20.66 | 53.73 | 183.18 |

**Table A.12:** Descriptive Statistics of Risk Perception Measures for Merged Dataset

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Analyst Dispersion | 59 | −0.52 | −0.43 | 0.52 | −2.37 | 0.11 |
| Statistical Measure | 96 | 0.04 | 0.03 | 0.01 | 0.02 | 0.12 |
| Employment Outlook | 288 | 100.00 | 101.60 | 10.00 | 52.30 | 116.20 |
| Production Outlook | 288 | 100.00 | 100.20 | 10.00 | 58.30 | 118.70 |
| OECD BCI | 288 | 100.26 | 100.37 | 1.67 | 94.19 | 103.67 |
| EPU Index | 288 | 172.76 | 160.72 | 81.14 | 47.69 | 433.28 |

### Descriptive Statistics of the Real Rates

**Real Rate NO** is the one-year Norwegian treasury bill yield net of the one-year Survey of Professional Forecasters inflation forecast.

**Real Rate SE** is the one-year Swedish treasury bill yield net of the one-year Survey of Professional Forecasters inflation forecast.

**Table A.13:** Descriptive Statistics of the Different Real Rates Utilized in this Thesis

| Variable | N | Mean | Median | St. Dev. | Min | Max |
|---|---|---|---|---|---|---|
| Real Rate SPF | 77 | −0.81 | −1.44 | 1.36 | −2.42 | 2.52 |
| Real Rate NO | 35 | −0.37 | −0.56 | 0.63 | −1.22 | 1.52 |
| Real Rate SE | 24 | −1.55 | −1.87 | 0.80 | -2.34 | 0.60 |

In Appendix C.2, the estimated relationships between Real Rate NO, Real Rate SE, and PVS are displayed.

## A.3 VIF of Multivariate Regressions

**Table A.14:** VIF of regressions with multiple explanatory variables

| | PVS & Agg BM | | | | High - & Low Vol BM | | | |
|---|---|---|---|---|---|---|---|---|
| | BM EW | BM VW | MB EW | MB VW | BM EW | BM VW | MB EW | MB VW |
| Oslo | 1.006 | 1.011 | 1.005 | 1.017 | 1.073 | 1.157 | 1.020 | 1.005 |
| Stockholm | 1.077 | 1.277 | 1.009 | 1.027 | 1.085 | 1.021 | 1.354 | 1.005 |
| Merged dataset | 1.152 | 1.248 | 1.009 | 1.018 | 1.002 | 1.010 | 1.031 | 1.001 |

*Note:* The table displays the Variance Inflation Factor (VIF) between the regressors in the multivariate models. VIF = 1: No colinearity, VIF > 5: Severe colinearity

# B PVS on Risk Perception Measures Expansion

## B.1 Alternative PVS Constructions on Risk Perception Measures

Tables B.1, B.2, and B.3 present regressions of three different PVS constructions on measures of risk perception.

**Table B.1:** PVS on Different Measures of Perceived Risk, PVS is Constructed Using the BM VW Method

*$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$*

| Explanatory | Dependent Variable: $PVS_{\text{Oslo}}$ | | | | | | Dependent Variable: $PVS_{\text{Stockholm}}$ | | | | | | Dependent Variable: $PVS_{\text{Total}}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Analyst Dispersion | −0.347** | | | | | | 0.036 | | | | | | −0.039 | | | | | |
| | (0.136) | | | | | | (0.366) | | | | | | (0.166) | | | | | |
| Statistical Measure | | 0.081 | | | | | | 0.006 | | | | | | −0.003 | | | | |
| | | (0.086) | | | | | | (0.190) | | | | | | (0.103) | | | | |
| Employment Outlook | | | 0.244** | | | | | | 0.391 | | | | | | 0.435*** | | | |
| | | | (0.110) | | | | | | (0.276) | | | | | | (0.166) | | | |
| Production Outlook | | | | 0.127 | | | | | | 0.609** | | | | | | 0.606*** | | |
| | | | | (0.135) | | | | | | (0.247) | | | | | | (0.110) | | |
| OECD BCI | | | | | 0.263*** | | | | | | 0.473*** | | | | | | 0.566*** | |
| | | | | | (0.097) | | | | | | (0.177) | | | | | | (0.089) | |
| EPU Index | | | | | | 0.010 | | | | | | −0.032 | | | | | | −0.171 |
| | | | | | | (0.125) | | | | | | (0.110) | | | | | | (0.191) |
| Constant | −0.107 | 0.010 | 0.010 | 0.006 | −0.121 | −0.018 | 0.015 | 0.013 | −0.005 | −0.015 | −0.117 | −0.002 | −0.058 | 0.023 | 0.037 | 0.012 | −0.099 | 0.030 |
| | (0.202) | (0.207) | (0.218) | (0.183) | (0.234) | (0.203) | (0.695) | (0.258) | (0.209) | (0.238) | (0.534) | (0.321) | (0.328) | (0.221) | (0.163) | (0.172) | (0.300) | (0.217) |
| Observations | 56 | 88 | 76 | 76 | 88 | 85 | 47 | 88 | 88 | 88 | 88 | 88 | 59 | 88 | 88 | 88 | 88 | 88 |
| $R^2$ | 0.120 | 0.011 | 0.062 | 0.017 | 0.075 | 0.0001 | 0.001 | 0.00003 | 0.127 | 0.342 | 0.223 | 0.00003 | 0.002 | 0.030 | 0.167 | 0.323 | 0.325 | 0.00001 |
| Adjusted $R^2$ | 0.104 | −0.006 | 0.049 | 0.004 | 0.065 | −0.012 | −0.021 | −0.016 | 0.117 | 0.334 | 0.214 | −0.011 | −0.016 | 0.019 | 0.157 | 0.316 | 0.317 | −0.015 |
| Residual SE | 0.949 | 1.037 | 0.956 | 0.978 | 0.967 | 1.012 | 1.132 | 1.116 | 0.940 | 0.816 | 0.887 | 1.116 | 1.000 | 0.990 | 0.918 | 0.827 | 0.826 | 1.074 |
| F Statistic | 7.354*** | 0.665 | 4.894** | 1.271 | 7.001*** | 0.011 | 0.047 | 0.002 | 12.543*** | 44.607*** | 24.656*** | 0.002 | 0.090 | 2.699 | 17.261*** | 41.117*** | 41.465*** | 0.001 |

