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# FIRM CHARACTERISTICS AND STOCK MARKETS' ASYMMETRIC REACTIONS TO MONETARY POLICY SURPRISES

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## ABSTRACT

The purpose of this study is to find out whether the surprises related to the European Central Bank's decisions about the level of the key interest rate causes asymmetric reactions among characteristic-classified stock portfolios. Hypotheses propose that the stock returns of small, indebted and unprofitable firms are unequal to the returns of inverse firms. Positive and negative surprises are investigated also separately taking possible nonlinearity into account which exposes whether monetary policy actions have circumstantial effects on stock prices. The evidence implicates the importance of credit channels in transmission mechanism.

The sample data during 1999–2010 consists of the daily returns of stock portfolios constructed from the EURO STOXX index, the ECB's monthly decisions about the level of the key interest rate, daily values of Euribor and Euribor swap rates for one week and one month maturity and overnight Eonia rate. The different market rates are used to measure the magnitude of surprise and to explain portfolio returns in regression analysis. Seemingly unrelated regression estimation and the Wald test are applied to find hypothetical difference in firm-level.

The results imply, as opposed to prior studies, that the firm size is not important factor in this context in the euro area whereas financial standing and profitability are more remarkable. Small firms seem to gain relatively more from monetary policy than large firms and thus show reverse evidence against former understanding. The most indebted firms react to surprises but self-financing firms are immune to them. Profitability-portfolios behave similarly with portfolios related to financial standing but more often average-profitable portfolios are statistically significant than the far portfolios. In general, stocks seem to be more sensible to negative surprises than positive ones. Only trivial signs of nonlinearity are observed.

The ECB's monetary policy decisions are forecasted quite faithfully in stock markets. Still, the sense of credit channel is noticeable in the euro area. The results indicate also problems to find indicator which measure validly and reliably monetary policy surprises.

**KEYWORDS**: Monetary policy surprises, firm characteristics, stock price reactions

## 1. INRODUCTION

According to widely received theory and evidence, central banks' monetary policy affect to economy aggregates through certain transmissions or channels. That complex construction is commonly called within economy watchers as a transmission mechanism. Stock prices are exposed to monetary policy effects in the transmission mechanism through channels both immediate and indirect. Valuation theories based on the fundamental facts of firm imply that stock price is comprised mainly of discounted future cash flows. Seeing that monetary policy indicates central bank's opinions about upcoming economic trends in future, it has immediate influence to stock prices. Intuitively reviewed, the shares of those economic trends can be direct to isolated firms which are reflected in their stock prices. That is proved also empirically by Bernanke and Kuttner (2005), whose result is that the influence is mainly a consequence of changes in expected cash flows and dividends, while changes in expected interest rates, which define the discount rates, are inconclusive. The indirect influences which can be specified through channels are for example firm's changed borrowing limitations or changes in investors' allocation preferences.

The role of common stocks in the transmission mechanism has kept track in academic discussion over decades. Studies related on the implications of monetary policy have likely been done most of all in the district of interest rate markets. In case of stock markets, absolute price changes and volatility alike have been under examination. The subject matter has been approached in addition to settle causality interrelationships, also to challenge the efficient market hypothesis in this respect. Over the last years, important contributions have been taken up: business cycles, the globalization of financial markets and behavioral finance.

The knowledge of this causality is relevant information for many market participants. The recognition of the relationship between monetary policy and stock prices is especially important for decision-makers of monetary policy. The European Central Bank's (ECB) expressed main object is price stability. According to the ECB, the definition of price stability is to hold inflation rates below, but close to, 2 % over the medium term (ECB 2004). Stock market development is used in monetary policy decision-making process because it indicates the development of real economy and the uncertainty of future expectations (ECB 2010a). Central banks' price stability-target gives benefits also to the stock markets. According to Bernanke and Gertler (1999) and Cassola and

Morana (2004), keeping up the price stability is working aid in long term when aspired to avoid stock market volatility in advance.

Secondly, consciousness of the causality is relevant information for both stock holders and active traders. Some investors may see monetary policy to be so trivial or exogenous that it does not affect to their trading decisions. However, Conover, Jensen and Johnson (1999a; 1999b) show that it could be useful to abuse different status quos of countries' monetary economies when doing allocation decisions of internationally diversified stock portfolio. Konrad (2009: 112) argue that monetary developments can be useful when estimating future asset prices and volatility. More precisely, the varying response of several asset classes may be essential for investors' asset allocation. According to many prior studies, the intensity-level of how monetary policy affects to stock price depends much on the firm characteristics underlying the stock. That may be significance in investors' trading decisions. Finally, it may find out that research done in this subject matter has partly evolved the efficiency of financial markets.

Although the subject matter is widely investigated, studies have strongly focused to the U.S regardless of time. The largest part of studies has been executed from the outset in the U.S. stock market and by force of the Federal Reserve's (FED) monetary policy. Even if the economies of China and other developing countries grows extraordinarily compared to developed countries, the U.S. economy is still for the present the world's largest and followed and the combined value of its stock exchanges is over 40 % of the world's all stock exchanges' value (World Federation of Stock Echanges 2010: 102). In addition, economic changes in the U.S. are strongly reflected in all other economies at a considerable rate. These reasons make very followed and a big deal about the U.S. economy, especially in financial markets all over the world.

When approaching this subject, some noticed facts have to be taken into consideration. Firstly, it has been found that the FED's monetary policy affects also in the euro area to some extent. (see Ehrmann & Fratzscher 2003) Secondly, the monetary policies of the FED and the ECB (or any other developed countries) are correlated, mainly because the world economy and its pursuits are more and more integrated and globalized. For example, Conover et al.'s (1999a) finding is that the stock markets of many countries are more strongly related to the FED's monetary policy than to local monetary policy. The research included, on top of the U.S., 15 other OECD countries. Significantly higher returns were found in these countries during the FED carried out expansive monetary policy. Ehrmann and Fratzscher's (2009) similar investigation support prior cross-

country findings. Even 30–35% of the variations in global equity markets on the particular days can be explained by monetary shocks incurred by the FED. Ehrmann and Fratzscher (2003) find as well that the money markets of the U.S. and the Europe have converged, become interdependent and more integrated during 1993–2002, though the FED's monetary policy was anyway the determinant. There are three explanatory factors for discrepancy between local stock markets' sensitivity to the FED's actions: firstly and primarily, integration into the international financial markets, secondly integration of real economy into the U.S. economy and thirdly the flexibility of exchange rates (Wongswan 2009: 360).

### 1.1. The purpose of the thesis

This thesis is focused on the causality between the ECB's monetary policy and the European stock markets. To be exact, the main purpose is to find out whether there occur asymmetric price responses among sample stocks to the Governing Council's decisions and announcements about the level of key interest rates. Certain characteristics of a firm are suggested to have an influence to conceivable price behavior. The approach is to measure whether sample stock portfolios are susceptible to the monetary policy surprises. To define surprise component, the financial markets' expectations deviation from the realized change is calculated. In addition, the aim is to argue why certain stocks may behave in certain ways.

Second purpose is to investigate what role plays positive and negative surprise components separately taking possible nonlinearity into account. Enclosed to the main purpose, evidence may expose whether monetary policy actions have asymmetric circumstantial effects on stock prices.

Based on many previous studies related to the causality under discussion, the bases for the hypotheses development can be specified. Firstly, the stock returns of small, financial constrained or unprofitable firms (compared to firms with inverse characteristics) are expected to be in inferior position when changes in the key ECB interest rate take place. Secondly, the recent evidence is ambiguous whether stocks are more responsive to positive or negative monetary surprises.

Considering that the relationship is much investigated in the last decade, as mentioned in the introduction, it has to confront the necessity of the existence of this study. The

other fact mentioned in the introduction, that the most of studies has been done through the U.S. markets allows eligibility to examine whether the findings are in effect also in the euro area. Blinder, Ehrmann, Fratzscher, Haan and Jansen (2008) find that the desired direction of monetary policy announcements on markets are too little investigated and ensure robustness is required. In addition, they hold the view that the effects have been investigated in too few countries for too short time periods.

The last contribution is to add the profitability of a firm to the study. As far as is known, the conceivable difference of the stock's response depending on firm's profitability has not been gone through in open academic discussion. This factor is tested in many studies implicitly but not distinctly. The thesis introduces also the comparison between the relative importances of various firm characteristics.

*Note on explanatory power in the context*

The ECB's monetary policy announcements are always well-anticipated and surprise component is typically small which leads to situation where suitable models have low explanatory power. Therefore, the aim is not to maximize information or provide quantitative interpretations from empirical results but investigate the existence of proposed stock asymmetries in general.

## 1.2. Research hypotheses

When approaching the subject empirically, four hypotheses are identified. These hypotheses are constructed on the grounds of the theoretical frameworks and the empirical results of prior studies. In compliance with prior results, the hypotheses ought to receive confirmation. The hypotheses of this study and reasons for them have been listed in the following item. The summary of prior studies connected to hypotheses 1, 2 and 3 is presented in table 1 and table 3 summarizes studies connected to hypothesis 4.

$H_1$: The extent of stock's response to monetary policy surprise depends on firm size.

This hypothesis is a mainly consequence of the sense of the credit channel. At first, shifts in the key interest rate influence banks' lending in depth. The cost of commercial banks owned liabilities changes. Accordingly, simultaneous adjustment is obliged to happen in banks' assets. Commercial banks must reduce holdings or add funds, otherwise lending must reduce. Borrowing cost from bank or financial markets is therefore determined by the key interest rate.

Small firms are more likely to use borrowing from bank (Gertler & Gilchrist 1994: 313). Especially they suffer from the lack of information in lending. As small firms have often difficulties to raise funds from nonbank sources, banks are unsympathetic toward them. On the contrary, large firms have more chances to use nonbank funding. In addition, large firms have larger net worth to use as collaterals. The better firm's collaterals are the more banks are able to lend or the lower are the loan costs. If small firms attain less external financing, their potential to thrive as investors expect diminish.

Other argument is the level of information which affects in credit markets. There exists less publicly available information related to small firms. This kind of firm is seen as a risk in credit markets. Banks are not disposed to lend without necessary information and reduce lending first to risk firms in tightening credit conditions. (Gertler & Gilchrist 1994.)

The evidence of Kashyap, Stein and Wilcox (1993) shows that tightening monetary policy causes increase in nonbank loans at the expense of bank loans. This implicates the sources of loans being imperfect substitutes, which appears as a gap between loan costs. Oliner and Rudebusch's (1996) competing view is that since monetary policy turn to be contractive both bank and nonbank loans shift from small firms to large firms.

Gertler and Gilchrist (1994) show that contractive monetary policy causes worse mediations to small firms than to large firms. The asymmetry is more remarkable in recessions. They argue that small firms' sales and borrowing reduce and their interest rates on loans increases relatively more than large firms. The asymmetry does not arise from firm size itself. Instead, young firms which may have a high degree of idiosyncratic risk or inadequately collateralized firms are on average small firms. Thus borrowing costs due to these primitive factors are relatively high. However, many other studies have noticed the asymmetry between small and large firms (see Thorbecke 1997; Perez-Quiros & Timmermann 2000; Ehrmann & Fratzscher 2004).

$H_2$: The extent of stock's response to monetary policy surprise depends on firm's debt-equity ratio.

First way of thinking is that a change in the key interest rate influences directly on balance sheets through cash flows of interest and the value of collateral assets. Indirectly, a change brings about a change in firms' spending at the same time which reasserts chain of events (Gertler & Gilchrist 1994: 311–312). On the other way, second hypothesis is based on banks' way to calculate cost of risks for lending. Suitable structure of balance sheet and high equity ratio of firm are favorable from bank's point of view. This kind of debtor is priced to have less default risk. Thereupon, the amount and costs of bank loan are more likely near to investors' wishes.

The amount of debt is a trade-off for firm. Excess debt may increase the production scale and expected future profits. On the other hand, the volatility of profits will increase too. Cooley and Quadrini (2006: 244) argue that debt-equity ratio and firm size are connectable conversely because firm with less equity is willing to raise profits by using leverage. This may be determinant in asymmetric reactions to monetary policy.

Lamont et al. (2001) do not find any significant results about the role of financial constraints factor in stock prices' reactions to monetary policy. However, they suppose that the factor is important and the results may be due to the rudimentary tests (Lamont et al. 2001: 550). Later, some studies support that financial constraints causes asymmetric reactions in stock markets (see Ehrmann & Fratzscher 2004; Basistha & Kurov 2008). Also, Basistha and Kurov (2008) find that highly indebted firms react similar to the average firm but firms out of debt react the most. Although the financial constraints factor is not equal to the financial standing, the linkage is obvious.

$H_3$: The extent of stock's response to monetary policy surprise depends on return on assets-ratio.

Third hypothesis takes the need of credit into consideration. Firm financing can be separated to internal and external. Profitable firm is more likely able to use internal financing for its operations or investment spending. Instead, firm which performs poorly is likely to resort external financing. This implicates borrowing from banking sector,

which expose firm to impact on credit channel. In addition, changes in common interest level determined by central bank have a bearing on interest payments of the firm's debt and thus following profits (Cooley & Quadrini 2006: 245).

Bernanke, Gertler and Gilchrist (1996) account implications which induce asymmetric responses on stock prices. Firstly, external financing is always more expensive than internal finance (Hahn and Lee 2009). Secondly, if a firm is unable to make a good impression in credit markets or its costs of lack of information are high, it is in worse situation than capable firm. This asymmetry is strongly related to the amount of net worth and its inverse relationship to the cost of external finance. Net worth is therefore important determinant when defining credit terms. Failed borrowing prejudices firm's operations or investment spending.

**Table 1**. A summary of asymmetric stock market reaction to monetary policy.

| Study | Time period | Monetary policy measure | Dependent variable | Conclusions |
|---|---|---|---|---|
| Gertler & Gilchrist (1994) | 1958-1994 | Federal Funds rate | Quarterly financial reports for manufacturing corporations | • Small firms suffer more on tightening monetary policy because worsening balance sheet positions makes borrowing difficult |
| Thorbecke (1997) | 1953-1990 | Nonborrowed reserves<br>Federal Funds rate | Stocks of CRSP value-weighted index | • The impact of monetary shock on stock price increases as the firm size becomes smaller |
| Perez-Quiros & Timmermann (2000) | 1954-1997 | 1-month Treasury bill rate<br>Money supply | Stocks of CRSP value-weighted index | • Small firms suffer more on tightening monetary policy |
| Lamont, Polk & Saá-Requejo (2001) | 1968-1997 | Log real M2<br>Federal Funds rate<br>Federal Reserve discount rate<br>Commercial paper-treasury bill spread | Stocks of NYSE, AMEX and NASDAQ | • The reactions of financial constrained firms to monetary policy (measured by abnormal returns) do not differ from unconstrained ones |
| Thorbecke & Coppock (2001) | 1974-1979<br>1982-1989 | Federal Funds rate<br>Nonborrowed reserves | Stocks of NYSE | • Contractive monetary policy decreases both small (larger effect) and large firms'stock prices<br>• Expansive policy increases stock prices only stock prices in large size-class |
| Guo (2004) | 1974-1979<br>1988-2000 | Federal Funds rate | Stocks of NYSE, AMEX and NASDAQ | • The asymmetric stock market reactions depending on firm size are related to common business condition: "size effect" is evident during non-favorable times but not during favorable ones |
| Ehrmann & Fratzscher (2004) | 1994-2003 | Federal Funds future | Stocks of S&P500 index | • The more financially constrained firm is the more susceptible it is to monetary policy<br>• Highly indebted firms react similar to the average firm but firms out of debt react the most<br>• Firm's with high Tobin's q are more susceptible to monetary policy<br>• Firms with a high P/E ratio are more susceptible, possibly due to the sensitivity of earnings expectations to the changes in interest rates |
| Basistha & Kurov (2008) | 1990-2004 | Federal Funds future | Stocks of S&P500 index | Financially constrained firms are more responsive than unconstrained ones to monetary shocks |

$H_4$: The positive monetary policy surprises affect stock prices differently from negative surprises.

*Overreaction Hypothesis* proposes that financial events are reacted systematically too exaggeratedly in stock markets, not depending whether the news is good or bad (Ajayi & Mehdian 1994: 533). Instead, Brown, Harlow and Tinic's (1988) theoretical model, U*ncertain Information Hypothesis,* proposes that stock prices react to bad news more pronounced than good ones. This is due to the investors' manner to set the stock prices below their fundamental prices. Both hypotheses are against to the *Efficient Market Hypothesis*.

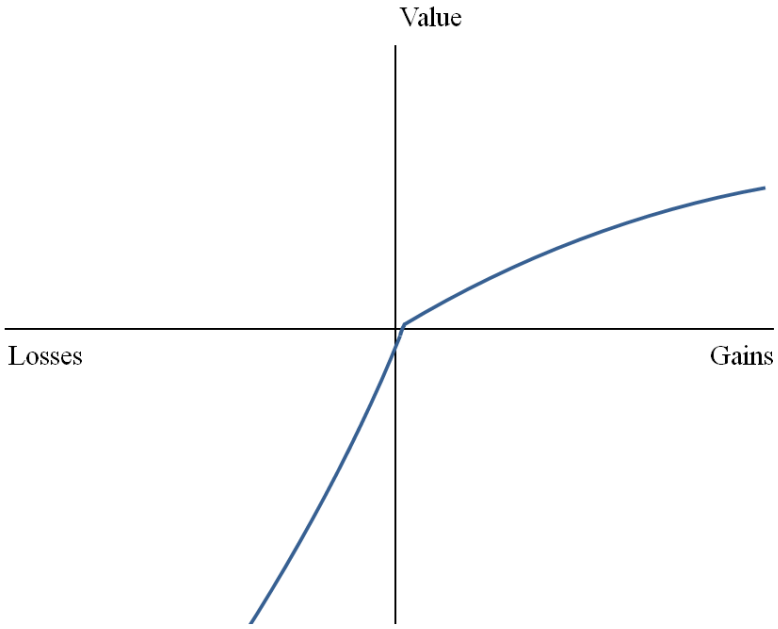


**Figure 1.** Asymmetry between gains and losses.

Ding, Charoenwong and Seetoh (2004) investigate the asymmetric stock return patterns towards firms' positive and negative earnings surprises. Their findings lean on the advance of Tversky and Kahneman's (1979; 1991) prospect theory. Illustrated in figure 1, investor suffers more for a loss than enjoy for the equal amount of win. Thereupon, a negative surprise that struck investors makes them refrain to realize their loss but hope that a stock would recover. This diminishes trading and stock's bid price does not de-

crease in line with fundamental value. On the contrary, a positive surprise encourages realizing investors' profits. Incidentally, the theoretical framework suggests decreasing returns to scale for both positive and negative surprises. That is, the function is concave for positive surprises and convex for negative surprises but stickier for negative ones.

As Tversky and Kahneman (1979) argue, investors tend to perceive gains and losses through the reference point in origin. The hypothesis in this study proposes that gains and losses can be transformed to the positive and negative surprises of monetary policy announcements (figure 2) as Ding et al. (2004) do to the firm's reported earnings. [1]

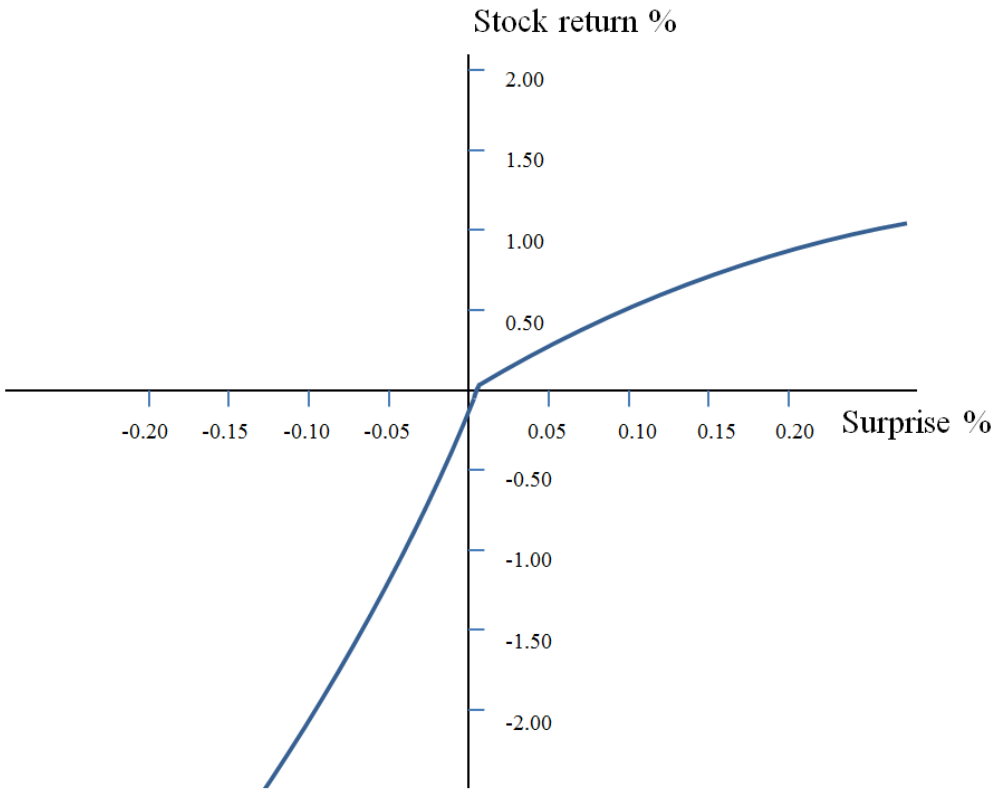


**Figure 2.** Asymmetric effects between the directions of the surprises.

The evidence from the other subject matters supports this theoretical framework. Ding et al. (2004) show that positive earnings surprises produces significant abnormal stock

1 Usage of terminology in signs is confusing in prior literature. The majority of those discuss a positive surprise as rise in interest rates (or bad news for stock markets) and vice versa. In this study, positive (negative) surprise in monetary policy is viewed as positive (negative) for stock markets. The reader must bear this in mind through the thesis.

returns while negative surprises are insignificant. Prior study of Shefrin and Statman (1985) also notice that investors are reluctant to sell loser stocks but bid up stock price after a positive earnings surprise. The opposite way of thinking suggests that a negative surprise (for stock markets) has larger impact to the downward movement in stock prices than equal positive surprise has to the upward movement. This is connected to the understanding that stock markets overreact to the bad news and underreact to the good news (Brown, Harlow & Tinic 1988).

There are some surveys related specifically to asymmetries in the directions of monetary policy surprises. Lobo (2000) finds limited signals about the asymmetric effects of monetary announcement to daily S&P500 stock prices during 1990–1998 by using federal Funds rate as an explanatory variable. The results are consistent with Ding et al.'s (2004) ones.

Lobo's (2002) further examination with a similar data shows that positive surprises have significant impact on stock returns while negative surprises are insignificant. In addition, only negative surprises are found to impact on volatility. Farka (2009) focus on the same subject matter using intraday data of S&P500 index futures and Federal Funds futures. The evidence indicates that easing surprises have larger impact than tightening ones. Bernanke and Kuttner (2005) touch the issue but do not find statistically significant difference between the sign of the surprise or the direction of the rate change.

Vähämaa and Äijö (2011) separate surprises that occur in VIX implied volatility index data and driven by the FED's monetary policy. They point out that a negative target rate surprise increases stock market uncertainty but a positive one decreases it. The market reaction to surprises tends to be more remarkable during economic downturns or expansive policy cycles.

Chuliá, Martens and van Dijk (2010) used high-frequency intra-day data and find strong evidence that negative surprises cause stronger impact on stock markets than positive ones. In fact, the mere occurrence of negative surprise tends to be more important than its magnitude. For positive surprise, the magnitude is principal.

Conrad, Cornell and Landsman (2002) find that stock responses to news depend on prevailing price level of the markets. Prices react aggressively to bad earnings news and moderately to good news in bullish markets. In addition, small firms are quite immune

to the overreaction for the bad news. Since small firms' earnings fluctuate relatively much over time, the news may have lower information content so a relation between surprise and excess returns is hard to detect (Conrad et al. 2002: 2529).

Firm's earnings announcements and monetary policy announcements have many similarities. The following list shows that it is justifiable to expect that stock prices react of the same kind and parallel to monetary policy announcements than earnings announcements reported by Ding et al. (2004). By contrast dissimilarities are delineated to challenge the ability to find significant results from monetary policy-stock markets interrelationship.

**Table 2.** Monetary policy–earnings announcements comparison.

| |
|---|
| **Similarities** |
| • Information is public at the same time for the entire markets |
| • The date of announcement is known in advance |
| • The markets make assumptions about future path from the news |
| • Though monetary policy is not straight related to single firm, the implicit influence come up from the transmission mechanism |
| **Dissimilarities** |
| • Monetary policy announcements are well-anticipated and surprise component is small. By contrast, earnings announcements have often larger surprise component. |
| • The importance of earnings announcements for stock price is larger. |

Theoretical model contrived by Veronesi (1999) may confuse the last hypothesis furthermore. The model suggests that stock prices overreact to non-favorable news in favorable times. That pattern occurs because increased uncertainty due to the news causes stock prices declines which surpass the actual impact in expected future dividends. Similarly, stock prices underreact to favorable news in non-favorable times because the increase in expected future dividends surpasses the discount that investors require to hold a stock. The type of news is irrelevant. The theory should hold true in both monetary news and other aggregate economic news.

Veronesi (1999) show that during recession there exist high volatility in stock markets which leads to more uncertainty among investors. Thus, stock prices are more sensitive to news in recession than in expansion. This pattern originates from investors' anticipations that future cash flows react more easily to news in high uncertainty state. Farka (2009) find that non-favorable monetary policy actions have larger impact in favorable times than non-favorable ones. Altogether, both theoretical models and empirical evidence related to the fourth hypothesis yield inconsistent results. Therefore, further clarification is needed.

Stocks' time-varying sensibility to monetary policy surprises is not taken into account in the empirical part of this thesis. Nevertheless, the possibility that dynamic states of economy may prejudice the results would be desirable to notice hence.

**Table 3.** A summary of the relevance of the sign of the monetary policy surprise.

| Study | Time period | Monetary policy measure | Dependent variable | Conclusions |
|---|---|---|---|---|
| Lobo (2000) | 1990-1998 | Changes in the federal Funds rate target | S&P500 index | • Favorable monetary policy surprises have relatively larger impact on S&P500 index than non-favorable ones |
| Lobo (2002) | 1990-1998 | Survey data on market participants' expectations 3-month Treasury bill yield | S&P500 index | • Favorable surprises have significant impact on stock returns while non-favorable surprises are insignificant<br>• Only non-favorable surprises are found to impact on volatility |
| Bernanke & Kuttner (2005) | 1989-2002 | Federal Funds future | Stocks of CRSP value-weighted index | • Monetary policy surprises causes heterogenous returns among industry-based portfolios<br>• The sign or the direction of the surprise does not have an influence on the intensity of stock prices reaction |
| Farka (2009) | 1994-2005 | Federal Funds future | S&P500 futures | • Easing surprises have larger impact on stock market than tightening ones<br>• Tightening surprises have larger impact in favorable times than non-favorable ones |
| Chuliá, Martens & van Dijk (2010) | 1997-2006 | Federal Funds future | S&P100 index | • Non-favorable surprise leads to higher reaction in stock markets. The mere occurrence of negative surprise is more important than its magnitude.<br>• For positive surprise, the magnitude is prime. |

*The linkage of hypotheses*

The hypotheses are pronouncedly interrelated. The firm characteristics may be coexistent and therefore a prime factor is miscible. If the hypotheses are supported, proportional importance of the firm characteristics are taken into account betweentimes. The arguments for the characteristic-related hypotheses are linked up via credit markets and information asymmetry[2]. As certain prior studies have focused to differences of industries, one can argue that an industry is not important per se but the differences arise from certain characteristics of an industry.

In this context, a point of the causalities of the firm characteristics is made. Any factor does not surely imply that the firm has or not has other factors. For example, the size-factor does not surely imply that firm is indebted or performing poorly. Instead, the case is whether some of portfolios constructed from the factor-based firms have significantly different susceptibility to the monetary policy surprises. The examination exposes also whether some of candidate portfolios react unequal to positive and negative surprises.

In this case, Hahn and Lee's (2009) study of financial structure of a firm and stock returns imply that the characteristics related to debt-level and profitability are negatively correlated so that the profitability of indebted firms are at lower level. Also, as Cooley and Quadrini (2006) note, debt-level and firm size are likely negatively correlated. Particular description of portfolio construction is given in section 6.2.1. and correlations are reported in table 11.

## 1.3. Overview of the thesis

The thesis includes both theoretical and empirical part. Theoretical part is included in chapters 2–5. The first chapter contains introduction to the subject and purpose of the thesis and research hypotheses as well. In the second chapter, previous accomplished research results substantially touching the subject of this thesis have been gone over. Third chapter introduces essential ways to price common stocks. In the fourth chapter, efficient market hypothesis and three forms of market efficiency has been presented. The fifth chapter presents theoretical economic framework to handle stock price move-

2 Despite of above-mentioned reasonable theoretical causal-connections, investors' motivation to trade stocks based on these arguments cannot be sustained. One cannot make confident conclusion that investors rationalize their trading-decisions, which shift stock prices, by fundamental reasons.

ments, examines the ECB's monetary policy actions and their arguments and clarifies the structure and channels of the transmission mechanism.

The empirical part begins from chapter six. The data used and statistical methods are introduced in this chapter. Chapter seven includes empirical results. The thesis terminates in conclusions in chapter eight.

## 2. PREVIOUS STUDIES

Many surveys have noticed that when stocks are segregated according to fundamental aspects there seems to be a wide range of diverse reactions in their response to monetary policy. Remarkable reasons for that have been identified. The size of firms (see Gertler & Gilchrist 1994; Thorbecke 1997; Perez-Quiros & Timmermann 2000; Thorbecke & Coppock 2001, Guo 2004), general financial situations (see Gertler & Gilchrist 1994, Ehrmann & Fratzscher 2004; Guo 2004; Basistha & Kurov 2008) and the industry-specificity (see Ehrmann & Fratzscher 2004; Basistha & Kurov 2008; Becher, Jensen & Mercer 2008) are dimensions which govern the strength of reaction to monetary policy. Basically, monetary policy affects stronger to small firms, firms in cyclical industries and firms with financial troubles.

### 2.1. The importance of choosing monetary policy indicator

In academic literature has been mentioned that the direct effects of monetary policy to stock markets is difficult to verify reliably because stocks react to the changed common interest level at the same time. It is hard to contrive a measure for monetary policy, which would not be correlated with changes in common interest level. (Rigobon & Sack 2003: 639.) This incurs that common interest level is easily used as a monetary policy indicator. However, that is not enough exhaustive measure when measuring stocks' reactions to monetary policy.

Central bank's key interest rate is useful indicator for (money supply-based) monetary policy actions, because it reacts parallel with changes in money supply (Bernanke & Blinder 1992: 910). As central banks' monetary policies are nowadays more interest rate-oriented, this conclusion has become even more essential in two decades. By comparing international stock indices' reactions to the various FED's monetary policy indicators, Mann, Atra and Dowen (2004: 547, 558) make some conclusions about the order of superiority of the indicators. As set out in their study, the optimum indicator is difference in the average Federal Funds rate (or the FED's interest rate) which is calculated as the monthly average Federal Funds rate minus average Federal Funds rate in previous month. Central bank's key interest rates are successful also from an another viewpoint: Federal Funds futures are found out to be efficient predictor to the actual forthcoming changes in Federal Funds rate (Krueger & Kuttner 1996: 879). However, the usage of raw futures data is biased by reason of their risk premia. That incurs distorted forecasts

of the future path of monetary policy and measures of monetary policy shocks. This can be avoided by using intraday dissections. (Piazzesi & Swanson 2008; Konrad 2009.) Other feasibility is to use polls of market participants as Ehrmann and Fratzscher (2004) do.

## 2.2. Macroeconomic cycle as an explanation for price behavior

McQueen and Roley (1993) attest that stock markets reactions to monetary policy depend on business cycles. They find that kind announcements of the FED's monetary policy interact only slightly during high states of economy but similar news upraises substantially stock prices in depression. In addition, these findings are considered to exist due to variability of expectations about cash flows instead of equity discount rate proxies. Bernanke and Kuttner (2005) make later the same conclusion about the source of the response of stock prices.

Lately, Basistha and Kurov (2008) confirm those findings about the discrepancy of economic situations. Their results are remarkable: monetary policy is founded to affect to stock prices in recessions over twice as intensively than in favorable states of economy. The part of explanation for that is the role of the credit channel and to be exact, tightened credit market conditions.

In expansions, central bank uses tightening monetary policy for counteract the overheating of economic activity. According to the article by Patelis (1997) in which is examined the capability of the stances of monetary policy to predict future stock returns, stock prices responded more to that tightening than to loosening monetary policy in recessions. In poor states of economy firms' financial health has already impaired because of diminished borrowing chances and balance sheet income. Patelis' explanation is that if firm's financial susceptibility to contractive monetary policy actions in future increases the required risk premium of firm's stock increases too. In this case, firm's expected future cash flows, and simultaneously stock price, should increase to compensate weakened health caused by contractive monetary policy actions.

Jensen and Johnson (1995) consider that stocks' expected returns are at the higher level during expansive monetary regimes (or low common interest level) than contractive ones (or high common interest level). In the long run, stock returns are better and less volatile during expansive regimes. Conover, Jensen and Johnson (1999a) realize as well

that in the U.S. and 15 other OECD countries stock returns are greater during expansive monetary policy regimes than contractive ones. They connect superiority specifically to the monetary policy instead of increased risk premiums.

Järvinen (2000) examines the effect of monetary proxies to Finnish stock prices by separating different stages of economic situation. While there was bullish cycle in economy, money supply announcement which surpasses expectations decreased monthly stock returns but the corresponding reaction in recession was positive. By way of conclusion, the better the common economic situation is the more stock prices appear to decrease as a consequence of increased money supply. It is suggested that this order is caused by increase in the markets' inflation expectations (which usually leads to tightening monetary policy). McQueen and Roley (1993) find similar results from the U.S. markets. However, the worse common economic situation is the more pronounced is the negative reaction of market participants to unexpected increase in interest level.

When the reactions of S&P500 index was measured to the changes in the FED's interest rate instruments (the discount rate or the Federal Funds rate), contractive operations decreased stock prices in both bearish and bullish trends but the major effects were in bearish ones. This occurrence is caused not only by lowering the returns directly but also by changing investors' sentiment. As a conclusion, contractive monetary policy increases the probability of switching trend from bullish to bearish. Also, this kind of monetary policy decreases the probability of stock markets to keep in bull market but increases the probability to keep in bear market. (Chen 2007.) As a parallel, Kurov (2009) find that stocks react strongly to monetary policy in bear market but not much in bull market. Konrad (2009) has similar returns about the sense of the market sentiment on the German stock market volatility.

## 2.3. The sense of firm's size and financial situation

Thorbecke (1997) attest that small firms' stock prices are more susceptible to the effects of monetary policy as compared to large firms. Similar results has been presented in subsequent surveys (Perez-Quiros and Timmermann 2000; Lamont, Polk & Saá-Requejo 2001; Guo 2004). According to Thorbecke and Coppock (2001), small firms suffers relatively more about inflation lowering monetary policy operations, whereas large firms benefit more from expansive monetary policy in relative terms. That difference is caused by large firms' better success in credit markets all times. The increase of

relative utility does not seem to be linear. Researchers find that midsized firms' stock prices increases the most in consequence of expansive monetary policy when broad New York Stock Exchange (NYSE) index was delivered to several value-weighted portfolios.

Monetary policy affected more to the small firms' stocks than to the large ones, in the period of 1974–1979, when economy was depressed and inflation high in the U.S. due to two oil crises. Compared to the period of 1988–2000, the firm size was less important. The distinctive factor was found to be firms' business conditions. In the 1970s small firms' business conditions were generally speaking weak and in the 1990s firms' earnings were better. (Guo 2004.)

Guo's (2004) supplementary explanation for the previous facts is that in the earlier period firms were more dependent on debt than later. Liabilities are more sensitive to the changes in interest level than shareholders' equity. High indebtedness toughens asymmetric between small and large firms, which reflect in stock prices. In years 1988–2000 small firms had also more undivided profits which deducted asymmetry. Schwert (2002) confirms that size and value premiums have diminished significantly in the 1990s. According to Guo (2004), this is possible because small and value stocks have become in time less susceptible to liquidity constraints (in other words, to the debt limitation). That diminishes investors' required liquidity premium for these stocks.