*Notes:* This table displays the result of regressions with PVS as the dependent variable, and measures of perceived risk as the explanatory variables. PVS is defined as the market-value-weighted book-to-market ratio of the highest volatility firms, subtracted from the market-value-weighted book-to-market ratio of the lowest volatility firms. Analyst Dispersion utilizes the range divided by the median of EPS forecasts for each firm. The Analyst Dispersion is defined as the difference between the median dispersion of high- and low-volatility firms. Statistical Measure utilizes the difference between average rolling standard deviations for high- and low-volatility firms. An AR(1) model is then fitted to this differential time series, and utilized to make a volatility prediction for $t+1$. The Statistical Measure is defined as this predicted time series. For Oslo, the Employment Outlook and Production Outlook are business indicators for Norway provided by *Regional Network*. For Stockholm and the merged dataset, Employment Outlook and Production Outlook are defined as the Employment Expectation Indicator and the Economic Sentiment Indicator for Sweden and the EU, respectively. The OECD BCI is the Business Confidence Index for Norway, Sweden, and the euro area. EPU Index is the Economic Policy Uncertainty Index for Norway, Sweden, and large European economies, respectively. Newey-West standard errors are in parentheses. Each column represents a single-variable regression for the indicated dependent variable.

**Table B.2:** PVS on Different Measures of Perceived Risk, PVS is Constructed Using the MB EW Method

*p<0.1; **p<0.05; ***p<0.01

| Explanatory | Dependent Variable: $PVS_{\text{Oslo}}$ | | | | | | Dependent Variable: $PVS_{\text{Stockholm}}$ | | | | | | Dependent Variable: $PVS_{\text{Total}}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Analyst Dispersion | 0.222 | | | | | | −0.147 | | | | | | −0.075 | | | | | |
| | (0.183) | | | | | | (0.138) | | | | | | (0.174) | | | | | |
| Statistical Measure | | −0.051 | | | | | | 0.564* | | | | | | −0.097 | | | | |
| | | (0.045) | | | | | | (0.300) | | | | | | (0.112) | | | | |
| Employment Outlook | | | 0.439*** | | | | | | 0.383* | | | | | | 0.172 | | | |
| | | | (0.078) | | | | | | (0.203) | | | | | | (0.130) | | | |
| Production Outlook | | | | 0.441*** | | | | | | 0.314*** | | | | | | 0.147 | | |
| | | | | (0.074) | | | | | | (0.101) | | | | | | (0.115) | | |
| OECD BCI | | | | | 0.370*** | | | | | | 0.454** | | | | | | 0.224** | |
| | | | | | (0.103) | | | | | | (0.224) | | | | | | (0.108) | |
| EPU Index | | | | | | −0.138 | | | | | | 0.140 | | | | | | 0.035 |
| | | | | | | (0.108) | | | | | | (0.097) | | | | | | (0.136) |
| Constant | −0.078 | 0.030 | 0.120 | 0.120 | 0.009 | 0.013 | 0.137 | 0.097 | 0.012 | −0.003 | −0.015 | 0.010 | 0.060 | 0.076 | 0.009 | 0.005 | 0.009 | −0.006 |
| | (0.123) | (0.151) | (0.119) | (0.124) | (0.132) | (0.178) | (0.297) | (0.191) | (0.148) | (0.144) | (0.113) | (0.163) | (0.167) | (0.181) | (0.153) | (0.155) | (0.146) | (0.149) |
| Observations | 56 | 88 | 76 | 76 | 88 | 85 | 47 | 88 | 88 | 88 | 88 | 88 | 59 | 88 | 88 | 88 | 88 | 88 |
| $R^2$ | 0.054 | 0.005 | 0.187 | 0.189 | 0.149 | 0.026 | 0.013 | 0.219 | 0.091 | 0.206 | 0.019 | 0.051 | 0.005 | 0.001 | 0.019 | 0.011 | 0.051 | 0.001 |
| Adjusted $R^2$ | 0.036 | −0.012 | 0.176 | 0.178 | 0.139 | 0.014 | −0.009 | 0.206 | 0.080 | 0.196 | 0.007 | 0.040 | −0.012 | −0.010 | 0.008 | −0.004 | 0.040 | −0.010 |
| Residual SE | 0.938 | 1.009 | 0.920 | 0.919 | 0.928 | 0.977 | 1.302 | 1.023 | 0.959 | 0.896 | 0.996 | 0.980 | 1.076 | 1.005 | 0.996 | 1.100 | 0.980 | 1.005 |
| F Statistic | 3.070* | 0.275 | 17.039*** | 17.234*** | 15.022*** | 2.179 | 0.591 | 17.072*** | 8.583*** | 22.268*** | 1.644 | 4.626** | 0.287 | 0.108 | 1.678 | 0.704 | 4.626** | 0.108 |

*Notes:* This table displays the result of regressions with PVS as the dependent variable, and measures of perceived risk as the explanatory variables. PVS is defined as the equal-weighted market-to-book ratio of the lowest volatility firms, subtracted from the equal-weighted market-to-book ratio of the highest volatility firms. Analyst Dispersion utilizes the range divided by the median of EPS forecasts for each firm. The Analyst Dispersion is defined as the difference between the median dispersion of high- and low-volatility firms. Statistical Measure utilizes the difference between average rolling standard deviations for high- and low-volatility firms. An AR(1) model is then fitted to this differential time series, and utilized to make a volatility prediction for $t + 1$. The Statistical Measure is defined as this predicted time series. For Oslo, the Employment Outlook and Production Outlook are business indicators for Norway provided by *Regional Network*. For Stockholm and the merged dataset, Employment Outlook and Production Outlook are defined as the Employment Expectation Indicator and the Economic Sentiment Indicator for Sweden and the EU, respectively. The OECD BCI is the Business Confidence Index for Norway, Sweden, and the euro area. EPU Index is the Economic Policy Uncertainty Index for Norway, Sweden, and large European economies, respectively. Newey-West standard errors are in parentheses. Each column represents a single-variable regression for the indicated dependent variable.