Ehrmann and Fratzscher (2004) outline that the intensity of the effect of monetary policy to stock price depends on firm's financial constraints and investment opportunities. Firms with a high *Tobin's q* (see appendix 1.) are more sensitive to monetary policy. Financial constrained firms (that is to say, firms which potential growth is limited by financial realities) react stronger to monetary policy than non-constrained ones. General financial constraining measures are size, required return of firms' various bonds, return on assets, the amount of assets and trade credits (Basistha & Kurov 2008: 2613; Almeida, Campello & Weisbach 2004: 1802). Contrary to the others, Lamont et al. (2001) did not find correlation between financial constraints and monetary policy, which would appear higher returns of constrained firms.

Diminished credit granting is the result of tightened monetary policy. Thorbecke (1997) notices that small firms have difficulties to borrow money from credit market. Gertler and Gilchrist (1994) come to the same conclusion: during recessions and tight monetary regimes the credit granting of small firms reduce relatively more than large firms, which

reflects in stock prices. According to this study, the turnover and types of property are more susceptible to the contractive monetary policy. The pattern is not as powerful during expansive monetary policy.

Bernanke and Gertler (1989) investigate why firms have heterogeneous borrowing possibilities. They notice that the larger is net asset value of a firm, the less risky is the firm in front of banks' eyes. Those firms get loans easier and the more advantageous are loan terms. In this case, banks mark the price of small firm's default risk notable, which forces liquidity constrained firms to operate at the inferior production level. Due to the diminished production, profits and stock prices of this kind of firms depreciate.

Perez-Quiros and Timmermann (2000) approach the asymmetry of firm size in stock pricing throughout the credit markets. In the light of the fact that small firms has not great premises to use collaterals or guarantees on loans, they receive less loan and are rammed to pay more interest for it. The natural result of that chain of events is decline in stock value.

The level of lending is in touch with the quantity of money in circulation, which is under central bank's control. As documented in the research of Perez-Quiros and Timmermann (2000), money supply is found to be significance factor explaining small firms' stock returns. When the sample stock data distributed to size-sorted portfolios, changes in money supply in recession incurred statistically significance changes in portfolios which included the smallest firms' stocks while large stocks' reactions were weak. On the contrary, in expansion changes in money supply was insignificant in any case.

## 2.4. The sensitivity of industry on monetary policy

The reactions of several industry indices to monetary proxies in Helsinki stock exchange (now OMXH) is investigated by Järvinen (2000). The influence of the real money supply (which fill in for monetary policy) generated asymmetric reactions. Higher than expected thus positive surprises in money supply decreased stock returns while the similar news in industrial production elevated stock returns. Likely explanation for that is contained in changes in expected future inflation.

The combined explanatory power of all macroeconomic news (from which major was related to the real money supply or interest level) to shifts in stock prices among industries was at its lowest 2.4 % (metal and engineering) and at its highest 15.5 % (insurance and investment) and 11.4 % to aggregate market. Cyclical firms did not react statistically significantly to news about changes in interest level but banks and financial sectors reacted twice as strong as aggregate market on average. (Järvinen 2000: 16, 40.) On the contrary, financial sectors' stocks in S&P500 index reacted to changes in the Federal Funds rate quite parallel with manufacturing industry (Basistha & Kurov 2008: 2615). This is not consistent with Chuliá et al.'s (2010) view that the financial sector is the most suspectible among industries.

Under survey made through S&P500 index and by force of the FED, cyclical and capital-intensive industries react repeatedly two or three times stronger to monetary policy than non-cyclical industries (Ehrmann & Fratzscher 2004: 721). The sensitivity of the demand of firm's products accounts for that occurrence, traditional interest channel being anyway relevant. (Basistha & Kurov 2008: 2615). According to Bernanke and Kuttner (2005: 1253), high-technology and telecommunications sectors response to monetary policy half again as strongly as overall, all industries extensive, stock index. Energy and commodity industries' respond were not statistically significant.

Industries appearing outstandingly sensitive to monetary conditions are retail and consumer durables and less susceptible are oil, mining, steel, chemicals and utilities. Explanation for this order is that monetary policy has an influence on such industries as whose financial success depends much on consumer discretionary spending. (Becher, Jensen & Mercer 2008: 377–378.) Bredin, Hyde, Nitzsche and O'Reilly (2009) support that and cite autoparts and household as very sensitive industries to monetary policy. On the contrary, Kholodilin, Montagnoli, Napolitano and Siliverstovs (2009) find that consumption services are the most immune sector while telecommunication sector reacts the most. Both of these studies are made by using the euro area data and the ECB as monetary author.

Overall, the explanations for what ways monetary policy impacts to stock prices can be found at firm-level, industry-level and aggregate market level. Stocks react not only by fundamental reasons, related to discounted cash flows but also by sentiment.

## 3. DETERMINATION OF STOCK PRICE

In this chapter the ways to determine rational price for a stock is discussed. The behavior of stock market prices follows the equilibrium of demand and supply. The levels of demand and supply are determined by market participants' opinions and interests to trade stocks. Under the efficient market hypothesis, the market price of a stock is always the most rational price. Basically, there is no situation where this supposition holds longer than momentarily (Summers 1986). In reality, the market price can differ from the price based on stock valuation models. In addition, stocks are risky security class and there is always parallel interrelationship between risk and return.

The traditional "buy-and-hold"-strategy is constructed from the presumption that trading is unhelpful because stocks have always the most rational price. So, long-term stock performance is better when stocks are bought based on fundamental aspects. Speculative investing is situated when an investor's opinion is that the short-term market price deviates from the rational price. In this case a stock is profitable to:

1) buy if the market price is below the rational price defined by a investor
2) sell short if the market price is above the rational price

Well-known theories expect that market prices of stocks fluctuate hand in hand with firm-specific fundamentals. In fundamental analysis stock price is composed of all relevant information. This means mainly the expectations of firm's operating incomes, stock dividends appreciation and susceptibility to risk. Hence, prospects of macroeconomic developments are also relevant information because that affect to earnings (Schwager 1995: 565). Stock price should therefore be the present value of future cash flows which are based on optimal forecasts (Bodie, Merton & Cleeton 2009: 198).

As it turns out, market sentiment has an effect to stock price throughout prevalent future expectations. The trend is prevalent price process to positive or negative direction. Underlying reason is investors' collective optimism or pessimism. These emotional responses are not based on fundaments but psychological factors which may lead to misguided market price. (Shefrin 2005: 206.) The information of market sentiment is used when market participant is doing trading-decisions based on technical analysis.

There are several frameworks to value intrinsic stock price. Theoretical valuation frameworks based on discounting include expected return on capital compared to re-

quired return (Bodie, Kane & Marcus 2005: 377). The frameworks do not generally match to current market price. First explanation is that frameworks are quite simplified compared to the complex structures of the financial markets in which stock price are pressed by countless separate factors. Secondly, frameworks process stock price on the grounds of long-term while stock markets are more like short-term-oriented. (Koller, Goedhart & Wessels 2005: 21).

## 3.1. Pricing models based on discounting

On fundamental analysis basis the determinants of stock price can be formulated as mathematical formulation (McQueen & Roley 1993):

(1) $$P_t = E\left[\sum_{r=1}^{\infty} \frac{D_{t+r}}{1+r_{t+r}} | \omega_t\right]$$

where: $P_t$ = stock price at time t

$E[\cdot|\omega]$ = expectation conditional on information available at time t

$D_{t+r}$ = paid dividend at time t+r

$r_{t+r}$ = required return at time t+r

Stock price represents then the present value of forecasted dividends advanced by using all available relevant information. Seeing that future is always uncertain, the results of pricing model are uncertain and time-varying. The best defined price is only estimate or the result of "the parameters of a conditional probability distribution summarizing the various potential outcomes" (Brown et al. 1988: 356). Dividend represents future returns because it is only actual income which a stockholder gets during holding time. Required return is affected by risk involved in investment. According to *Capital Asset Pricing*-model (CAPM), stock's required return is sum of risk-free return and stock's risk premium. The more risky a stock is the larger becomes the required return (Bodie et al. 2005: 283).

Dividend-based pricing models are diverging but the principles are the same. In these models future dividends are discounted to the present by required return. Pricing model developed by Gordon and Shapiro (1956) allows define stock price by simple factors. Gordon growth model (equation 2) represents that stock price is all future dividends to infinity discounted by required return minus dividends' growth rate. The greater divi-

dend growth is the more valuable is a stock. At the same time, the greater required return is the lower is stock price.

(2) $$P_0 = \frac{D_1}{k-g}$$

where: $P_0$ = stock price at time 0
$D_1$ = expected dividend at time 1
$k$ = stock's required return
$g$ = dividends' growth rate

First problem in the model is the situation in which dividends' growth rate (g) is larger than required return (k). Second problem is that even small miscalculations in forecasting model's factors cause large deviation in the outcome. (Bodie et al. 2005: 612; 622.)

Possibly more reliable model define exact dividends for few upcoming years and after that presupposed constant dividends' growth rate, as in the Gordon growth model. Dividends can be forecasted more faithfully in the near future than the remote dividends. (Blake 2002: 201.)

*Free cash flow* is firm's real cash flow which is remained under shareholders' control after taxes. By means of calculation, paid liabilities to interest groups are deducted from gained earnings during firm's accounting period. Free cash flow model is similar with Gordon's growth model but the dividend is replaced as free cash flow and dividends' growth rate as free cash flow's growth rate. When calculating free cash flow, the importance of firm's remaining debt has to take into account. In practice, indebted firm has no possibility to use free cash flow as firm's fashion but it has to be used for payment of a debt even if the amount of free cash flow would be large. (Bodie et al. 2005: 634, 643.)

*Economic value added* (or *residual income*) method quantify how much book value of stock generates added value annually. It may be profitable to buy a stock at higher price than its book value is, if its present value of future added values is above the required return. Stock price is therefore all expected future added values of a stock discounted by required return added on current book value of a stock. (Bodie et al. 2009: 82)

## 3.2. The importance of macroeconomic information

Since monetary policy has significant impacts on stock prices through many channels, the proportional importance of policy actions and other macroeconomic factors are considered in common framework. The examination of financial market responses with the aid of intra-day data discloses that two major events are above the others: the releases of macroeconomic announcements and monetary policy decisions (Andersson, Hansen & Sebastyén 2009). Until now, the research of this topic is rich and has been long-term in focus. The large amount of studies and wide-ranging methodology used has led to inconsistent evidences. Anyway, the majority of variation in stock prices cannot be explained by macroeconomic news (see Fama 1981; Roll 1988; Cutler, Poterba & Summers 1989).

Pearce and Roley (1985) find that monetary policy surprises are above the others when measuring macroeconomic determinants on their announcements days on stock prices. Inflation seems to have a little impact and the role of real activity figures is null. Still, monetary policy surprises can explain only a small portion of overall variability of stock prices (Bernanke & Kuttner 2005).

Hardouvelis (1987) finds as well that stocks in the U.S. markets were the most affected by monetary news when the FED used non-borrowed reserves as policy targeting. The responses were not significant anymore since monetary policy changed to borrowed reserves targeting. Meanwhile, stocks reacted to the announcements of the trade deficit, the unemployment rate and personal income.

Particular intra-day examination of the role of economic news reveals that stock returns are affected significantly by money supply and consumer price index (CPI) but not by producer price index (PPI), industrial production or unemployment rate. In addition, trading volume is not responsive to none of macroeconomic news. (Jain 1988.)

McQueen and Roley (1993) find that in the high state of economy the favorable macroeconomic news lead to negative movements in stock prices. This kind of news leads to the fears of an overheating economy, higher inflation and therefore undesirable monetary policy tightening. The forces of those fears surpass the force of higher cash flows (or dividends) expectations and stock prices decrease. Again, the similar news may have positive influence on asset prices in some states of economy.

McQueen and Roley (1993) resolve generalized framework of contest between expected future dividends and required return. Their finding is that the response of stock markets on macroeconomic news takes place mainly through expected future dividends. Bernanke and Kuttner (2005) confirm this process in particular in the case of monetary policy actions.

By using daily data from 1977 to 1988, McQueen and Roley (1993) find that S&P 500 index react significantly only to money supply and inflation indicators. When states of economy are considered separately, significant factors in high state are money supply, inflation, industrial production, unemployment rate and merchandise trade deficit. In medium state, significant factors are inflation and money supply. In low state, none of factors is significant.

Chen, Roll and Ross (1986) notice that some macroeconomic variables can explain a proportion of systematic risk in financial markets. The most remarkable variable is industrial production and the various inflation measures are less weighted. Also Flannery and Protopapadakis (2002) put up macroeconomic variables to explain systematic risk. Six variables are suggested to serve as risk factor: money supply, CPI and PPI as the nominal variables and employment variables, balance of trade and housing starts as the real variables.

Unemployment news is found to cause time-varying reactions. Since unemployment figures implicate substantial macroeconomic information for stock valuing components, the eventual short-run impact depends on the state of economy. Stock prices generally increase after news about increasing unemployment in expansion. Again, stock markets react negatively to similar news in recession. In expansion, the anticipated impact of news on interest rates is determinant. Bad news implicates loosening monetary policy and falling interest rates which stimulate stock markets. On the contrary, increasing unemployment in recession lowers expected future cash flows. (Boyd, Hu & Jagannathan 2005.)

# 4. MARKET EFFICIENCY

Efficiency in financial markets means that a security price is defined continuously as faithfully as it is possible by using all available relevant information. The e*fficient market hypothesis* suppose that new information issued to market place adjusts immediately to stock prices. Any market participant has not more or better quality of information than others so one cannot thereby earn systematically better profits than others. (Bodie, Kane & Marcus 2005: 370–371.)

Perfectly efficient markets can be reviewed also by the components: *allocative*, *operative* and *informative* efficiency. Allocative efficiency means that traded resource is utilized optimally or it is got the market participant who needs it the most. In operative efficient markets trading costs are non-existent. That is, trading is not failed due to transaction costs. In informative efficient markets the security price involves all available relevant information at every moment. (Blake 2002: 389).

## 4.1. Rational expectations and optimal forecasts

Kendall and Bradford (1953) looked systematic elements from stock markets time series which would make possible to forecast price behavior. They concluded that this is not possible without the market-exterior information. Authors argue that concept of *random walk* could illustrate by claim that time series analysis is as reliable predictor for stock price changes at upcoming week than drawing lots.

Rational expectation hypothesis suggests that rational expectations are exactly same than optimal forecasts which are formulated by using all available relevant information. If information about the fundamental value of a stock changes, simultaneous change in the rational expectations affect also to the optimal forecasts. The theory of efficient markets assumes that this leads to immediate price changes. Prices in financial markets reflect thus the situation in which optimal forecasts corresponds with the equilibrium of demand and supply (Muth 1961.) The price adjustment should happen immediately also after the release of monetary policy action. As Kendall and Bradford's *random walk*, the theory of efficient markets requires that upcoming stock price movements are unpredictable.

## 4.2. Efficient market hypothesis and forms of market efficiency

Fama (1970) enlarged substantially the concept of market efficiency. Market efficiency was distributed to three classes: filling weak, semi-strong and strong forms. The classes are separated for each other by the amount of information. In weak form efficient markets stock prices are determined by all previously emerged trading information. In semistrong efficient market stock prices involve also all other publicly available information related to underlying firms. In strong-form efficiency information consists of inside information related to firms on top of everything else. The forms of classes are realized since any market participant cannot use information to gain systematically abnormal returns. (Bodie et al. 2005: 373.)

Later Fama (1991) developed tests for measure the fulfilment of forms: tests for return predictability (weak form), event studies (semi-strong form) and tests of private information (strong form). The surveys in financial markets attest that they cannot fulfil weak form but conformity is occurred in asset price behavior. Event studies give evidence that also semi-strong form is rejected in many cases. Strong form remains in force, excluding some exceptions. So, many surveys have shown that there is lacks in stock markets for filling every forms. (Blake 2002: 394-397.)

## 4.3. Efficient markets in monetary policy context

In accordance with the efficient market hypothesis, market participants are supposed to react only to news which involves previously unknown information. Therefore only unexpected part of information may shift prices. Market, as a group, has a consensus forecast about the disposition and strength of monetary policy action. The deviation of the consensus forecast from the actual policy action is therefore unexpected information or surprise component. Bernanke and Kuttner (2005) find that expected part of action has not impact on stock prices. The more notable the surprise component is the more stock prices adjust because changed optimal forecasts about firms' success. Remaining component which is forecasted properly does not affect shifts in stock prices.

Logically, the direction of the reaction depends on what are the market expectations. The monetary policy decisions are published regularly at certain moments, so the market participants preconceive about upcoming news. Thereupon, the market participants have two choices to act: trade stocks exploiting the expectations or wait and act until the

news is published. This decision-making process depends on what are one's interests and the level of uncertainty.

Aggarwal, Mohanty and Song (1995) test whether the market watchers are able to produce rational forecasts about macroeconomic variables. They notice that there exists large amount of variables (involving monetary policy indicators) which are forecasted systematically against rational expectations hypothesis. Today, the transparency of central banks has led to small forecast deviations.

## 5. THE ROLE OF MONEY AND THE ECB MONETARY POLICY

Central banks are monetary authorities which establish the quantity of money and its price (or interest) in economy. In the euro area monetary policy is controlled by the joint central bank of the EU member states. National central banks operate therefore as middlemen of monetary policy. Elsewhere world central banks and monetary policy pursuing are under national authority.

Central bank controls the quantity of money in circulation and interest rate by money supply. This action is way to execute main targets, primarily maintain price stability and after that sustainable economy growth, high employment and the stability of financial markets, interest rates and exchange rates. The harm of general price level rise or inflation is found to be so notable that central banks are ranked the control of it to the main object. The basis for inflation is the excess growth in money supply. (Mishkin 2007: 393, 635.)

Central banks use intermediate targets to overtake final targets. These consist of the growth of money aggregates or various types of market rates or exchange rate. To achieve intermediate targets, operational targets are used. These targets are to achieve by using monetary policy instruments. Central banks' salient instrument is the level of interest. The concept is presented in table 4. The ECB focuses to bolded phrases above all. (Bindseil 2004; de Grauwe 2007.)

The business cycles largely stipulate the sort of monetary policy used. Central bank tries to smooth business cycles, thus economy growth would be as stable as possible. In expansion the economy activity can be worried to turn overheated and inflation grew. In this case, central bank uses contractive or tightening operations. This leads to rise in interest rates and economy activity weakening. In recession economy activity and inflation are low so central bank uses expansive operations. Interest rates are reduced in order to grow economy activity. (Mishkin 2007: 9, 106; Durham 2001: 2.)

**Table 4.** Central bank's targets

| |
|---|
| **Operational targets** |
| • **Short-term interbank interest rate** |
| • The liquidity in the banking industry |
| • Foreign exchange rate |
| **Intermediate targets** |
| • **Monetary aggregate** (M1 or **M3**) |
| • Credit in circulation |
| • Capital markets interest rates |
| • Exchange rate |
| **Final targets** |
| • **Price stability** |
| • Economic growth |
| • Employment |
| • External balance |

5.1. The equilibrium of money demand and money supply

The key information of money demand and supply ought to bring out in order to understand the formation of monetary equilibrium. The theories related to monetary economy and those schools that support them are out of tune with the others partly. Keynesianism argues that balancing processes in economy may last a long time. To aid this, economy policy is capable to accelerate the process by influencing economy aggregates. Monetarism claims that the self-balancing process of economy is fast. Hence, economy policy is more often than not only disturbing while market mechanism runs balancing. New classical macroeconomics assumes that nominal quantities are perfectly flexible and the markets are always in the equilibrium. Under these assumptions only surprising economy policy can impact on markets but even then only for a short time. (Stein 1981.) Regardless of school, two universally accepted major notices are that:

1) Money demand depends on level of nominal interest rate.
2) Money demand is not constant for neither short-term nor long-term. (Mishkin 2007:511.)

Three functions are distinguished for money: a store of value, a unit of account and a medium of exchange. (Mishkin 2007: 50). The money capability to serve as a medium

of exchange gives the money demand because it open the way for transactions. The quantity theory of money suggests that money is neutral. Money has not therefore any absolute value but its role is premised on its usability as a unit of account of commodities. (Burda & Wyplosz 2001: 180.)

Money demand equals the quantity of money that economic participants wish to hold at the moment under the existing economic conditions (Howells & Bain 2008: 266). The theoretical money demand function for short term can be formulated as:

(3) $M/P = L(Y, i, c)$

| | | |
|---|---|---|
| where: | M/P | Real money supply (involving nominal money supply M and price level P) |
| | Y | Level of output |
| | i | Common level of interest |
| | c | Transaction costs of money |

Money demand increases as economy activity or output aggregate increases and as the transaction costs of money increases. Increase in common level of interest decreases the money demand and vice versa. These permanent money market equilibriums are illustrated in following figures:

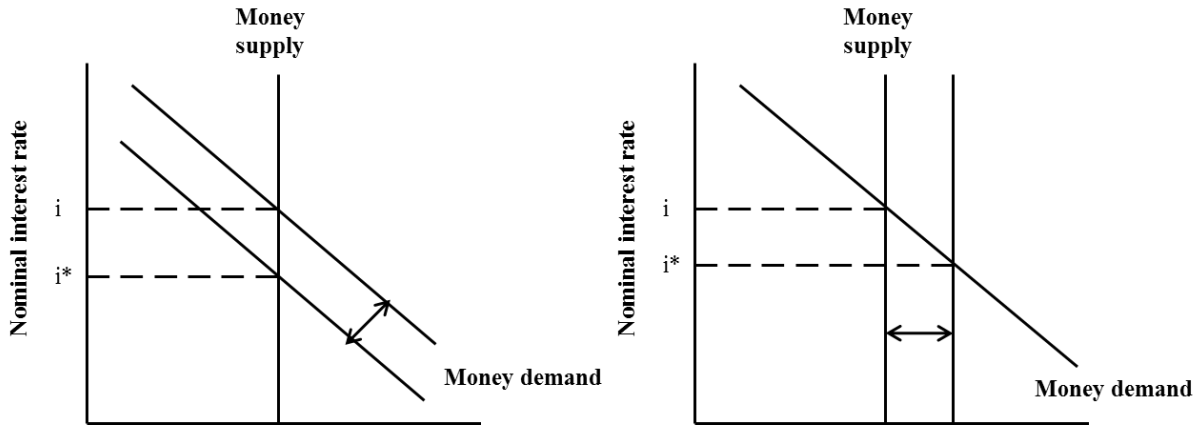


**Figure 3.** Simple monetary equilibrium model.

The figure on the left-side presents that as the level of output or the transaction costs of money shifts, nominal interest rate adjust along ceteris paribus. Money supply-based monetary policy presented on the right-side gives rise to shift in nominal interest rates ceteris paribus.

In the long run, equation (6) can be shortened. The transaction costs (c) are fixed and nominal interest rates (i) have not trend in the long run or money supply is aimed to adjust to increase in output. Equation (7) implicates that the money demand increases only if there happens increase in real output aggregates and the equilibrium requires price level adjustment to nominal money supply.

(4) $$M/P = L(Y)$$

A change in money supply causes disequilibrium from money demand in the money market. The readjustment of money demand to money supply comes about through changes in the economy. (Howells & Bain 2008: 267.) This process is gone over in figure 4 and more detailed in table 5. The table based on Bernanke & Blinder (1988) study, shows how shocks (rows) effects on some aggregate variables (lines).

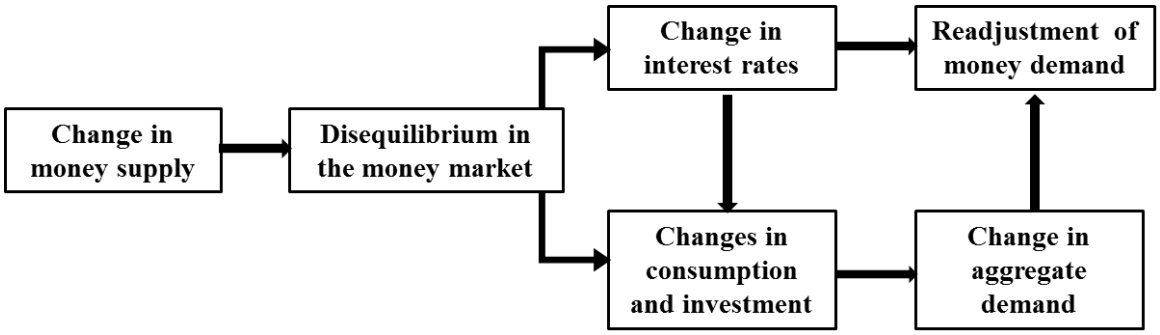


**Figure 4.** The readjustment in money market disequilibrium.

The elasticity of money demand as to interest rates determines whether the readjustment take place through them (Keynesian view) or through aggregate demand (Monetarism view). As many surveys have found out, the theoretical framework of money demand is unrealistic. To boot, present common way to execute monetary policy through short-term interest rates reduces the importance of the money demand-supply-equilibrium (Walsh 2003: 4). However, the basic idea of the relationship between equilibrium and

level of interest associated with monetary policy prepare the way to understand the huge authority of central bank in the economy.

**Table 5.** The effects of shocks on aggregate variables.

| **Rise in:** | **Income** | **Money** | **Credit** | **Interest rate[1]** |
|---|---|---|---|---|
| **Bank Reserves** | + | + | + | − |
| **Money Demand** | − | + | − | + |
| **Credit Supply** | + | + | + | + |
| **Credit Demand** | − | − | + | − |
| **Commodity Demand** | + | + | + | + |

[1]On bonds

*The quantity theory of money*

The quantity theory of money is based on Fisher equation (Mishkin 2007: 494):

(5) $M \times V = P \times T$

where:

| | | |
|---|---|---|
| | $M$ | The amount of money (nominal money supply) |
| | $V$ | The velocity of circulation of money (The amount of times of one money unit) |
| | $P$ | Common price level |
| | $T$ | Amount of transactions (level of output) |

The velocity of circulation of money (V) is constant for short-term, so it is fixed and self-sufficient from other factors of the equation. Amount of transactions (T) is independent from money supply (M) in long-term. That is, the real GDP and monetary figures are independent of each other. In the circumstances, remaining money supply (M) expounds entirely common price level (P):

(6) $M = P$

Thus, the amount of money has not any real impacts or impacts on purchasing power. Under the theory, interest level has not impact on money demand either, and monetary policy is useless. Although expansive monetary policy would upraise equity prices in nominal terms, real effect on money demand did not happen. The examination of money

aggregates presents that the velocity of circulation of money fluctuate much that discredits the quantity theory of money partially. (Mishkin 2007: 493-496.)

For the success of monetary policy, the behavior of the money demand-function is essential to know. Nonlinear observed function set down the challenges for its usability as the aid for monetary policy. The exercise of the amount of money as an only monetary policy resort is not therefore effective. The more varying the velocity of circulation of money is the more susceptible is money demand to interest level. Central bank is required to be able to pitch the accurate interest level so the impacts on money demand would be desired. (Mishkin 2007: 492; 509–511.)

Neither central bank's way to control the amount of money nor money demand is the only determinant of the money in circulation or monetary shocks. There may happen endogenous changes in commercial banks' credit supply. While central bank is up to stimulate financial markets by monetary policy action, the intermediaries of money may diminish the effect by setting own confines for lending. This is due to changes in interest margin (changes in competition) or redistribution of risk (securitization) (Goodhart 2009: 62, 66.) Therefore, prevailing state of banking sector makes demand for further expertise of the monetary analysis.

## 5.2. The basic information of the ECB

The ECB started effective operations in January 1999. Since then the ECB has been responsible for the monetary policy of the euro area. At that time Economy and Monetary Union (EMU) had 11 member states. Finland has been a participant from the outset. Nowadays 16 countries are members of the EMU and part of integrated monetary policy. These participants are adopted the euro currency. The whole system which includes the ECB and all European Union member countries' central banks (non-euro countries as well) is called the European System of Central Banks (ESBC) (Scheller 2006: 25-28, 42.)

The strategy makes sure that the ECB's monetary policy objectives are efficiently aspired. First function for the strategy is to argue policy decision-making process. The strategy arranges sufficient information and analyses for the Governing Council to execute policy that attain objectives. Secondly, the strategy is tool related to the communication with the public. The monetary policy strategy is based on a broad economic anal-

ysis and a monetary analysis. That allows using monetary policy tools when controlling price stability. (ECB 2010a.)

The decisions of monetary policy actions are made by the Governing Council and the Executive Board. The Governing Council consists of the governors of the national central banks of the 16 euro area countries and members of the Executive Board. It works up the guidelines and formulates the monetary policy implementation and supervises them. That involves decisions about intermediate targets, key interest rates and liquidity. The Executive Board runs the ECB. It consists of a president, vice-president and four members who all are installed for every eight years and the offices are non-renewable. The Executive Board carries out the Governing Council's steered monetary policy, day-to-day business, prepares national central banks and the meetings of the Governing Council. In addition, the General Council is the third organ as a transitional body which operates only as long as there are non-euro members in the ESBC. (ECB 2010b.)

### 5.3. The importance of monetary policy transparency

Certain linkage with the direction of causality between monetary policy and stock markets is troubled to perceive because policy transparency and communication has been varied over time. In 1970s the FED did not even publish its monetary policy. The market participants marked it only by changes in interest rates. In 1990s monetary policy turned to be much more transparency. After 1993 the FED has published its decisions about interest rates generally. This can be a part of the diverging reactions in stock markets at different times. (Guo 2004; Van der Gruijsen 2007.) The ECB is seen to be more transparency than the FED even from the beginning of its existence (Blinder et al. 2008).

Outdated impression was that surprising monetary policy brings good results in economy. At the same time the fear was that transparency would threaten the independence and the weight of central bank. Instead, according to the present outlook, predictability and transparency of monetary policy are necessary factors when aspired to hold economy stable. Market participants' decision-making on the grounds of future expectations in addition to current realities presents the call for predictability. (Blinder et al. 2008.) The transparency of monetary policy has been noticed to be beneficial for the public predictability (see Poole, Rasche & Thornton 2002; Poole & Rasche 2003; Kohn & Sack 2003). King (2000) suggests that the transparency presents that financial markets

are less reacted to monetary policy compared to macroeconomic news. That is also wanted because the attention of the market participants should be concentrated on real economy figures instead of monetary policy announcements.

Central banks' main objective, low inflation, place demands for monetary policy practicing. As inflation consists of expectations, monetary policy has to interact to the expectations. The way to do this has been perceived to come through by increasing transparency. Transparency can be seen as an informative and open understanding of monetary policy between central bank and market participants. (van der Cruijsen & Eijffinger 2008.)

Inflation expectations are a result of central bank's planned and the past inflation. Higher transparency leads expectations to be more sensitive to the past realized monetary policy. The central bank's chances to use surprising decisions to enliven economy are impaired on the other hand. To solve this problem, ambiguity in communication may be used. (van der Cruijsen & Eijffinger 2008.)

It is not clear at present how public action and what sort of communication central bank should carry on. (Ehrmann & Fratzscher 2007a; Blinder et al. 2008). The central banks of New Zealand, Sweden and Norway are the only national central banks which have added transparency further by publishing the forecasts of upcoming interest rate paths. On top of these central banks, the Bank of England is the pioneer of monetary policy transparency (Blinder et al. 2008:8). The monetary policy transparency of three world's most important central banks (the FED, the ECB and the Bank of Japan) deviates slightly. The FED does not externalize exact price stability target or justify entirely the monetary policy actions. The ECB does not publish the proceedings of the Governing Council. However, the monetary policy actions of separate central banks do not differ in practice. (Gerdesmeier, Mongelli & Roffia 2007: 1815–1816.)

Transparency can be classified to five categories according to Geraats (2002). Political transparency states mainly central bank goals, ordinarily inflation targets. Other exposed things are central bank independence and the motives of policy makers. Economic transparency shows the knowledge about the economy, for example the economic data, policy models and internal forecasts. Procedural transparency refers how the procedures used to execute monetary policy are stated. The strategy, minutes and voting records are published to make procedures clear. Policy transparency involves instant presentment of policy decisions and its reasons and future policy paths. Operational transparency

means how directly the problems in the implementation of decisions and the macroeconomic disturbances are stated. The types of share information are shared to these classes by van der Cruijsen and Eijffinger (2007):

**Table 6.** The five classes of transparency.

**Political**
- Goals laid down
- Main task is supporting the economy
- Main task is supporting price stability
- Main goal expressed by a number
- Is independent

**Economic**
- Provides economic data
- Provides economic forecasts
- Provides economic models

**Procedural**
- Interest rate decisions are made in a clear fashion
- Provides comprehensive minutes
- Provides voting records

**Policy**
- Announces interest rate decisions immediately
- Immediately explains the interest rate decision
- Tells future policy preferences

**Operational**
- Provides information about relevant economic shocks
- Provides information about forecasting errors
- Provides information about its performance

Other impact of transparency is increased concurrence among monetary policy analysts. Biefang-Frisancho Mariscal and Howells (2007) find that the improved ability to forecast policy actions is not concentrated on policy itself but inflation rate forecasts. As against, Bauer, Eisenbeis, Waggoner and Zha (2006) show that the forecasts of market participants have become more concurrence but are not more accurate overall.

The empirical surveys show that procedural transparency can be even harmful from the viewpoint of criticality. Meade and Stasavage (2004) argue that the quality of discus-

sion and debate are possible to decrease. Van der Cruijsen and Eijffinger (2008: 30) notice that other types of transparency are favorable.
Van der Cruijsen, Eijffinger and Hoogduin (2008) find out the optimal degree of transparency which minimizes the inflation persistence. Lower than optimal transparency weakens the markets' inflation forecasts. On the contrary, higher than optimal transparency confuse forecast makers by excess amount of information. Also, the focus may move too much to the suspicion of the quality of their forecast. Accordingly, too high transparency leads to diminished quality of forecasts.

### 5.4. The central bank's communication

The ECB can choose several ways to communicate to market participants. It uses press conferences, minutes of the meetings of the decision-making council, monthly bulletins, speeches and interviews for expose the details about overall objectives and strategy, the reasons for policy decisions, the economic outlook or future monetary policy decisions. Deciding short-run central bank communication involves the weighting between official statements, reports, minutes and speeches. As against, long-run communication is disclosing central bank's goals and strategies. This fixes also financial markets' inflation expectations. (De Haan 2008.)

The central bank communication requires discretion among different target groups of public. According to van der Cruijsen and Eijffinger (2007), there exists a discrepancy between the ECB's actual transparency and its perceptions among the market participants, even financial experts. This is due to psychological biases and defective knowledge about transparency. Authors remind that communication plays a big part of managing inflation expectations. Issing (2005) argues that the efficient communication should affect markets' expectations not only over short-run but also over longer periods.

Ehrmann and Fratzscher's (2007a) comparison between the communications of the ECB, the FED and the Bank of England implicates that the markets' response depends on the communication strategy. They find that when informing financial markets about monetary policy decisions, the delivery of committee members is more important agent than decision-making-process itself. The asset prices react more in the U.S. markets and the predictability of policy decisions are higher than in the United Kingdom and the euro area. Furthermore, the FED is able to have an influence on markets through both monetary policy and the economic outlook. The ECB and the Bank of England can in-

fluence to financial markets almost merely through monetary policy communication. The end results of different policy communications to aggregates are quite similar, so there is not necessarily certain type of optimal communication (Ehrmann & Fratzscher 2007a).

Krueger and Kuttner (1996) attested the possibility to measure the sense of unexpected changes in central bank's interest rates by using the Federal Funds futures. Kuttner (2001) found that expected changes do not cause important response on the U.S market interest rates. On the contrary, unexpected part was significant determinant. Separable surprise from anticipated change in interest rates was measured using futures market data. This methodology was contributed to stock markets by Bernanke and Kuttner (2005).

Gürkaynak, Sack and Swanson (2005) innovate that two factors of the FED's monetary policy can be separated when measuring the reactions to asset prices. The empirical findings show that *current Federal Funds rate target* is not the only factor which matters. *Future path of policy* have an influence through the markets' expectations of future monetary policy actions. That is, exploiting both factors in a controlled way in communication, the desired outcome is more liable to reach.