**Table B.3:** PVS on Different Measures of Perceived Risk, PVS is Constructed Using the MB VW Method

**p<0.1; **p<0.05; ***p<0.01*

| Explanatory | Dependent Variable: $PVS_{\text{Oslo}}$ | | | | | | Dependent Variable: $PVS_{\text{Stockholm}}$ | | | | | | Dependent Variable: $PVS_{\text{Total}}$ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Variables | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Analyst Dispersion | 0.232 | | | | | | −0.020 | | | | | | 0.099 | | | | | |
| | (0.149) | | | | | | (0.103) | | | | | | (0.146) | | | | | |
| Statistical Measure | | 0.034 | | | | | | 0.288 | | | | | | −0.137 | | | | |
| | | (0.058) | | | | | | (0.244) | | | | | | (0.112) | | | | |
| Employment Outlook | | | 0.292*** | | | | | | 0.350*** | | | | | | 0.165 | | | |
| | | | (0.107) | | | | | | (0.134) | | | | | | (0.114) | | | |
| Production Outlook | | | | 0.304*** | | | | | | 0.313*** | | | | | | 0.163 | | |
| | | | | (0.116) | | | | | | (0.111) | | | | | | (0.115) | | |
| OECD BCI | | | | | 0.321*** | | | | | | 0.385*** | | | | | | 0.251*** | |
| | | | | | (0.112) | | | | | | (0.115) | | | | | | (0.090) | |
| EPU Index | | | | | | −0.082 | | | | | | 0.176 | | | | | | −0.028 |
| | | | | | | (0.146) | | | | | | (0.181) | | | | | | (0.122) |
| Constant | 0.015 | 0.020 | 0.112 | 0.112 | 0.008 | −0.007 | 0.084 | 0.031 | 0.011 | −0.003 | −0.012 | 0.013 | 0.067 | 0.005 | 0.009 | 0.010 | 0.006 | 0.024 |
| | (0.120) | (0.130) | (0.130) | (0.129) | (0.128) | (0.167) | (0.234) | (0.192) | (0.125) | (0.127) | (0.113) | (0.151) | (0.177) | (0.140) | (0.144) | (0.141) | (0.135) | (0.169) |
| Observations | 56 | 88 | 76 | 76 | 88 | 85 | 47 | 88 | 88 | 88 | 88 | 88 | 59 | 88 | 88 | 88 | 88 | 88 |
| $R^2$ | 0.055 | 0.002 | 0.088 | 0.096 | 0.112 | 0.009 | 0.0003 | 0.069 | 0.102 | 0.090 | 0.148 | 0.030 | 0.009 | 0.001 | 0.024 | 0.023 | 0.064 | 0.021 |
| Adjusted $R^2$ | 0.038 | −0.014 | 0.076 | 0.083 | 0.102 | −0.003 | −0.022 | 0.054 | 0.091 | 0.080 | 0.138 | 0.018 | −0.008 | −0.011 | 0.013 | 0.012 | 0.053 | 0.006 |
| Residual SE | 0.969 | 0.947 | 0.946 | 0.942 | 0.948 | 0.985 | 1.159 | 1.013 | 0.953 | 0.959 | 0.928 | 0.991 | 1.060 | 1.005 | 0.994 | 0.994 | 0.973 | 1.087 |
| F Statistic | 3.144* | 0.136 | 7.145*** | 7.823*** | 10.861*** | 0.759 | 0.014 | 4.527** | 9.733*** | 8.535*** | 14.934*** | 2.625 | 0.512 | 0.070 | 2.122 | 2.059 | 5.880** | 1.422 |

*Notes:* This table displays the result of regressions with PVS as the dependent variable, and measures of perceived risk as the explanatory variables. PVS is defined as the market-value-weighted market-to-book ratio of the lowest volatility firms, subtracted from the market-value-weighted market-to-book ratio of the highest volatility firms. Analyst Dispersion utilizes the range divided by the median of EPS forecasts for each firm. The Analyst Dispersion is defined as the difference between the median dispersion of high- and low-volatility firms. Statistical Measure utilizes the difference between average rolling standard deviations for high- and low-volatility firms. An AR(1) model is then fitted to this differential time series, and utilized to make a volatility prediction for $t + 1$. The Statistical Measure is defined as this predicted time series. For Oslo, the Employment Outlook and Production Outlook are business indicators for Norway provided by *Regional Network*. For Stockholm and the merged dataset, Employment Outlook and Production Outlook are defined as the Employment Expectation Indicator and the Economic Sentiment Indicator for Sweden and the EU, respectively. The OECD BCI is the Business Confidence Index for Norway, Sweden, and the euro area. EPU Index is the Economic Policy Uncertainty Index for Norway, Sweden, and large European economies, respectively. Newey-West standard errors are in parentheses. Each column represents a single-variable regression for the indicated dependent variable.

## B.2 PVS on Volatility Indices

Tables B.4 through B.7 present regressions of PVS on the CBOE VIX and the VSTOXX (sourced from Yahoo Finance and STOXX). These indices capture a broad range of option-implied volatilities for stocks in the S&P 500 and the EURO STOXX 50, respectively.