Blinder et al. (2008) separate efficient monetary policy communication into "create news" and "reduce noise". Reducing noise means reducing financial markets' volatility through increasing the predictability. Create news means how statements affect expectations.

Ehrmann and Fratzscher (2007b) mark the most obvious portion of monetary policy decision in which the market participants take notice. While the public announcement is given 45 minutes before the explanations for decision made at the moment, the latter has the larger shift effect and smaller volatility effect on asset prices. Also, the higher is common uncertainty about the economy development the slighter is the markets' reaction to the public announcement. That indicates that the market participants are on the watch for the explanations before the reaction.

## 5.5. The most used monetary policy instruments

Central banks have been adopted certain established instruments that supervise economy activity or execute monetary policy. Commercial banks act as a medium when money is transferred from central bank to financial markets. In table 6, the simplified balance sheet of central bank is presented (Mishkin 2007: 334). Liabilities constitute the *monetary base*. Central bank determines currency in circulation (C) and reserves (R) which includes bank deposits with the central bank. Money supply is determined based on the *monetary base* but is also affected by the *money multiplier* which quantifies how forceful the shifts in money supply mediate to economy (Freeman & Kydland 2000). Central bank trade the government bonds (G) and the discount loans (D) in assets with the financial institutions.

**Table 7.** Simplified balance sheet of central bank.

| Assets | Liabilities |
|---|---|
| (G) Government deposits | Currency in circulation (C) |
| (D) Discount loans | Reserves (R) |

*Open market operations* consist of trading with bonds (G) between central bank and financial markets. Trading impacts currency in circulation (C) and reserves (R). The discount loans (D) are credit for commercial banks granted by central bank. The price of this loan is discount rate determined by central bank. Applied interest rate is the rate determined by central bank in open market operations. This rate is basically considered to be the most followed and the most informative monetary policy instrument because it has the straightest impact on common interest level and the quantity of money in markets. *Reserve requirements* are quantitative proportion determined by central bank that commercial banks are to keep out of operative business. (Mishkin 2007: 221, 375, 378, 385.)

### 5.5.1. The ECB's used instruments

*Open market operations*

The ECB's main monetary policy instrument is the key interest rates used in main refinancing operations. The main refinancing operations are loans directed on commercial banks with a maturity generally one week and are executed weekly. The operations lay on more liquidity to the financial markets and cover majority of markets' liquidity needs. Other key interest rates are the rate on the deposit facility (banks use to make overnight deposits with the Eurosystem) and the rate on the marginal lending facility (overnight credit to banks from the Eurosystem). The key interest rates are informative and the most watched ECB's instrument. The influence on common interest rates take place thus through short-term money market rates. (ECB 2010d.)

**Table 8.** The four types of the ECB's open market operations.

| Operation | Frequency | Maturity | Function | Medium |
|---|---|---|---|---|
| The main refinancing | 1 week | 1 week | Put on liquidity<br>Implicate state of monetary policy<br>Influence short-term money market rates | Standard tenders |
| The longer-term refinancing | 1 month | 3 months | Increase longer-term liquidity | Standard tenders |
| Fine-tuning | If necessary | No regularities | Balance market rates fluctuation<br>Stem from unexpected events | Quick tenders or bilateral operations between NCB or the ECB |
| Structural | If necessary | No regularities | Contribute to the structural stature of the Eurosystem in the financial markets | No regularities |

In general, the ECB uses variable rate tenders in main refinancing operations. This procedure was in use from 28th June 2000 to 8th October 2008. As a response to the lack of liquidity and confidence in the latest financial crisis, the auctions were changed to fixed-rate tenders with full allotment. (Catalão-Lopes 2010: 200–201). However, the auction process in the main refinancing operations conducted as liquidity-providing variable rate tenders is illustrated in figure 5.

a) The ECB decides the amount of money it wants to loan
b) Bids are listed as demand curve in which counterparties offer bids about the amount of money and rates at which they are able to do transaction
c) The offered bids below minimum bid rate are discarded
d) The amount of money is distributed to counterparties in order from the highest

rate bids until the liquidity is exhausted. (ECB 2010f.)

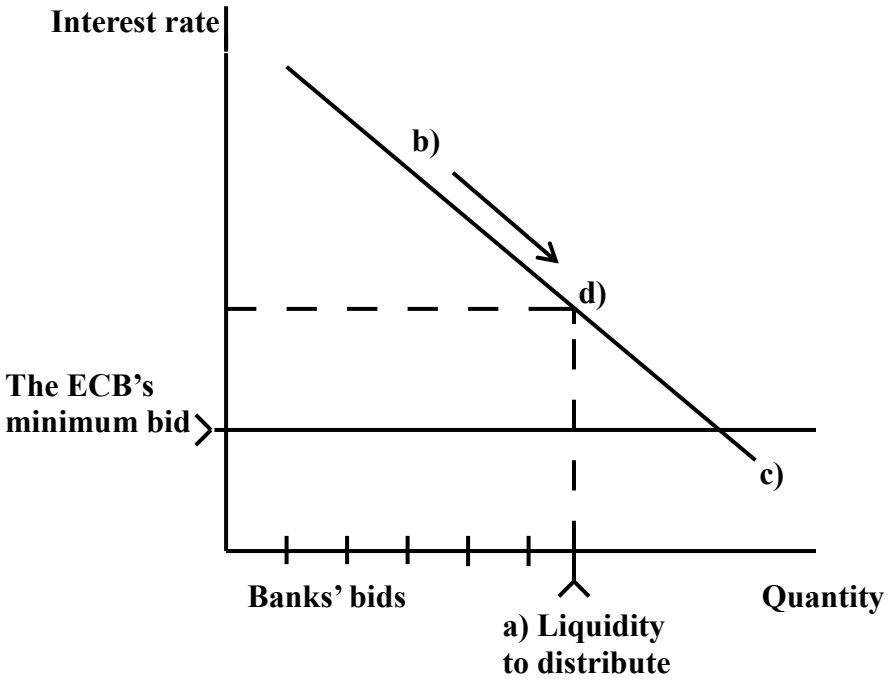


**Figure 5.** Auction process in the main refinancing operation.

*Standing facilities*

Standing facilities are aimed at bounding overnight market rates and signaling the general stance of monetary policy. Two standing facilities are available to eligible counterparties on their own initiative: the marginal lending facility and the deposit facility. Counterparties can use the marginal lending facility to obtain overnight liquidity from the national central banks against eligible assets. The interest rate on marginal lending facility normally provides a ceiling for the overnight market interest rate. Counterparties can use the deposit facility to make overnight deposits with the national central banks. The interest rate on the deposit facility normally provides a floor for the overnight market interest rate. (ECB 2010d.)

*Minimum reserves*

Minimum reserves system aim is to balance money market interest rates and determine the degree of deposits which commercial banks have to hold on accounts with the na-

tional central banks. The system regulates also the money multiplier. The interest rate of the main refinancing operations is paid for deposits. (ECB 2010d.)

### 5.5.2. The ECB publishing the level of key interest rates

In touch with the actual published decision about the key interest rate, the ECB's president introduces the arguments for the decision in monthly press conference. The order of the meeting is following:

The Governing Council makes decision about the level of key interest rate in the meeting on the first Thursday of each month. During the first three active years, the Governingn Council announced the decision about the key interest rate twice a month. The ECB publishes this decision on the same day at 13.45 CET. The ECB's president and vice-president hold a binary press conference within 45 minutes, at about 14.30. Firstly, the introductory statement goes through the arguments for the just published decision. This involves versatile analyses of the substantial economy factors. Subsequently, the audience put the questions to the authors in the discussion. (De Haan 2008.) This order prepares the way to clarify open issues among the public (Ehrmann & Fratzscher 2007b).

## 5.6. The transmission mechanism of monetary policy

Monetary policy would be unsafe to carry on if it's all influences to all real economy sectors are not known. The transmission mechanism of monetary policy is developed to recognize *channels* and causalities between monetary policy and economy aggregates. However, the amount of frameworks developed (see Bank of England 1999, Kuttner & Mosser 2002, ECB 2010e) makes hard to sum up the section for short. Thereby the basic framework which is based on Mishkin's (1995) symposium is presented to clarify the ways monetary policy influence on asset prices.

Expansive monetary policy actions are used in the following demonstration of structure pattern. Contractive actions are considered to have reversed impacts. Channels are divided to three classes which are collected to figure 6 (Mishkin 2007: 597-604):

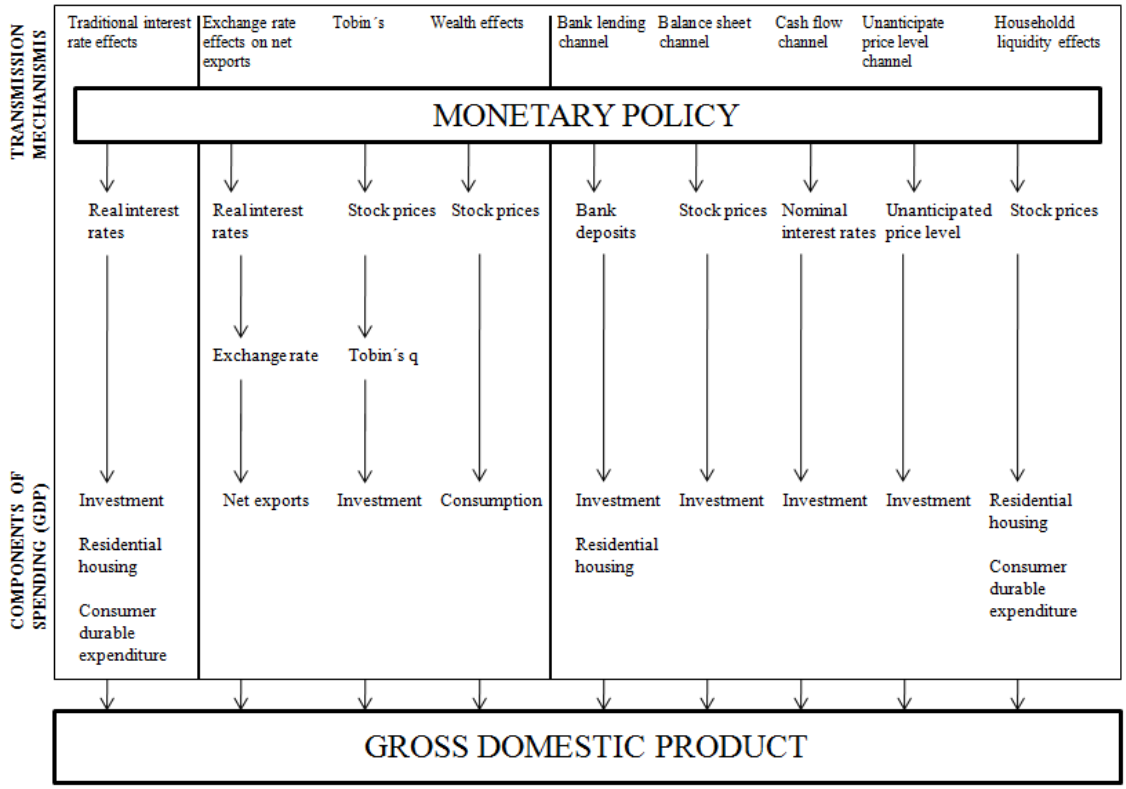


**Figure 6.** The transmission mechanisms of monetary policy.

1) *Interest rate channel*: Along with expansive monetary policy real interest rate decreases in which case investments increase due to cheapened money price. Investment is a part of demand-aggregate and its growth leads therefore increase in the level of output. Other parts are housing and consumer durable expenditure.

Wealth channels:

2) *Exchange rate channel*: Decrease in real interest rate corresponds with domestic currency devalvation relative to foreign currency. Domestic deposits become more expensive relative to deposits denominated in foreign currency. The devalvation makes domestic goods favorable and export increases. The growth of net export leads to increase in the level of output.

3) *Tobin's q channel*: Investors have more disposable money due to decrease in interest rates. The portion of money is channeled to stocks. Stock prices increase due to increased demand which leads to increase in Tobin's q and therefore also invest-

ments. The increased amount of investments increases output aggregate.

4) *Wealth effect channel*: In compliance with Tobin's q channel, decrease in interest rates leads to higher stock prices. Seeing that the portion of consumers' wealth are invested to stocks, their wealth expand. The portion of wealth is invested to residential housing and land whose prices react similarly than stock prices. Increased consumption is the resultant of the expanded wealth.

Credit channels:

5) *Bank lending channel*: Expansive monetary policy increases bank deposits. This enforces increase in bank loans. Received loans are used to finance investments when output aggregate increases.

6) *Balance sheet channel:* Net assets increase along increase in stock prices. Larger net worth leads to better capability to use collaterals. Adverse selection (the lack of confidence consequent of the lack of information in the case of financing firms) and moral hazard (firm is using loans to wrong objects, e.g. too risky objects) diminish. Accordingly, the amount of loans increases in which case investments and output aggregate increase in compliance with bank lending channel.

7) *Cash flow channel*: Decrease in nominal short-term interest rates lead to the growth in cash flows of the market participants. Adverse selection and moral hazard diminish and the results are the same than in balance sheet channel.

8) *Unanticipated price level channel*: Since loans in developed countries are nominal, the unexpected increase in price level depreciates the actual value of debt. Thereupon, proportional cash flow increases and the results are the same than in balance sheet channel.

9) *Household liquidity channel*: While the value of stocks in households' possession increase the aggregate wealth expands. In this case the probability for embarrassments decrease which leads to the increase in consumer durable expenditure and residential housing or altogether the increase in output aggregate.

Monetary policy therefore influence on stock prices through in more ways than one. Firstly, according to traditional interest channel, occurred change in the output affects to

a firm’s earnings underlying a stock. The shifts in firm’s expected future earnings shift stock price. Credit channels affect to firms future earning by determining constraints on debt financing. In addition, households’ consumption in wealth channel stimulates stock markets. The straight link to stock prices is occurred also in the effect on firm’s investments due to change in Tobin’s q. (Basistha & Kurov 2008.)

# 6. DATA AND METHODOLOGY

The data used is proposed in detail in the first part of this chapter. Second part presents the basics of econometric models used. Time horizon is limited to the period since the beginning of 1999, when ECB started to be responsible for euro area-wide monetary policy, to the 5th August 2010. The first published monetary policy decision came up 4th March 1999. The source of the ECB's monetary policy of this time scale has been provided from the Statistical Data Warehouse (ECB 2010c). Stock market data and the Euribor swap rates are received from the Thomson Financial's databases with the support of the department of Accounting and Finance at the University of Vaasa. The Eonia and the Euribor rates are gleaned from the website of the Bank of Finland (Bank of Finland 2010).

## 6.1. Monetary policy data description

The data of the ECB's monetary policy actions consists of the daily key interest rate values since the beginning of 1999 to the August 2010. During this period, the Governing Council made 173 decisions on the key interest rate. Several decisions are truncated from the data and refined data is largely used in statistical testing. During 1999–2001 the Governing Council made policy decisions twice a month. The other decision was formal and not as informative as the first meeting. These decisions are truncated, expect for two observations which are included also to the refined data sample. The governing Council decided to shift the key interest rate in the second meeting twice, 16th March 2000 and 10th May 2001.

There are also two uncommon and excess events which are truncated: firstly the decision after terrorism attacks in 11th September 2001 and secondly eight decisions after financial market crash October 2008. 8th October 2008 the ECB co-operated with other central banks and counteracted the imploding of financial markets. The surprise components of these two events are out of all proportion due to their timing surprise (also Bernanke & Kuttner (2005) excluded several unscheduled observations). The rationality of financial markets was momentarily fully confused during finance crisis. Fluctuation of stock prices was a consequence of the thorough lack of confidence which is not under central bank's control. Therefore also seven decisions from 6th November 2008 to 7th May 2009 are truncated. Finally, the refined data contains 133 observations. On top of that, some of monetary policy surprise measures (1 week and 1 month Euribor swap

rates) are available until from June 2005. This data sample consists of 63 and refined data of 55 observations.

As seen in table 8, majority of decisions does not involve shift in the key interest rate. In full data sample, 15 of those were downward shifts (positive to financial markets) and 16 upward shifts (negative to financial markets). Accordingly, 142 times the Governing Council left the key interest rates unchanged. Second panel shows the observations of the refined data. Illustrative pattern about the development of the key interest rate can be followed in figure 7.

**Table 9.** Changes in the key ECB interest rate 1999–2010.

| **Panel a. Full data sample** | | | |
|---|---|---|---|
| Δ Key interest rate | Downwards | Upwards | Unchanged |
| 0.00 % | – | – | 142 |
| 0.25 % | 5 | 14 | – |
| 0.50 % | 9 | 2 | – |
| 0.75 % | 1 | 0 | – |
| Count | 15 | 16 | 142 |
| **Panel b. Refined data sample** | | | |
| Δ Key interest rate | Downwards | Upwards | Unchanged |
| 0.00 % | – | – | 110 |
| 0.25 % | 3 | 14 | – |
| 0.50 % | 4 | 2 | – |
| 0.75 % | 0 | 0 | – |
| Count | 7 | 16 | 110 |

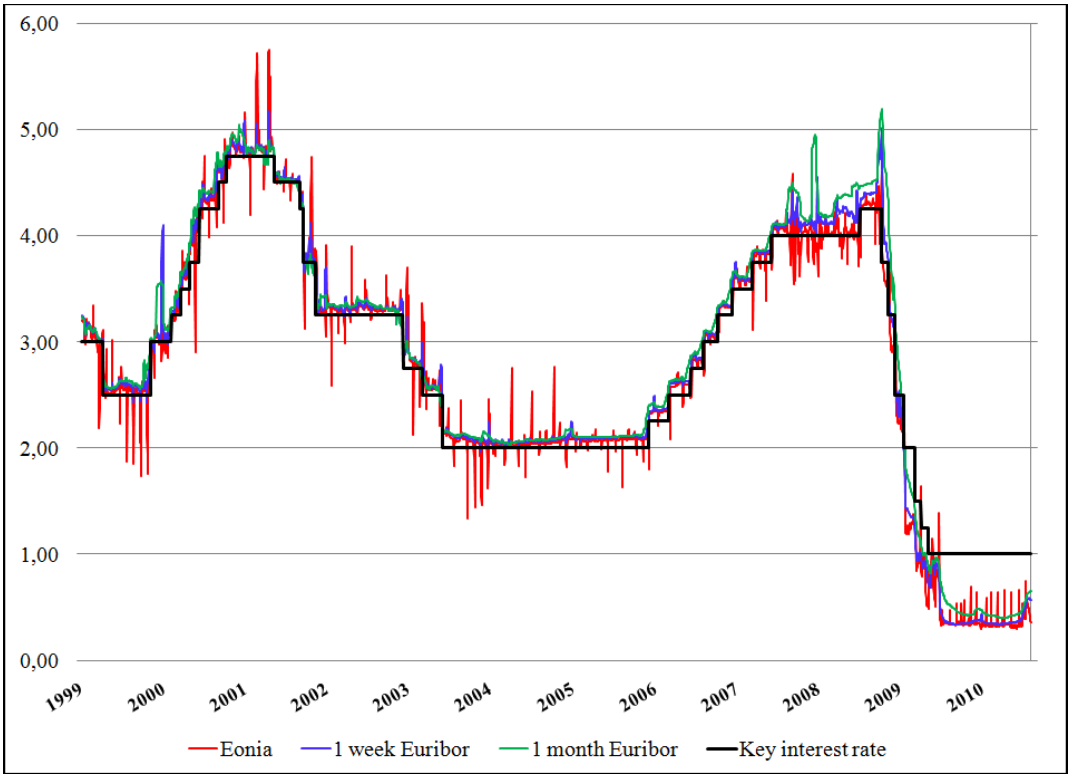


**Figure 7.** The key ECB interest rate and short-term rates over the 1999–2010 period.

*Surprise component of monetary policy announcement*

The examination of the hypotheses requires a surprise component which indicates margin between financial markets' expectations and actual shift in the key ECB interest rate. Measuring the surprise component requires two assumptions:

1) the published monetary policy decisions are the determinants of changes in the measure on publishing days
2) the measure is not susceptible to market disturbances .