**Table B.4:** PVS on Volatility Indices, PVS is Constructed with BM EW Method

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VIX | −0.123 | −0.315*** | −0.227 | | | |
| | (0.216) | (0.114) | (0.221) | | | |
| VSTOXX | | | | −0.311** | −0.199 | −0.350** |
| | | | | (0.150) | (0.243) | (0.167) |
| Constant | 0.002 | 0.076 | 0.035 | −0.000 | 0.000 | −0.000 |
| | (0.225) | (0.150) | (0.201) | (0.198) | (0.378) | (0.194) |
| Observations | 86 | 86 | 86 | 88 | 88 | 88 |
| $R^2$ | 0.015 | 0.130 | 0.053 | 0.097 | 0.040 | 0.122 |
| Adjusted $R^2$ | 0.003 | 0.120 | 0.042 | 0.086 | 0.029 | 0.112 |
| Residual Std. Error | 1.010 | 0.820 | 0.963 | 0.956 | 0.986 | 0.942 |
| F Statistic | 1.267 | 12.551*** | 4.735** | 9.216*** | 3.559* | 11.996*** |

*Note:* Newey-West standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table B.5:** PVS on Volatility Indices, PVS is Constructed with BM VW Method

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VIX | −0.268*** | −0.290* | −0.266* | | | |
| | (0.079) | (0.172) | (0.153) | | | |
| VSTOXX | | | | −0.350*** | −0.201 | −0.233 |
| | | | | (0.093) | (0.248) | (0.181) |
| Constant | 0.001 | 0.073 | 0.059 | −0.000 | −0.000 | −0.000 |
| | (0.187) | (0.157) | (0.170) | (0.161) | (0.306) | (0.265) |
| Observations | 86 | 86 | 86 | 88 | 88 | 88 |
| $R^2$ | 0.070 | 0.108 | 0.081 | 0.123 | 0.040 | 0.054 |
| Adjusted $R^2$ | 0.059 | 0.097 | 0.070 | 0.113 | 0.029 | 0.043 |
| Residual Std. Error | 0.981 | 0.839 | 0.898 | 0.942 | 0.985 | 0.952 |
| F Statistic | 6.362** | 10.152*** | 7.446*** | 12.042*** | 3.620* | 4.926** |

*Note:* Newey-West standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table B.6:** PVS on Volatility Indices, PVS is Constructed with MB EW Method

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VIX | −0.163* | −0.006 | −0.080 | | | |
| | (0.087) | (0.123) | (0.116) | | | |
| VSTOXX | | | | −0.206** | −0.064 | −0.089 |
| | | | | (0.083) | (0.127) | (0.125) |
| Constant | 0.012 | 0.026 | 0.018 | −0.000 | −0.000 | 0.000 |
| | (0.157) | (0.127) | (0.160) | (0.148) | (0.129) | (0.151) |
| Observations | 86 | 86 | 86 | 88 | 88 | 88 |
| $R^2$ | 0.026 | 0.00004 | 0.006 | 0.043 | 0.004 | 0.008 |
| Adjusted $R^2$ | 0.015 | −0.012 | −0.006 | 0.031 | −0.007 | −0.004 |
| Residual Std. Error | 1.001 | 0.999 | 1.006 | 0.984 | 1.004 | 1.002 |
| F Statistic | 2.253 | 0.003 | 0.535 | 3.821* | 0.356 | 0.691 |

*Note:* Newey-West standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table B.7:** PVS on Volatility Indices, PVS is Constructed with MB VW Method

| | *Dependent variable:* | | | | | |
|---|---|---|---|---|---|---|
| | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ | $PVS_{Oslo}$ | $PVS_{Stockholm}$ | $PVS_{Total}$ |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| VIX | −0.273** | −0.153 | −0.283*** | | | |
| | (0.117) | (0.095) | (0.077) | | | |
| VSTOXX | | | | −0.327*** | −0.119 | −0.228*** |
| | | | | (0.100) | (0.104) | (0.077) |
| Constant | 0.006 | 0.028 | 0.018 | 0.000 | −0.000 | −0.000 |
| | (0.143) | (0.124) | (0.139) | (0.133) | (0.132) | (0.141) |
| Observations | 86 | 86 | 86 | 88 | 88 | 88 |
| $R^2$ | 0.073 | 0.024 | 0.080 | 0.107 | 0.014 | 0.052 |
| Adjusted $R^2$ | 0.062 | 0.012 | 0.069 | 0.096 | 0.003 | 0.041 |
| Residual Std. Error | 0.976 | 0.988 | 0.968 | 0.951 | 0.999 | 0.979 |
| F Statistic | 6.638** | 2.046 | 7.267*** | 10.277*** | 1.225 | 4.705** |

*Note:* Newey-West standard errors in parentheses. *p<0.1; **p<0.05; ***p<0.01

# C Real Rates on all PVS constructions

## C.1 Real Rate SPF on Alternative Constructions

Tables C.1, C.2, and C.3 on the following three pages display regressions Real Rate SPF on three separate PVS constructions.

**Table C.1:** Real Rate SPF and PVS. PVS is Constructed Using the BM VW Method

*p<0.1; **p<0.05; ***p<0.01

| | *Dependent variable: Real Rate SPF* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate on Oslo Data** | | | **Real Rate on Stockholm Data** | | | **Real Rate on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | 0.184 | 0.169 | | 0.127 | 0.013 | | 0.174 | 0.097 | |
| | (0.281) | (0.283) | | (0.161) | (0.244) | | (0.261) | (0.236) | |
| Aggregate BM | | −0.128* | | | −0.268 | | | −0.169 | |
| | | (0.078) | | | (0.489) | | | (0.200) | |
| High Volatility BM | | | −0.243 | | | −0.290 | | | −0.317 |
| | | | (0.286) | | | (0.188) | | | (0.208) |
| Low Volatility BM | | | −0.078 | | | −0.444** | | | −0.448** |
| | | | (0.117) | | | (0.200) | | | (0.174) |
| Constant | −0.037 | −0.038 | −0.052 | −0.028 | −0.039 | −0.032 | −0.026 | −0.031 | −0.046 |
| | (0.447) | (0.455) | (0.458) | (0.478) | (0.435) | (0.288) | (0.509) | (0.482) | (0.279) |
| Observations | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| $R^2$ | 0.028 | 0.044 | 0.041 | 0.016 | 0.061 | 0.191 | 0.028 | 0.051 | 0.213 |
| Adjusted $R^2$ | 0.015 | 0.019 | 0.015 | 0.003 | 0.036 | 0.169 | 0.015 | 0.025 | 0.192 |
| Residual Std. Error | 1.061 | 1.059 | 1.061 | 1.067 | 1.049 | 0.974 | 1.061 | 1.055 | 0.961 |
| F Statistic | 2.174 | 1.717 | 1.583 | 1.193 | 2.421* | 8.742*** | 2.185 | 1.969 | 10.032*** |

*Notes:* Columns 1-3 utilize PVS- and book-to-market data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and book-to-market data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and book-to-market data from the merged dataset (e.g. $PVS_{Total}$). The real rate, derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield, is the dependent variable in all regressions. Newey-West standard errors in parenthesis.

**Table C.2:** Real Rate SPF and PVS. PVS is Constructed Using the MB EW Method

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

| | *Dependent variable: Real Rate SPF* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate on Oslo Data** | | | **Real Rate on Stockholm Data** | | | **Real Rate on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | 0.256 | 0.268 | | −0.219 | $-0.244^{**}$ | | −0.018 | −0.039 | |
| | (0.201) | (0.200) | | (0.140) | (0.107) | | (0.212) | (0.198) | |
| Aggregate MB | | $-0.163^{*}$ | | | −0.299 | | | −0.215 | |
| | | (0.094) | | | (0.310) | | | (0.220) | |
| High Volatility MB | | | 0.274 | | | −0.122 | | | 0.002 |
| | | | (0.225) | | | (0.169) | | | (0.218) |
| Low Volatility MB | | | −0.015 | | | $-0.156^{**}$ | | | 0.015 |
| | | | (0.101) | | | (0.075) | | | (0.225) |
| Constant | −0.058 | −0.061 | −0.061 | −0.024 | −0.032 | −0.020 | −0.030 | −0.032 | −0.032 |
| | (0.346) | (0.339) | (0.325) | (0.390) | (0.314) | (0.408) | (0.471) | (0.444) | (0.465) |
| Observations | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| $R^2$ | 0.059 | 0.085 | 0.066 | 0.046 | 0.118 | 0.055 | 0.0003 | 0.045 | 0.0002 |
| Adjusted $R^2$ | 0.047 | 0.061 | 0.041 | 0.033 | 0.094 | 0.030 | −0.013 | 0.019 | −0.027 |
| Residual Std. Error | 1.044 | 1.036 | 1.047 | 1.051 | 1.017 | 1.053 | 1.076 | 1.059 | 1.083 |
| F Statistic | $4.717^{**}$ | $3.458^{**}$ | $2.635^{*}$ | $3.603^{*}$ | $4.953^{***}$ | 2.165 | 0.022 | 1.735 | 0.008 |

*Notes:* Columns 1-3 utilize PVS- and market-to-book data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and market-to-book data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and market-to-book data from the merged dataset (e.g. $PVS_{Total}$). The real rate derived, from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield, is the dependent variable in all regressions. Newey-West standard errors in parenthesis.

**Table C.3:** Real Rate SPF and PVS. PVS is Constructed Using the MB VW Method

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

| | *Dependent variable: Real Rate SPF* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate on Oslo Data** | | | **Real Rate on Stockholm Data** | | | **Real Rate on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | 0.093 | 0.074 | | −0.241 | −0.289 | | −0.225 | −0.258 | |
| | (0.137) | (0.134) | | (0.171) | (0.209) | | (0.165) | (0.170) | |
| Aggregate MB | | −0.135 | | | −0.325 | | | −0.245 | |
| | | (0.100) | | | (0.329) | | | (0.198) | |
| High Volatility MB | | | 0.067 | | | −0.186 | | | −0.181 |
| | | | (0.087) | | | (0.202) | | | (0.163) |
| Low Volatility MB | | | −0.369*** | | | 0.033 | | | 0.023 |
| | | | (0.140) | | | (0.144) | | | (0.163) |
| Constant | −0.040 | −0.040 | −0.046 | −0.021 | −0.028 | −0.024 | −0.014 | −0.014 | −0.016 |
| | (0.460) | (0.462) | (0.324) | (0.364) | (0.325) | (0.406) | (0.361) | (0.343) | (0.397) |
| Observations | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 | 77 |
| $R^2$ | 0.007 | 0.025 | 0.104 | 0.055 | 0.139 | 0.033 | 0.047 | 0.104 | 0.030 |
| Adjusted $R^2$ | −0.006 | −0.001 | 0.080 | 0.042 | 0.115 | 0.007 | 0.034 | 0.080 | 0.004 |
| Residual Std. Error | 1.072 | 1.069 | 1.025 | 1.046 | 1.005 | 1.065 | 1.050 | 1.025 | 1.067 |
| F Statistic | 0.558 | 0.963 | 4.283** | 4.362** | 5.957*** | 1.271 | 3.679* | 4.294** | 1.158 |

*Notes:* Columns 1-3 utilize PVS- and market-to-book data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and market-to-book data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and market-to-book data from the merged dataset (e.g. $PVS_{Total}$). The real rate, derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield, is the dependent variable in all regressions. Newey-West standard errors in parenthesis.

## C.2 Local Real Rates on PVS

Tables C.4, C.5, C.6, and C.7 on the following four pages display regressions of the local real rates on all four PVS constructions considered in this thesis.

**Table C.4:** Local Real Rates and PVS. PVS is Constructed Using the BM EW Method

*p<0.1; **p<0.05; ***p<0.01

| | *Dependent variable: Local Real Rate* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate NO on Oslo Data** | | | **Real Rate SE on Stockholm Data** | | | **Real Rate SPF on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | −0.212 | −0.234*** | | −0.352*** | −0.345*** | | 0.051 | −0.037 | |
| | (0.137) | (0.083) | | (0.059) | (0.078) | | (0.360) | (0.359) | |
| Aggregate BM | | −4.659 | | | 0.174 | | | −0.224 | |
| | | (3.121) | | | (0.286) | | | (0.205) | |
| High Volatility BM | | | −0.007 | | | 0.378*** | | | −0.274 |
| | | | (0.186) | | | (0.054) | | | (0.305) |
| Low Volatility BM | | | −0.308 | | | −0.053 | | | −0.449** |
| | | | (0.198) | | | (0.104) | | | (0.204) |
| Constant | −0.271 | −0.981*** | −0.229 | −1.549*** | −1.538*** | −1.566*** | −0.034 | −0.032 | −0.038 |
| | (0.362) | (0.310) | (0.280) | (0.248) | (0.278) | (0.303) | (0.452) | (0.446) | (0.300) |
| Observations | 35 | 35 | 35 | 24 | 24 | 24 | 77 | 77 | 77 |
| $R^2$ | 0.108 | 0.324 | 0.178 | 0.308 | 0.327 | 0.315 | 0.002 | 0.044 | 0.253 |
| Adjusted $R^2$ | 0.081 | 0.282 | 0.126 | 0.276 | 0.263 | 0.249 | −0.011 | 0.019 | 0.233 |
| Residual Std. Error | 0.602 | 0.532 | 0.587 | 0.681 | 0.687 | 0.694 | 1.075 | 1.059 | 0.936 |
| F Statistic | 3.993* | 7.675*** | 3.461** | 9.786*** | 5.106** | 4.821** | 0.163 | 1.720 | 12.536*** |