In this study, positive and negative surprises are separated to measure asymmetric stock markets reactions. Positive (negative) surprise arise when the key interest rate

a) decrease more (less) than expected
b) increase less (more) than expected
c) does not change when increase (decrease) is expected

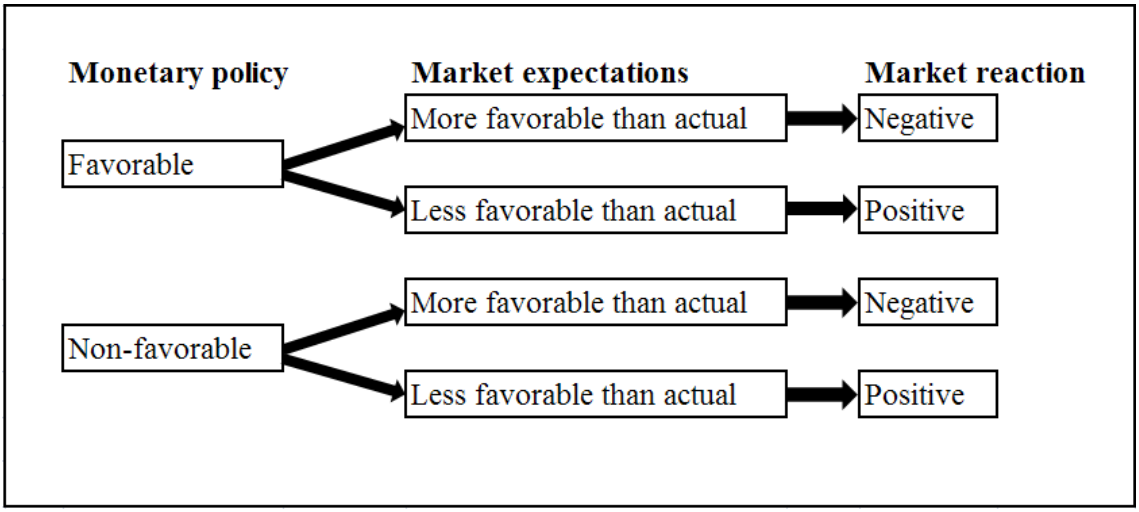


**Figure 8.** The pattern of emerged market reactions depending on expectations.

The width of financial markets' unexpectedness related to monetary policy has been measured by using changes in short money market instruments (see Roley & Sellon 1998; Kuttner 2001; Poole & Rasche 2001, Cochrane & Piazzesi 2002). Sebestyén and Sicilia (2005) argue that very short-term money market rates are good proxy to measure surprise component of monetary policy. Hassler and Nautz (2008) recognize that the Euro Overnight Index Average Rate (henceforth Eonia) follows the key ECB interest rate effectively. On the contrary, Bohl, Siklos and Sondermann (2008: 122) argue that rates with shorter maturity than one month are unreliable due to their high volatility while longer maturities are not sensitive to monetary policy decisions. Perez-Quiros and Sicilia (2002:14) also remark liquidity issues in the Eonia rate. In addition, Nautz and Offermanns (2007) find that the readjustment of the Eonia rate to the changes in the key interest rate depends on spread between those rates and the auction format. For that reason, several measures of surprise component are sampled.

Table 10 shows descriptive statistics of stock index returns on percentage-basis and market rates on basis points. The table reveals that the means and standard deviations near to zero as the maturity of a market rate increases. Although there is no remarkable difference between the means of Euribor rates, standard deviations deviate largely. Instead, the means of swap rates diverse.

**Table 10**. Descriptive statistics of market rates and the EURO STOXX index.

| N of obs. | | Mean | Std | Min | Max |
|---|---|---|---|---|---|
| 173 | **EURO STOXX** | -0.11 | 1.59 | -6.35 | 5.18 |
| | **Eonia** | -1.36 | 8.92 | -53.80 | 63.00 |
| | **Euribor 1 week** | -0.32 | 5.30 | -20.70 | 25.40 |
| | **Euribor 1 month** | -0.44 | 2.05 | -10.40 | 6.00 |
| 133 | **EURO STOXX** | -0.16 | 1.39 | -4.10 | 3.10 |
| | **Eonia** | 1.73 | 6.61 | -53.80 | 11.00 |
| | **Euribor 1 week** | 0.29 | 4.53 | -20.70 | 16.60 |
| | **Euribor 1 month** | 0.27 | 1.68 | -10.40 | 3.30 |
| 63 | **EUROSTOXX** | -0.49 | 1.78 | -6.35 | 5.18 |
| | **Euribor 1 week swap** | 1.40 | 8.96 | -36.40 | 17.50 |
| | **Euribor 1 month swap** | -0.27 | 3.48 | -17.70 | 5.60 |
| 55 | **EUROSTOXX** | -0.31 | 1.22 | -3.30 | 2.04 |
| | **Euribor 1 week swap** | 3.48 | 5.02 | -3.70 | 17.50 |
| | **Euribor 1 month swap** | 0.62 | 1.49 | -2.30 | 5.60 |

*Euro Overnight Index Average rate*

The surprise component is firstly measured by using changes in the Eonia. The Eonia is reference rate which indicates market rates for overnight unsecured loan transactions in interbank markets. The Eonia is defined by using 49 banks with the highest volume of business in the euro zone money markets. The Eonia is average rate of these banks' loans weighted by the amount of loans. It is published daily 19.00 CET. (EBF 2010a.)

The daily change in the Eonia is measured on the days when the ECB publishes its decision about the key interest rate. In equation, *KIR* denotes the key ECB interest rate. $E_{t-1}$ denotes markets' expectations about monetary policy action the day before the actual publishing.

(7) $$Surprise_t = \Delta EONIA_t = \Delta KIR_t - E_{t-1}[\Delta KIR_t]$$

Account for time-varying KIR-Eonia spread and its volatility is needed. The ECB adjudicated in March 2004 to shorten the maturity of main refinancing operations and

change the reserve maintenance period. These changes in the ECB's operational framework have led to reduced speculation in money markets and more permanent KIR-Eonia spread. (ECB 2004; Jardet & Le Fol 2007.) Hassler and Nautz (2008) report that the spread has increased from 5 (before March 2004) to 8 (after March 2004) basis points for no apparent reason. They show that this is likely due to the ECB's declined controllability of the KIR-Eonia spread. Lintzert and Schmidt (2007) show that the most part of the spread after March 2004 to August 2006 can be explained by liquidity deficit in banking sector. Their important finding about the insignificance of future interest rate expectations behind the varying spread allows ignoring the fluctuation. Despite the fluctuating spread, there is no threat for biased results of measured surprise component. The widening of the KIR-Eonia spread has gone on slowly over time. Since the surprise proxy is measured in daily terms, the widening is unrelevant.

The attention must turn also to the fact that markets do not react only to the raw decision about the level of key interest rate on the day. On top of that, the ECB publish information and statistics about economy development overall related to the monetary policy decision. Ignoring intraday movements in market rates excludes facts about in which part of monetary policy process they react. Prior intraday studies (see Sebastyén & Sicilia 2005; Ehrmann & Fratzscher 2007b) share the view that the main effect in financial markets comes from the introductory statement. That means the decision itself is not as informative as its underlying motives published in press conference. Further, the more surprising is a decision, the larger are the anticipations to the arguments. (Ehrmann & Fratzscher 2007b.)

Market watchers are eager to forecast upcoming monetary policy actions up to year forwards. In general, the next policy action about the key interest rate is well-known. Ross (2002) shows that the large changes and cuts in the key ECB interest rate embodied remarkable surprise components during the first three active years of the ECB monetary policy. Using the same time period, Perez-Quiros and Sicilia (2002: 38) also find that the financial markets can fully predict the ECB's contractive actions but not as well expansive ones.

*Euro Interbank Offered rates*

Other measures for the surprise component are changes in Euro Interbank Offered rates (henceforth Euribor) for one week and one month maturity. The definition of the Euribor is quite similar to the Eonia. The Euribor rate is reference rate that is calculated av-

erage from 42 representative banks' quotes for willingness to lend to prime banks for certain maturity within the EMU zone. It is published daily 11.00 CET. (EBF 2010b)

Swap rates for one week and one month Euribor are used as well. Those rates have been used earlier by Perez-Quiros and Sicilia (2002), Ehrmann and Fratzscher (2007a) and Bohl et al. (2008). Euribor swap rates are available from 20th June 2005. Therefore full swap data includes 63 observations and refined data 55 observations. The comparison with the positive and negative surprises is not made by using swap rates due to the lack of observations. When the Euribor rates and swap rates are used, the surprise component is calculated similarly as in equation 8.

## 6.2. Stock market data description

Full stock market data contains 2983 daily closing quotations of each stock belonged to the EURO STOXX index. The EURO STOXX index consists of approximately 300 liquid stocks of large, mid and small capitalization companies of 12 Eurozone countries. (STOXX 2010). There exists lacks in stocks' quotations. A stock is excluded from data sample if it does not have quotation on monetary policy decision day or its measured characteristic is missing. Therefore the amount of selectable stocks ranges between 224 (in 1999) to 308 (in 2010). Stocks react largely within the same day the central bank announces its monetary action. (Pearce & Roley 1983). This notice allows using change from previous day closing quotation to announcement day closing quotation as a stock markets' reaction.

### *Portfolio construction*

The stock characteristics under consideration are firm size, financial standing and profitability and measured by market capitalization, equity ratio and return on assets ratio (ratio formulas are reported in appendix 1.). To construct portfolios, the applied way of Thorbecke (1997: 638) is used. That is, to define firm's suitability to certain portfolio, its defined suitability-value at the end of previous year is used.

The firms are sorted by fifth based on these characteristics. Every firm included in the data is therefore placed to some of the five equally-weighted portfolios for every characteristic. Stock characteristics are updated annually, based on firms' financial statements. Reasonably, deliberation on the correlation between firm characteristics is need-

ed. Only weak perceived correlation is found between return on assets and equity ratio which implies that higher amount equity relative to debt produces higher profitability ratio. Thus there is not the considerable threat of wrong interpretation what factor causes the reaction to surprise in the portfolios.

**Table 11.** Descriptive statistics of firm characteristics (full data sample).

| | **Profitability (%)** | **Size (mil. €)** | **Equity ratio** |
|---|---|---|---|
| **Mean** | 5.37 | 11494.430 | 0.515 |
| **Median** | 4.88 | 4821.726 | 0.530 |
| **Maximum** | 62.35 | 222876.300 | 1.057 |
| **Minimum** | -274.06 | 5.863 | -3.578 |
| **Std. Dev.** | 8.54 | 18214.540 | 0.281 |
| **Skewness** | -10.46 | 3.745 | -2.208 |
| **Kurtosis** | 351.19 | 25.150 | 31.150 |
| **Observations** | 3445 | 3303 | 3529 |
| **CORRELATIONS** | **Profitability** | **Size** | **Solvency** |
| **Profitability** | 1 | | |
| **Size** | 0.0259 | 1 | |
| **Solvency** | 0.2656 | -0.0877 | 1 |
| **PORTFOLIO MEANS** | **Profitability** | **Size** | **Solvency** |
| **Portfolio 1** | -1.81 | 1034.72 | 0.14 |
| **Portfolio 2** | 2.60 | 2443.84 | 0.39 |
| **Portfolio 3** | 4.89 | 4877.79 | 0.54 |
| **Portfolio 4** | 7.15 | 10023.92 | 0.66 |
| **Portfolio 5** | 14.29 | 38890.29 | 0.87 |

## 6.3. Methodology

The outline of empirical testing process is following:

1) The parameter estimates of the effect of monetary policy decisions on stock portfolio returns are calculated by using ordinary least squares method in linear regression model

2) Seemingly unrelated regressions method is applied to estimate parameters in equations

3) The Wald coefficient restrictions test is used to check for equality of parameters and compare asymmetric effects

4) Multiple regression model and shared data sample is used to test nonlinearity and positive and negative surprises separately

The first estimated linear regression model (equation 8) includes observations on the days when the ECB published its monetary policy decision about the key interest rate. Dependent variable is logarithmic daily change in a portfolio's value and explanatory variable is monetary policy announcement. First three hypotheses are investigated by using identical method of implementation. In this part, positive and negative surprises are not separated. The baseline estimates are based on simple linear regression model. Thereafter regressions are controlled against heteroskedasticity by using White heteroskedasticity-consistent estimates. Similar methodology is used in several prior studies (see Guo 2004; Ehrmann & Fratzscher 2004; Basistha & Kurov 2008). Although not reported here, tests made against heteroskedasticity indicate serious variation in error terms.

In revised regression model (9) $M_t$ is added and denotes logarithmic stock market index return on day t. The examination of the fourth hypothesis differentiates positive and negative surprises to separate data samples. The prospect theory suggests also nonlinearity in the function. Therefore, a quadratic second-order nonlinearity parameter is added and formulated in equation 10.

(8) $$r_{i,t} = \alpha + \beta_i S_t + \varepsilon$$

(9) $$r_{i,t} = \alpha + \beta_1 M_t + \beta_i S_t + \varepsilon$$

(10) $$r_{i,t} = \alpha + \beta_1 M_t + \beta_i S_t + \beta_j S_t^2 + \varepsilon$$

where:
- $r_{i,t}$ = stock portfolio i's return on day t
- $\alpha$ = constant
- $\beta_i$ = regression coefficient
- $S_t$ = monetary policy surprise component on day t
- $M_t$ = the EURO STOXX index return on day t
- $\varepsilon$ = random error term

# 7. EMPIRICAL RESULTS

This chapter has two sections. Firstly, hypotheses related to the asymmetric reactions of stock prices are tested. The asymmetry is directed to firm characteristics: profitability, size and solvency. Secondly, different stock market reactions to positive and negative monetary policy surprises are tested taking possible nonlinearity into account.

## 7.1. Asymmetric returns of firm characteristic based portfolios

Tables 12 and 13 show the baseline results of testing the hypotheses related to asymmetric returns. Firstly, table 12 reports the coefficients, standard errors and p-values of simple regressions in which the dependent variable is some of the portfolios and the independent variable is one of the surprise component measures. In order to satisfy the stock price dependence on surprise, estimated coefficients should be positive. In this case, the more positive (negative) surprise generates more positive (negative) stock returns.

Surprisingly, the coefficients are systematically negative which suggests that favorable surprises cause negative returns in stock markets. This is against the understanding of dynamics between interest rates and stock prices. Despite of the fact, interpretations can be made based on how the coefficients of portfolios diverge from each other.

All p-values of the regressions in which the independent variable is the Eonia or the 1 week Euribor are undoubtedly insignificant. The expansion of the coefficients consequent on rates with longer maturities indicates that the rates with very short maturity takes only immediate monetary policy surprise into account while longer rates observe longer horizon opinions (Farka 2009: 52).

Although only two portfolios in table 12 seem to react to the ECB's monetary policy decisions, the pattern of possible unequal impacts on portfolios can be seen. The stronger coefficient and smaller p-values are in touch with lower profitability and worse debt-equity ratio. Monetary policy decisions do not generate statistically significant returns in any size-portfolios.

However, as portfolio returns are set on logarithmic basis, the interpretation of coefficient estimates is that as the magnitude of a surprise is 100 basis points, the portfolio

return in percentages is beta coefficient multiplied by 100. In some studies, some kind of rules of thumb is offered how much stock market moves if given degree of surprise occur. Bernanke and Kuttner (2005), Basistha and Kurov (2008) and Farka (2009) all conclude that theoretical 100 basis points target rate surprise leads to 4–6 percent movement in the aggregate level of the U.S stock markets. Portfolios named as Solvency 1 and Profitability 1 tend to react twice as strongly, generating 10–12 % price movement, but to the irrational direction. Anyway, standard errors are quite large for every coefficient reported in table 12.