*Notes:* Columns 1-3 utilize PVS- and book-to-market data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and book-to-market data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and book-to-market data from the merged dataset (e.g. $PVS_{Total}$). The real rates for Oslo and Stockholm are derived from the Survey of Professional Forecasters inflation forecast and the 1-year bond-yields from the Norwegian and Swedish treasuries. The real rate for the merged dataset is derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield. Newey-West standard errors in parenthesis.

**Table C.5:** Local Real Rates and PVS. PVS is Constructed using the BM VW Method

$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$

| | *Dependent variable: Local Real Rate* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate NO on Oslo Data** | | | **Real Rate SE on Stockholm Data** | | | **Real Rate SPF on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | 0.249 | −0.091 | | −0.492*** | −0.484*** | | 0.174 | 0.097 | |
| | (0.438) | (0.263) | | (0.090) | (0.096) | | (0.261) | (0.236) | |
| Aggregate BM | | −4.805 | | | 0.048 | | | −0.169 | |
| | | (3.748) | | | (0.328) | | | (0.200) | |
| High Volatility BM | | | −0.074 | | | 0.392*** | | | −0.317 |
| | | | (0.274) | | | (0.087) | | | (0.208) |
| Low Volatility BM | | | 0.147 | | | −0.431*** | | | −0.448** |
| | | | (0.153) | | | (0.116) | | | (0.174) |
| Constant | −0.456** | −1.086** | −0.422** | −1.421*** | −1.420*** | −1.343*** | −0.026 | −0.031 | −0.046 |
| | (0.200) | (0.488) | (0.193) | (0.249) | (0.298) | (0.248) | (0.509) | (0.482) | (0.279) |
| Observations | 35 | 35 | 35 | 24 | 24 | 24 | 77 | 77 | 77 |
| $R^2$ | 0.039 | 0.198 | 0.050 | 0.345 | 0.346 | 0.382 | 0.028 | 0.051 | 0.213 |
| Adjusted $R^2$ | 0.010 | 0.147 | −0.009 | 0.315 | 0.284 | 0.324 | 0.015 | 0.025 | 0.192 |
| Residual Std. Error | 0.625 | 0.580 | 0.631 | 0.663 | 0.677 | 0.659 | 1.061 | 1.055 | 0.961 |
| F Statistic | 1.335 | 3.939** | 0.846 | 11.586*** | 5.564** | 6.499*** | 2.185 | 1.969 | 10.032*** |

*Notes:* Columns 1-3 utilize PVS- and book-to-market data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and book-to-market data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and book-to-market data from the merged dataset (e.g. $PVS_{Total}$). The real rates for Oslo and Stockholm are derived from the Survey of Professional Forecasters inflation forecast and the 1-year bond-yields from the Norwegian and Swedish treasuries. The real rate for the merged dataset is derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield. Newey-West standard errors in parenthesis.

**Table C.6:** Local Real Rates and PVS. PVS is Constructed Using the MB EW Method

*p<0.1; **p<0.05; ***p<0.01

| | *Dependent variable: Local Real Rate* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate NO on Oslo Data** | | | **Real Rate SE on Stockholm Data** | | | **Real Rate SPF on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | −0.010 | −0.073 | | 0.049 | 0.041 | | −0.018 | −0.039 | |
| | (0.086) | (0.131) | | (0.108) | (0.106) | | (0.212) | (0.198) | |
| Aggregate MB | | −4.578 | | | 0.218 | | | −0.215 | |
| | | (3.738) | | | (0.360) | | | (0.220) | |
| High Volatility MB | | | 0.048 | | | 0.111 | | | 0.002 |
| | | | (0.106) | | | (0.100) | | | (0.218) |
| Low Volatility MB | | | 0.123** | | | 0.010 | | | 0.015 |
| | | | (0.057) | | | (0.060) | | | (0.225) |
| Constant | −0.376 | −1.100** | −0.351 | −1.576*** | −1.558*** | −1.619*** | −0.030 | −0.032 | −0.032 |
| | (0.281) | (0.526) | (0.215) | (0.504) | (0.479) | (0.407) | (0.471) | (0.444) | (0.465) |
| Observations | 35 | 35 | 35 | 24 | 24 | 24 | 77 | 77 | 77 |
| $R^2$ | 0.0002 | 0.203 | 0.044 | 0.010 | 0.040 | 0.051 | 0.0003 | 0.045 | 0.0002 |
| Adjusted $R^2$ | −0.030 | 0.153 | −0.016 | −0.035 | −0.051 | −0.039 | −0.013 | 0.019 | −0.027 |
| Residual Std. Error | 0.638 | 0.578 | 0.633 | 0.814 | 0.821 | 0.816 | 1.076 | 1.059 | 1.083 |
| F Statistic | 0.006 | 4.076** | 0.729 | 0.232 | 0.441 | 0.568 | 0.022 | 1.735 | 0.008 |

*Notes:* Columns 1-3 utilize PVS- and market-to-book data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and market-to-book data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and market-to-book data from the merged dataset (e.g. $PVS_{Total}$). The real rates for Oslo and Stockholm are derived from the Survey of Professional Forecasters inflation forecast and the 1-year bond-yields from the Norwegian and Swedish treasuries. The real rate for the merged dataset is derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield. Newey-West standard errors in parenthesis.