**Table 12.** The effect of surprises on stock returns (full data).

| | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|
| | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | -0.008 | 0.010 | 0.426 | -0.013 | 0.017 | 0.441 | -0.065 | 0.044 | 0.145 |
| **Size 2** | -0.003 | 0.010 | 0.798 | -0.053 | 0.044 | 0.229 | -0.003 | 0.017 | 0.858 |
| **Size 3** | -0.000 | 0.011 | 0.973 | -0.006 | 0.018 | 0.739 | -0.049 | 0.046 | 0.284 |
| **Size 4** | -0.003 | 0.011 | 0.776 | -0.013 | 0.019 | 0.504 | -0.072 | 0.050 | 0.150 |
| **Size 5** | -0.001 | 0.014 | 0.943 | -0.020 | 0.024 | 0.401 | -0.078 | 0.061 | 0.206 |
| **Solvency 1** | -0.000 | 0.012 | 0.982 | -0.018 | 0.021 | 0.384 | -0.097 | 0.053 | **0.072*** |
| **Solvency 2** | 0.001 | 0.010 | 0.918 | -0.008 | 0.017 | 0.630 | -0.054 | 0.044 | 0.217 |
| **Solvency 3** | -0.004 | 0.010 | 0.687 | -0.012 | 0.017 | 0.499 | -0.069 | 0.045 | 0.127 |
| **Solvency 4** | -0.004 | 0.011 | 0.700 | -0.015 | 0.019 | 0.427 | -0.068 | 0.050 | 0.174 |
| **Solvency 5** | -0.006 | 0.011 | 0.575 | -0.001 | 0.019 | 0.941 | -0.025 | 0.049 | 0.615 |
| **Profitability 1** | -0.002 | 0.013 | 0.852 | -0.022 | 0.022 | 0.315 | -0.118 | 0.057 | **0.040**** |
| **Profitability 2** | -0.001 | 0.012 | 0.934 | -0.016 | 0.019 | 0.420 | -0.074 | 0.050 | 0.139 |
| **Profitability 3** | -0.003 | 0.010 | 0.742 | -0.004 | 0.017 | 0.802 | -0.048 | 0.044 | 0.272 |
| **Profitability 4** | 0.001 | 0.010 | 0.956 | -0.007 | 0.017 | 0.659 | -0.043 | 0.044 | 0.329 |
| **Profitability 5** | -0.009 | 0.011 | 0.398 | -0.006 | 0.018 | 0.753 | -0.029 | 0.048 | 0.547 |

The full data sample contains 173 observations from 4th March 1999 to 5th August 2010. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return on day t and $S_t$ is surprise component. Regression does not take heteroskedasticity into account. ***, **, * denotes the statistical significance of the coefficient at 1%, 5% and 10% levels, respectively.

In table 13 preceding surprise component measures are replaced by Euribor swap rates. The coefficients are stronger and standard errors smaller. Monetary policy decisions seem to cause surprises on stock markets and highly significant impact on every portfolio. As in table 12, the coefficients are systematically negative. In addition, tough divergence of significances of swap rate results compared to the Euribor and the Eonia ones raises doubt about joint determination of swap rates and stock returns. Swap rates are yet used as relevant surprise proxy (see note in section 6.1) and measurement bias are

not reported in prior literature. Despite of that issue, results indicate that either the basic model or the full data sample distorts results seriously.

**Table 13.** The effect of surprises on stock returns (full data) (b).

| | **Euribor swap 1 week** | | | **Euribor swap 1 month** | | |
|---|---|---|---|---|---|---|
| | β | SE | p-value | β | SE | p-value |
| **Size 1** | -0.051 | 0.025 | **0.047**** | -0.150 | 0.063 | **0.021**** |
| **Size 2** | -0.057 | 0.023 | **0.015**** | -0.161 | 0.058 | **0.007***** |
| **Size 3** | -0.060 | 0.022 | **0.010***** | -0.154 | 0.058 | **0.009***** |
| **Size 4** | -0.067 | 0.024 | **0.006***** | -0.167 | 0.061 | **0.008***** |
| **Size 5** | -0.059 | 0.025 | **0.019**** | -0.157 | 0.063 | **0.016**** |
| **Solvency 1** | -0.076 | 0.027 | **0.007***** | -0.186 | 0.071 | **0.011**** |
| **Solvency 2** | -0.054 | 0.021 | **0.014**** | -0.144 | 0.054 | **0.010**** |
| **Solvency 3** | -0.052 | 0.022 | **0.024**** | -0.142 | 0.057 | **0.016**** |
| **Solvency 4** | -0.068 | 0.025 | **0.009***** | -0.188 | 0.064 | **0.005***** |
| **Solvency 5** | -0.044 | 0.023 | **0.058*** | -0.129 | 0.058 | **0.030**** |
| **Profitability 1** | -0.089 | 0.028 | **0.002***** | -0.226 | 0.071 | **0.002***** |
| **Profitability 2** | -0.058 | 0.025 | **0.022**** | -0.147 | 0.064 | **0.024**** |
| **Profitability 3** | -0.051 | 0.022 | **0.021**** | -0.148 | 0.055 | **0.009***** |
| **Profitability 4** | -0.049 | 0.022 | **0.031**** | -0.132 | 0.057 | **0.024**** |
| **Profitability 5** | -0.046 | 0.023 | **0.047**** | -0.137 | 0.058 | **0.022**** |

The full data sample contains 63 observations from 7th July 2005 to 5th August 2010. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i S_t + \varepsilon$, where $r_t$ is portfolio return on day t and $S_t$ is surprise component. Regression does not take heteroskedasticity into account. ***, **, * denotes the statistical significance of the coefficient at 1%, 5% and 10% levels, respectively.

Improving the model and data sample transfigures results someway. The results in following tables (14 and 15) present results of refined data and White heteroskedasticity-consistent estimates. Non-swap rates do not bring forth any significant results. However, the coefficients from far portfolio to the other seem to shift on a sliding scale, being more visible as rate maturity increases.

Right-hand panel (1 month swap rate) in table 15 discloses some statistically significant signs of asymmetric reactions in the portfolios. The least profitable and the most indebted firms' stocks seem to react more among factor portfolios. Notable is that the absolute value of a coefficient increases when portfolio comes less profitable (range from -0.224 to -0.085) or more indebted (range from -0.253 to -0.123).

Again, size-factor does not suggest any logical regularity and thus the size-factor hypothesis is rejected. This diverges from prevalent view that small firms react more to monetary policy as Thorbecke (1997), Perez-Quiros and Timmermann (2000) and Ehrmann and Fraztscher (2004) conclude. One possible explanation is that size is less important factor in credit channel in the euro area as compared to the U.S. from where data of prior studies are collected. That means that commercial banks would not price the risk of a borrower firm grounded on firm size but on other factors.

**Table 14.** The effect of surprises on stock returns (refined data).

| | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|
| | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | -0.001 | 0.007 | 0.858 | 0.004 | 0.026 | 0.873 | 0.025 | 0.056 | 0.651 |
| **Size 2** | 0.004 | 0.009 | 0.661 | 0.005 | 0.025 | 0.841 | 0.021 | 0.069 | 0.765 |
| **Size 3** | 0.004 | 0.008 | 0.609 | 0.000 | 0.023 | 0.984 | 0.013 | 0.062 | 0.832 |
| **Size 4** | 0.005 | 0.009 | 0.618 | -0.003 | 0.027 | 0.900 | 0.014 | 0.088 | 0.875 |
| **Size 5** | 0.006 | 0.014 | 0.660 | -0.021 | 0.038 | 0.587 | -0.056 | 0.136 | 0.679 |
| **Solvency 1** | -0.002 | 0.009 | 0.843 | -0.018 | 0.027 | 0.513 | -0.045 | 0.085 | 0.598 |
| **Solvency 2** | 0.011 | 0.010 | 0.246 | 0.000 | 0.024 | 0.987 | 0.012 | 0.078 | 0.876 |
| **Solvency 3** | -0.001 | 0.009 | 0.904 | -0.006 | 0.026 | 0.822 | 0.003 | 0.080 | 0.969 |
| **Solvency 4** | 0.004 | 0.009 | 0.640 | -0.001 | 0.027 | 0.966 | 0.022 | 0.070 | 0.751 |
| **Solvency 5** | 0.005 | 0.012 | 0.641 | 0.012 | 0.030 | 0.682 | 0.029 | 0.086 | 0.736 |
| **Profitability 1** | 0.005 | 0.011 | 0.666 | -0.009 | 0.031 | 0.779 | -0.028 | 0.100 | 0.780 |
| **Profitability 2** | 0.003 | 0.009 | 0.718 | -0.017 | 0.028 | 0.552 | -0.038 | 0.093 | 0.682 |
| **Profitability 3** | 0.000 | 0.009 | 0.989 | 0.005 | 0.027 | 0.839 | 0.023 | 0.075 | 0.762 |
| **Profitability 4** | 0.005 | 0.009 | 0.531 | -0.003 | 0.022 | 0.898 | 0.018 | 0.066 | 0.780 |
| **Profitability 5** | 0.003 | 0.011 | 0.754 | 0.009 | 0.026 | 0.727 | 0.045 | 0.069 | 0.517 |

The refined data sample contains 133 observations from 4th march 1999 to 5th August 2010. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i S_t + \varepsilon$, where $r_t$ is portfolio return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the coefficient at 1%, 5% and 10% levels, respectively.

**Table 15.** The effect of surprises on stock returns (refined data) (b).

| | **Euribor swap 1 week** | | | **Euribor swap 1 month** | | |
|---|---|---|---|---|---|---|
| | β | SE | p-value | β | SE | p-value |
| **Size 1** | 0.001 | 0.040 | 0.989 | -0.169 | 0.092 | **0.072*** |
| **Size 2** | -0.008 | 0.034 | 0.808 | -0.133 | 0.089 | 0.142 |
| **Size 3** | -0.012 | 0.034 | 0.723 | -0.135 | 0.091 | 0.143 |
| **Size 4** | -0.026 | 0.032 | 0.417 | -0.181 | 0.087 | **0.042**** |
| **Size 5** | -0.032 | 0.036 | 0.374 | -0.189 | 0.089 | **0.039**** |
| **Solvency 1** | -0.046 | 0.037 | 0.224 | -0.253 | 0.108 | **0.023**** |
| **Solvency 2** | -0.013 | 0.028 | 0.650 | -0.136 | 0.073 | **0.067*** |
| **Solvency 3** | -0.010 | 0.034 | 0.776 | -0.152 | 0.091 | **0.098*** |
| **Solvency 4** | -0.011 | 0.037 | 0.774 | -0.142 | 0.088 | 0.112 |
| **Solvency 5** | 0.002 | 0.041 | 0.958 | -0.123 | 0.086 | 0.157 |
| **Profitability 1** | -0.030 | 0.038 | 0.437 | -0.224 | 0.103 | **0.034**** |
| **Profitability 2** | -0.027 | 0.035 | 0.432 | -0.187 | 0.096 | **0.058*** |
| **Profitability 3** | -0.006 | 0.034 | 0.860 | -0.147 | 0.080 | **0.071*** |
| **Profitability 4** | -0.017 | 0.031 | 0.588 | -0.163 | 0.082 | **0.052*** |
| **Profitability 5** | 0.003 | 0.038 | 0.939 | -0.085 | 0.082 | 0.303 |

The refined data sample contains 55 observations from 7th July 2005 to 5th August 2010. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i S_t + \varepsilon$, where $r_t$ is portfolio return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the coefficient at 1%, 5% and 10% levels, respectively.

Table 16 and 17 show the results of applied multiple regression model which takes portfolios' sensitivity to broad market movements into account. Only statistically significant coefficients at 5 % level are reached using Eonia rate. The coefficients of the market index are anyhow irrelevant and the attention is paid to surprise coefficients. There is some evidence for the importance of size-factor. Firstly, contrary to other factors, the coefficients go down as the firm size increase. Noticing merely this fact, implication is that small firms gain relatively more from monetary policy. This shows evidence against the results of prior studies. This order does not either can be explained rationally. However, only rational (or positive) and statistically significant coefficients appear in middle-size portfolios in table 17 and the majority of size-portfolios are immune to surprises.

**Table 16.** The effect of surprises on stock returns with market beta (refined data).

| | | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | M | 0.466 | 0.061 | (0.000) | 0.465 | 0.061 | (0.000) | 0.470 | 0.061 | (0.000) |
| | S | -0.006 | 0.006 | 0.346 | 0.008 | 0.018 | 0.677 | 0.031 | 0.044 | 0.488 |
| **Size 2** | M | 0.564 | 0.046 | (0.000) | 0.564 | 0.046 | (0.000) | 0.565 | 0.046 | (0.000) |
| | S | -0.001 | 0.004 | 0.717 | 0.009 | 0.010 | 0.372 | 0.026 | 0.022 | 0.234 |
| **Size 3** | M | 0.651 | 0.045 | (0.000) | 0.651 | 0.045 | (0.000) | 0.654 | 0.045 | (0.000) |
| | S | -0.002 | 0.004 | 0.691 | 0.005 | 0.009 | 0.546 | 0.020 | 0.025 | 0.429 |
| **Size 4** | M | 0.748 | 0.034 | (0.000) | 0.748 | 0.035 | (0.000) | 0.750 | 0.035 | (0.000) |
| | S | -0.002 | 0.004 | 0.620 | 0.002 | 0.006 | 0.698 | 0.021 | 0.017 | 0.235 |
| **Size 5** | M | 1.031 | 0.034 | (0.000) | 1.029 | 0.033 | (0.000) | 1.030 | 0.033 | (0.000) |
| | S | -0.004 | 0.004 | 0.327 | -0.013 | 0.007 | **0.072*** | -0.048 | 0.030 | 0.116 |
| **Solvency 1** | M | 0.774 | 0.051 | (0.000) | 0.771 | 0.052 | (0.000) | 0.773 | 0.052 | (0.000) |
| | S | -0.009 | 0.004 | **0.047**** | -0.012 | 0.007 | 0.096 | -0.038 | 0.022 | **0.087*** |
| **Solvency 2** | M | 0.631 | 0.039 | (0.000) | 0.632 | 0.039 | (0.000) | 0.633 | 0.039 | (0.000) |
| | S | 0.005 | 0.006 | 0.373 | 0.004 | 0.007 | 0.544 | 0.018 | 0.020 | 0.367 |
| **Solvency 3** | M | 0.666 | 0.036 | (0.000) | 0.664 | 0.037 | (0.000) | 0.669 | 0.037 | (0.000) |
| | S | -0.007 | 0.004 | **0.049**** | -0.001 | 0.008 | 0.896 | 0.010 | 0.022 | 0.649 |
| **Solvency 4** | M | 0.669 | 0.042 | (0.000) | 0.669 | 0.042 | (0.000) | 0.669 | 0.041 | (0.000) |
| | S | -0.002 | 0.004 | 0.656 | 0.004 | 0.011 | 0.736 | 0.028 | 0.028 | 0.324 |
| **Solvency 5** | M | 0.722 | 0.040 | (0.000) | 0.723 | 0.039 | (0.000) | 0.727 | 0.039 | (0.000) |
| | S | -0.001 | 0.007 | 0.846 | 0.018 | 0.012 | 0.160 | 0.037 | 0.026 | 0.161 |
| **Profitability 1** | M | 0.825 | 0.043 | (0.000) | 0.824 | 0.043 | (0.000) | 0.826 | 0.043 | (0.000) |
| | S | -0.003 | 0.005 | 0.545 | -0.003 | 0.008 | 0.732 | -0.021 | 0.023 | 0.366 |
| **Profitability 2** | M | 0.782 | 0.045 | (0.000) | 0.780 | 0.045 | (0.000) | 0.781 | 0.045 | (0.000) |
| | S | -0.004 | 0.005 | 0.400 | -0.011 | 0.006 | **0.092*** | -0.032 | 0.018 | **0.087*** |
| **Profitability 3** | M | 0.637 | 0.041 | (0.000) | 0.636 | 0.041 | (0.000) | 0.639 | 0.041 | (0.000) |
| | S | -0.006 | 0.004 | 0.170 | 0.010 | 0.010 | 0.317 | 0.029 | 0.025 | 0.244 |
| **Profitability 4** | M | 0.602 | 0.041 | (0.000) | 0.602 | 0.041 | (0.000) | 0.602 | 0.041 | (0.000) |
| | S | 0.000 | 0.005 | 0.985 | 0.002 | 0.008 | 0.842 | 0.023 | 0.024 | 0.337 |
| **Profitability 5** | M | 0.625 | 0.043 | (0.000) | 0.626 | 0.042 | (0.000) | 0.633 | 0.041 | (0.000) |
| | S | -0.002 | 0.007 | 0.739 | 0.014 | 0.013 | 0.297 | 0.052 | 0.034 | 0.127 |

The refined data sample contains 133 observations from 4th March 1999 to 5th August 2010. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis.

The coefficients of the Eonia rate are quite small and the deviations between portfolios are slight as well. Anyway, monetary policy decisions seem to impact indebted and average-debted firms' stocks. 1 month Euribor and 1 week Euribor swap measures support this. Also, the portfolio which includes firms of the highest equity ratio does not seem to react at all. This is quite opposite to Ehrmann and Fraztscher's (2004) finding that firms out of debt react the most. Some measures indicate that average-profitable firms react to surprises. Profitability does not appear to be a significant factor. Anyway, ascending coefficients of profitability and solvency are in view also in both tables 16 and 17.