**Table C.7:** Local Real Rates and PVS. PVS is Constructed Using the MB VW Method

*p<0.1; **p<0.05; ***p<0.01

| | *Dependent variable: Local Real Rate* | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **Real Rate NO on Oslo Data** | | | **Real Rate SE on Stockholm Data** | | | **Real Rate SPF on Merged Data** | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| PVS | 0.204*** | 0.161** | | 0.183** | 0.192*** | | −0.225 | −0.258 | |
| | (0.060) | (0.070) | | (0.075) | (0.050) | | (0.165) | (0.170) | |
| Aggregate MB | | −4.119 | | | 0.265 | | | −0.245 | |
| | | (3.173) | | | (0.461) | | | (0.198) | |
| High Volatility MB | | | 0.204*** | | | 0.175** | | | −0.181 |
| | | | (0.068) | | | (0.079) | | | (0.163) |
| Low Volatility MB | | | −0.091 | | | 0.408 | | | 0.023 |
| | | | (0.161) | | | (0.506) | | | (0.163) |
| Constant | −0.359* | −0.999*** | −0.361* | −1.624*** | −1.611*** | −1.761*** | −0.014 | −0.014 | −0.016 |
| | (0.227) | (0.373) | (0.209) | (0.450) | (0.510) | (0.247) | (0.361) | (0.343) | (0.397) |
| Observations | 35 | 35 | 35 | 24 | 24 | 24 | 77 | 77 | 77 |
| $R^2$ | 0.070 | 0.237 | 0.082 | 0.115 | 0.160 | 0.327 | 0.047 | 0.104 | 0.030 |
| Adjusted $R^2$ | 0.042 | 0.189 | 0.025 | 0.075 | 0.080 | 0.263 | 0.034 | 0.080 | 0.004 |
| Residual Std. Error | 0.615 | 0.566 | 0.620 | 0.770 | 0.768 | 0.687 | 1.050 | 1.025 | 1.067 |
| F Statistic | 2.477 | 4.959** | 1.433 | 2.866 | 1.997 | 5.113** | 3.679* | 4.294** | 1.158 |

*Notes:* Columns 1-3 utilize PVS- and market-to-book data from Oslo (e.g. $PVS_{Oslo}$). Columns 4-6 utilize PVS- and market-to-book data from Stockholm (e.g. $PVS_{Stockholm}$). Columns 7-9 utilize PVS- and market-to-book data from the merged dataset (e.g. $PVS_{Total}$). The real rates for Oslo and Stockholm are derived from the Survey of Professional Forecasters inflation forecast and the 1-year bond-yields from the Norwegian and Swedish treasuries. The real rate for the merged dataset is derived from the Survey of Professional Forecasters inflation forecast and the 1-year ECB bond-yield. Newey-West standard errors in parenthesis.

# D Portfolio Return Predictability Expansion

## D.1 Portfolio Return on PVS

### 2-Year Horizon

**Table D.1:** 2-Year Returns of Low Minus High Volatility Portfolios on PVS - Part 1

| | *Dependent variable: Yearly Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | BM EW | | | BM VW | | |
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| $PVS_{Oslo}$ | 0.634 | | | 3.449* | | |
| | (2.576) | | | (1.795) | | |
| $PVS_{Stockholm}$ | | 3.041* | | | 0.395 | |
| | | (1.744) | | | (1.335) | |
| $PVS_{Total}$ | | | −0.320 | | | 0.573 |
| | | | (2.543) | | | (1.429) |
| Constant | −8.840*** | −7.625*** | −6.423*** | −8.665*** | −7.307** | −6.483*** |
| | (3.412) | (2.812) | (2.311) | (3.308) | (3.183) | (2.395) |
| Observations | 80 | 80 | 80 | 80 | 80 | 80 |
| $R^2$ | 0.002 | 0.059 | 0.001 | 0.051 | 0.001 | 0.003 |
| Adjusted $R^2$ | −0.011 | 0.047 | −0.012 | 0.039 | −0.012 | −0.010 |
| Residual Std. Error | 15.684 | 10.144 | 10.165 | 15.290 | 10.451 | 10.156 |
| F Statistic | 0.141 | 4.879** | 0.079 | 4.221** | 0.083 | 0.217 |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table D.2:** 2-Year Returns of Low Minus High Volatility Portfolios on PVS - Part 2

| | *Dependent variable: Yearly Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | MB EW | | | MB VW | | |
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| $PVS_{Oslo}$ | 4.265* | | | 0.353 | | |
| | (2.468) | | | (2.136) | | |
| $PVS_{Stockholm}$ | | 3.684* | | | 3.927** | |
| | | (2.000) | | | (1.592) | |
| $PVS_{Total}$ | | | 0.524 | | | 2.561 |
| | | | (1.293) | | | (1.832) |
| Constant | −8.950*** | −6.850** | −6.399*** | −8.842*** | −6.996*** | −6.324*** |
| | (3.092) | (3.170) | (2.320) | (3.376) | (2.444) | (2.158) |
| Observations | 80 | 80 | 80 | 80 | 80 | 80 |
| $R^2$ | 0.076 | 0.033 | 0.002 | 0.001 | 0.087 | 0.052 |
| Adjusted $R^2$ | 0.064 | 0.021 | −0.011 | −0.012 | 0.076 | 0.040 |
| Residual Std. Error | 15.090 | 10.280 | 10.159 | 15.694 | 9.990 | 9.902 |
| F Statistic | 6.407** | 2.702 | 0.172 | 0.041 | 7.453*** | 4.275** |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

### 6-Month Horizon

**Table D.3:** 6-Month Returns of Low Minus High Volatility Portfolios on PVS - Part 1

| | *Dependent variable: Yearly Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | BM EW | | | BM VW | | |
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| $PVS_{Oslo}$ | 4.452 | | | 10.628** | | |
| | (5.648) | | | (4.498) | | |
| $PVS_{Stockholm}$ | | 9.088* | | | 3.332 | |
| | | (5.006) | | | (3.068) | |
| $PVS_{Total}$ | | | 3.418 | | | 4.086* |
| | | | (5.022) | | | (2.148) |
| Constant | −11.218** | −9.582** | −8.184* | −11.214** | −9.130* | −8.306* |
| | (4.690) | (4.600) | (4.302) | (4.562) | (4.904) | (4.332) |
| Observations | 86 | 86 | 86 | 86 | 86 | 86 |
| $R^2$ | 0.016 | 0.097 | 0.019 | 0.090 | 0.013 | 0.024 |
| Adjusted $R^2$ | 0.004 | 0.086 | 0.007 | 0.079 | 0.002 | 0.012 |
| Residual Std. Error | 35.828 | 24.374 | 24.440 | 34.454 | 25.480 | 24.374 |
| F Statistic | 1.343 | 9.034*** | 1.610 | 8.278*** | 1.134 | 2.074 |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table D.4:** 6-Month Returns of Low Minus High Volatility Portfolios on PVS - Part 2

| | *Dependent variable: Yearly Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | MB EW | | | MB VW | | |
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| $PVS_{Oslo}$ | 2.364 | | | 2.240 | | |
| | (4.168) | | | (4.376) | | |
| $PVS_{Stockholm}$ | | 2.734 | | | 2.994 | |
| | | (1.698) | | | (2.870) | |
| $PVS_{Total}$ | | | 0.822 | | | 2.948 |
| | | | (2.832) | | | (2.562) |
| Constant | −11.248** | −8.930* | −8.080* | −11.220** | −8.952** | −8.116** |
| | (4.846) | (4.744) | (4.308) | (4.804) | (4.500) | (4.018) |
| Observations | 86 | 86 | 86 | 86 | 86 | 86 |
| $R^2$ | 0.004 | 0.012 | 0.001 | 0.004 | 0.014 | 0.015 |
| Adjusted $R^2$ | −0.007 | −0.0001 | −0.011 | −0.008 | 0.002 | 0.003 |
| Residual Std. Error | 36.034 | 25.500 | 24.658 | 36.042 | 25.472 | 24.492 |
| F Statistic | 0.370 | 0.990 | 0.095 | 0.333 | 1.178 | 1.240 |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

## D.2 Portfolio Return on the Real Rate

### Real Rate SPF

**Table D.5:** Yearly Returns of Low Minus High Volatility Portfolios on Real Rate SPF

| | *Dependent variable: Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | h = 6 Months | | | h = 2 Years | | |
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| Real Rate SPF | −2.616* | −1.608 | −1.280 | 2.832 | −2.381 | −0.881 |
| | (1.548) | (3.124) | (1.628) | (3.360) | (1.822) | (1.273) |
| Constant | −7.644** | −7.126* | −4.974 | −6.702** | −6.023* | −4.568* |
| | (3.766) | (4.276) | (3.210) | (3.167) | (3.276) | (2.705) |
| Observations | 75 | 75 | 75 | 69 | 69 | 69 |
| $R^2$ | 0.007 | 0.007 | 0.004 | 0.038 | 0.059 | 0.010 |
| Adjusted $R^2$ | −0.007 | −0.007 | −0.009 | 0.024 | 0.045 | −0.005 |
| Residual Std. Error | 33.506 | 21.032 | 20.742 | 14.934 | 10.001 | 9.422 |
| F Statistic | 0.510 | 0.489 | 0.319 | 2.673 | 4.213** | 0.649 |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

## Local Real Rates

**Table D.6:** Yearly Returns of Low Minus High Volatility Portfolio on Local Real Rates

| | *Dependent variable: Yearly Portfolio Return* | | |
|---|---|---|---|
| | $Return_{Oslo}$ | $Return_{Stockholm}$ | $Return_{Total}$ |
| | (1) | (2) | (3) |
| Real Rate NO | 3.277 | | |
| | (5.468) | | |
| Real Rate SE | | 9.197 | |
| | | (7.466) | |
| Real Rate SPF | | | −1.481 |
| | | | (1.023) |
| Constant | −6.536 | 14.915 | −4.548 |
| | (4.865) | (15.195) | (2.786) |
| Observations | 31 | 22 | 73 |
| $R^2$ | 0.009 | 0.204 | 0.012 |
| Adjusted $R^2$ | −0.025 | 0.164 | −0.002 |
| Residual Std. Error | 21.620 (df = 29) | 13.535 (df = 20) | 14.823 (df = 71) |
| F Statistic | 0.262 (df = 1; 29) | 5.113** (df = 1; 20) | 0.833 (df = 1; 71) |

*Notes:* Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01

**Table D.7:** Returns of Low Minus High Volatility Portfolio on Local Real Rates

| | *Dependent variable: Portfolio Return* | | | | | |
|---|---|---|---|---|---|---|
| | h = 6 Months | | | h = 2 Years | | |
| | Oslo | Stockholm | Total | Oslo | Stockholm | Total |
| Real Rate NO | 8.210 | | | −21.938 | | |
| | (7.110) | | | (14.173) | | |
| Real Rate SE | | 5.512 | | | 18.754*** | |
| | | (5.042) | | | (4.778) | |
| Real Rate SPF | | | −1.280 | | | −0.881 |
| | | | (1.628) | | | (1.273) |
| Constant | −2.820 | 7.636 | −4.974 | −23.548*** | 30.091*** | −4.568* |
| | (5.146) | (9.396) | (3.210) | (8.338) | (11.101) | (2.705) |
| Observations | 33 | 23 | 75 | 27 | 18 | 69 |
| $R^2$ | 0.018 | 0.046 | 0.004 | 0.154 | 0.268 | 0.010 |
| Adjusted $R^2$ | −0.014 | 0.001 | −0.009 | 0.120 | 0.223 | −0.005 |
| Residual Std. Error | 39.212 | 20.512 | 20.742 | 13.880 | 10.237 | 9.422 |
| F Statistic | 0.559 | 1.015 | 0.319 | 2.268** | 2.934** | 0.649 |

*Note:* Yearly terms. Newey-West standard errors are in parentheses. *p<0.1; **p<0.05; ***p<0.01