**Table 17.** The effect of surprises on stock returns with market beta (refined data) (b).

| | | Euribor swap 1 week | | | Euribor swap 1 month | | |
|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value |
| **Size 1** | M | 0.932 | 0.078 | (0.000) | 0.921 | 0.080 | (0.000) |
| | S | 0.025 | 0.018 | 0.167 | -0.001 | 0.055 | 0.991 |
| **Size 2** | M | 0.908 | 0.052 | (0.000) | 0.910 | 0.054 | (0.000) |
| | S | 0.016 | 0.011 | 0.144 | 0.034 | 0.038 | 0.377 |
| **Size 3** | M | 0.959 | 0.036 | (0.000) | 0.964 | 0.037 | (0.000) |
| | S | 0.014 | 0.007 | **0.072*** | 0.041 | 0.022 | **0.063*** |
| **Size 4** | M | 0.935 | 0.025 | (0.000) | 0.933 | 0.026 | (0.000) |
| | S | -0.001 | 0.005 | 0.812 | -0.010 | 0.020 | 0.607 |
| **Size 5** | M | 0.978 | 0.021 | (0.000) | 0.978 | 0.021 | (0.000) |
| | S | -0.006 | 0.005 | 0.230 | -0.010 | 0.017 | 0.550 |
| **Solvency 1** | M | 1.073 | 0.077 | (0.000) | 1.065 | 0.080 | (0.000) |
| | S | -0.017 | 0.011 | 0.145 | -0.058 | 0.035 | 0.102 |
| **Solvency 2** | M | 0.846 | 0.034 | (0.000) | 0.847 | 0.035 | (0.000) |
| | S | 0.010 | 0.006 | 0.126 | 0.018 | 0.020 | 0.358 |
| **Solvency 3** | M | 0.934 | 0.043 | (0.000) | 0.932 | 0.045 | (0.000) |
| | S | 0.015 | 0.009 | **0.093*** | 0.018 | 0.031 | 0.566 |
| **Solvency 4** | M | 0.946 | 0.056 | (0.000) | 0.948 | 0.057 | (0.000) |
| | S | 0.014 | 0.011 | 0.199 | 0.031 | 0.038 | 0.415 |
| **Solvency 5** | M | 0.908 | 0.066 | (0.000) | 0.908 | 0.070 | (0.000) |
| | S | 0.026 | 0.016 | 0.115 | 0.043 | 0.038 | 0.269 |
| **Profitability 1** | M | 1.052 | 0.039 | (0.000) | 1.043 | 0.038 | (0.000) |
| | S | -0.002 | 0.006 | 0.768 | -0.033 | 0.021 | 0.111 |
| **Profitability 2** | M | 1.068 | 0.055 | (0.000) | 1.070 | 0.056 | (0.000) |
| | S | 0.001 | 0.008 | 0.894 | 0.009 | 0.025 | 0.728 |
| **Profitability 3** | M | 0.876 | 0.046 | (0.000) | 0.871 | 0.049 | (0.000) |
| | S | 0.017 | 0.010 | **0.087*** | 0.012 | 0.034 | 0.721 |
| **Profitability 4** | M | 0.858 | 0.049 | (0.000) | 0.853 | 0.049 | (0.000) |
| | S | 0.006 | 0.010 | 0.535 | -0.007 | 0.031 | 0.819 |
| **Profitability 5** | M | 0.851 | 0.067 | (0.000) | 0.859 | 0.072 | (0.000) |
| | S | 0.026 | 0.016 | 0.121 | 0.072 | 0.044 | 0.106 |

The refined data sample contains 55 observations from 7th July 2005 to 5th August 2010. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis.

Looking the results of various models and diverse measures all at once, the evidence which would support the hypotheses is inconclusive. This is likely due to several reasons:

1) The surprise component measures are inaccurate

2) Stock portfolios involves covert financial factors which dislocate results or omitted variable biases exist

3) One day return is not suitable to measure stock price reaction

4) The ECB's monetary policy is well predicted

The scatter plots in figure 9 (refined data is used) show that it is hard to find any defined relationship between index returns and monetary policy surprises and indicate that European stock markets are quite immune to measured surprises. Similar patterns were noticed by picturing individual portfolios. The main problem is therefore not involved in portfolio construction.

Problems which arise when surprise component is selected should not be ignored too flightily. Perez-Quiros and Sicilia (2002) as well as Bohl et al. (2008) point out the problems of the Eonia rate. Moreover, rates with longer maturities may be exposed to the many other forceful releases of macroeconomic announcements within a day. One way to improve the reliability of surprise measurement is high-frequency intraday analysis of price adjustment. However, the variability of the results depending on the choice of surprise measure indicates the necessary further clarification.

The last reason is the most likely explanation. Perez-Quiros and Sicilia (2002) find that the financial markets have predicted the Governing Council's monetary policy decisions rather well. Further, the ECB is seen to be more transparency than the FED even from the beginning of its existence (Blinder et al. 2008). Since the ECB's transparency is increased already during the last decade, the surprise shocks in stock market are naturally slight. Still, the inexplicable issue is why the most of the calculated returns are negatively correlated with surprises.

Bredin et al. (2009) find that monetary policy effects of the ECB are not detectable in the euro area. The data consist of the Bundesbank key interest rate changes during 1989–1998 and the ECB rate changes during 1999–2004. In contrast to this study, a surprise for the ECB policy actions are is measured by using the three month Euribor-futures.

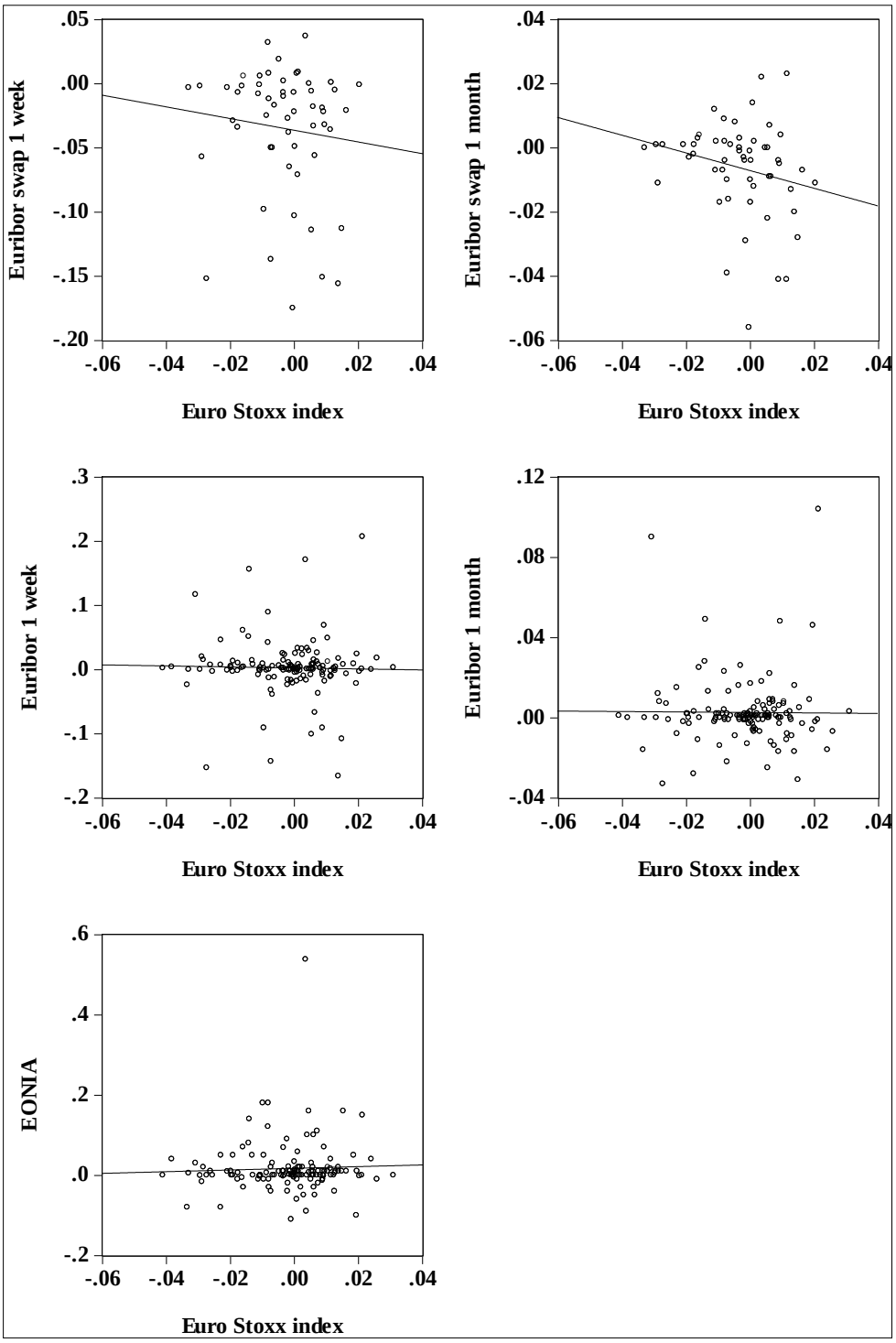


**Figure 9.** The EURO STOXX index regressed on surprise measures.

Given that the coefficients shift on a sliding scale from far portfolio to the other, the comparison is implemented by using these portfolios. The final part of this section is to make seemingly unrelated regressions (SUR) using multiple regression model (equation 9) which generate smaller standard errors. The Wald test statistics are used to check for equality of parameters and reported in table 18. The SUR parameters are reported in appendix 3 and 4.

**Table 18.** Test of asymmetric reactions of portfolios.

| Joint hypothesis $H_0$= $\beta_i$=$\beta_j$ | **Eonia** | **Euribor 1 week** | **Euribor 1 month** | **Euribor swap 1 week** | **Euribor swap 1 month** |
|---|---|---|---|---|---|
| **Size 1 = Size 5** | 0.858 | 0.161 | **0.041**** | 0.446 | 0.752 |
| **Solvency 1 = Solvency 5** | 0.561 | **0.026**** | **0.051*** | **0.016**** | **0.079*** |
| **Profitability 1 = Profitability 5** | 0.804 | 0.231 | **0.068*** | **0.060*** | **0.045**** |
| **Size 1 = Solvency 1** | 0.676 | 0.139 | **0.054*** | 0.113 | 0.493 |
| **Size 5 = Solvency 5** | 0.687 | **0.008***** | **0.007***** | **0.062*** | 0.329 |
| **Size 1 = Profitability 1** | 0.662 | 0.425 | 0.158 | 0.179 | 0.587 |
| **Size 5 = Profitability 5** | 0.707 | **0.034**** | **0.003***** | 0.113 | 0.180 |
| **Solvency 1 = Profitability 1** | 0.124 | 0.174 | 0.263 | 0.284 | 0.590 |
| **Solvency 5 = Profitability 5** | 0.976 | 0.578 | 0.252 | 0.798 | 0.333 |

The refined data sample contains 133 observations from 4th March 1999 to 5th August 2010 for Euribor rates and Eonia rate and 55 observations from 7th July 2005 to 5th August 2010 for swap rates. Joint hypothesis $H_0$= $\beta_i$=$\beta_j$ tests for equality of parameters i and j for surprise component, based on equation $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. ***, **, * denotes the statistical significance of the inequality at 1%, 5% and 10% levels, respectively.

The results support a view that firm characteristics have resonance. The direction of asymmetry is parallel with presumptions in the cases of profitability and solvency so that more prosperous and less indebted firms have more positive (or less negative in some cases) coefficients. This means that when non-favorable monetary policy surprise takes place, those firms' stock prices do not decrease as much as inverse firms' and favorable surprises generate relatively more positive returns.

Instead, the coefficients of size portfolios vary depending on the choice of surprise measure. Only statistically significant size-asymmetry is found using surprises derived from 1 month Euribor. In this case, coefficients show quite parallel, positive impacts in other size portfolios (not statistically significant) except in the largest firms' portfolio which has negative coefficient (highly statistically significant). This causes that there seems to be difference also between the largest stocks' returns compared to the most

profitable stocks and the least indebted stocks. In other cases, there are not plausible crosswise discrepancies.

## 7.2. Portfolio returns after positive and negative monetary policy surprises

The empirical testing focuses now to the last hypothesis which proposes that the stocks respond asymmetrically to positive and negative monetary policy surprises. The data is now set out to two parts and the direction of surprises is segregated. Simultaneously, observations whose surprise is null are extracted from the samples.

Albeit this study is not focused on surprises itself, the remarkable insight is that the financial markets tend to have regularly pessimistic view towards the ECB's policy announcements. That is, surprises measured by the Eonia rate are twice as often positive than negative. Correspondingly, positive surprises occur 70 % more using 1 week Euribor rate and 40 % more using 1 month Euribor rate.

Firstly, table 19 and table 20 are discussed. Negative surprises seem to impact on many portfolios mainly when the Eonia rate is used while positive surprises seem to impact more likely when longer rates are used. Anyway, the significances reported are not robust for different surprise measures but many portfolios are little conditional on monetary policy surprises regardless of the way of a surprise. Again, the negative coefficients of explanatory variables in some cases implicate results against rationality. No matter what the direction of surprise is, coefficients should be anyway positive, thus more negative surprise generate more negative stock returns and vice versa.

Only rational and statistically significant reactions are observed in profitability 3-portfolio for negative surprises and in solvency 2- and profitability 5-portfolios for positive surprises. The comparison between tables 19 and 20 exposes that negative surprises have overall stronger coefficients for surprise component and more often they have positive sign. The order is parallel with the results of intra-day dissection (Chuliá et al. 2010) but against to the prospect theory and Lobo (2000, 2002) and Farka (2009) findings that positive surprises have more sense to stock markets.

**Table 19.** The impact of negative surprises on stock returns.

| | | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | M | 0.516 | 0.094 | (0.000) | 0.707 | 0.126 | (0.000) | 0.597 | 0.101 | (0.000) |
| | S | -0.071 | 0.033 | **0.039**** | 0.022 | 0.031 | 0.471 | 0.238 | 0.189 | 0.215 |
| **Size 2** | M | 0.597 | 0.068 | (0.000) | 0.704 | 0.084 | (0.000) | 0.651 | 0.080 | (0.000) |
| | S | -0.069 | 0.023 | **0.005***** | 0.024 | 0.018 | 0.187 | 0.069 | 0.112 | 0.544 |
| **Size 3** | M | 0.727 | 0.077 | (0.000) | 0.755 | 0.070 | (0.000) | 0.721 | 0.074 | (0.000) |
| | S | -0.053 | 0.027 | **0.058*** | 0.019 | 0.013 | 0.141 | 0.064 | 0.088 | 0.471 |
| **Size 4** | M | 0.754 | 0.079 | (0.000) | 0.731 | 0.076 | (0.000) | 0.774 | 0.073 | (0.000) |
| | S | -0.031 | 0.033 | 0.361 | 0.006 | 0.011 | 0.544 | 0.002 | 0.066 | 0.977 |
| **Size 5** | M | 0.978 | 0.062 | (0.000) | 0.966 | 0.062 | (0.000) | 0.955 | 0.060 | (0.000) |
| | S | 0.001 | 0.023 | 0.958 | -0.007 | 0.006 | 0.209 | 0.002 | 0.051 | 0.965 |
| **Solvency 1** | M | 0.699 | 0.115 | (0.000) | 0.766 | 0.119 | (0.000) | 0.777 | 0.107 | (0.000) |
| | S | -0.043 | 0.040 | 0.297 | -0.003 | 0.016 | 0.854 | -0.200 | 0.119 | **0.099*** |
| **Solvency 2** | M | 0.664 | 0.095 | (0.000) | 0.734 | 0.096 | (0.000) | 0.684 | 0.079 | (0.000) |
| | S | -0.019 | 0.032 | 0.564 | 0.007 | 0.009 | 0.451 | 0.061 | 0.085 | 0.473 |
| **Solvency 3** | M | 0.688 | 0.072 | (0.000) | 0.771 | 0.094 | (0.000) | 0.723 | 0.077 | (0.000) |
| | S | -0.052 | 0.024 | **0.040**** | 0.015 | 0.014 | 0.290 | 0.148 | 0.109 | 0.180 |
| **Solvency 4** | M | 0.753 | 0.074 | (0.000) | 0.745 | 0.087 | (0.000) | 0.719 | 0.070 | (0.000) |
| | S | -0.069 | 0.027 | **0.015**** | 0.019 | 0.022 | 0.409 | 0.195 | 0.120 | 0.112 |
| **Solvency 5** | M | 0.789 | 0.055 | (0.000) | 0.864 | 0.074 | (0.000) | 0.798 | 0.066 | (0.000) |
| | S | -0.033 | 0.026 | 0.214 | 0.029 | 0.024 | 0.225 | 0.188 | 0.135 | 0.169 |
| **Profitability 1** | M | 0.806 | 0.085 | (0.000) | 0.845 | 0.090 | (0.000) | 0.840 | 0.082 | (0.000) |
| | S | -0.073 | 0.031 | **0.027**** | 0.012 | 0.014 | 0.406 | -0.063 | 0.096 | 0.514 |
| **Profitability 2** | M | 0.802 | 0.110 | (0.000) | 0.844 | 0.119 | (0.000) | 0.816 | 0.100 | (0.000) |
| | S | -0.056 | 0.035 | 0.117 | -0.002 | 0.011 | 0.871 | -0.017 | 0.088 | 0.850 |
| **Profitability 3** | M | 0.652 | 0.085 | (0.000) | 0.708 | 0.092 | (0.000) | 0.673 | 0.082 | (0.000) |
| | S | -0.038 | 0.028 | 0.189 | 0.030 | 0.016 | **0.063*** | 0.155 | 0.103 | 0.137 |
| **Profitability 4** | M | 0.717 | 0.062 | (0.000) | 0.750 | 0.063 | (0.000) | 0.680 | 0.058 | (0.000) |
| | S | -0.013 | 0.025 | 0.601 | 0.006 | 0.012 | 0.599 | 0.142 | 0.120 | 0.242 |
| **Profitability 5** | M | 0.641 | 0.065 | (0.000) | 0.762 | 0.085 | (0.000) | 0.716 | 0.068 | (0.000) |
| | S | -0.033 | 0.028 | 0.246 | 0.018 | 0.025 | 0.477 | 0.172 | 0.131 | 0.197 |

The data sample from 4th March 1999 to 5th August 2010 contains following observations: 35 for Eonia, 46 for Euribor 1 week, 48 for Euribor 1 month. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis.

**Table 20.** The impact of positive surprises on stock returns.

| | | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | M | 0.474 | 0.076 | (0.000) | 0.294 | 0.047 | (0.000) | 0.300 | 0.055 | (0.000) |
| | S | -0.007 | 0.018 | 0.717 | -0.012 | 0.012 | 0.314 | 0.004 | 0.025 | 0.872 |
| **Size 2** | M | 0.609 | 0.068 | (0.000) | 0.454 | 0.042 | (0.000) | 0.451 | 0.045 | (0.000) |
| | S | -0.001 | 0.011 | 0.945 | 0.005 | 0.010 | 0.598 | 0.015 | 0.023 | 0.514 |
| **Size 3** | M | 0.676 | 0.065 | (0.000) | 0.568 | 0.046 | (0.000) | 0.564 | 0.050 | (0.000) |
| | S | 0.006 | 0.012 | 0.597 | 0.002 | 0.009 | 0.793 | 0.014 | 0.017 | 0.423 |
| **Size 4** | M | 0.801 | 0.041 | (0.000) | 0.733 | 0.037 | (0.000) | 0.687 | 0.038 | (0.000) |
| | S | 0.005 | 0.011 | 0.659 | 0.005 | 0.009 | 0.601 | 0.031 | 0.023 | 0.176 |
| **Size 5** | M | 1.034 | 0.049 | (0.000) | 1.082 | 0.036 | (0.000) | 1.069 | 0.042 | (0.000) |
| | S | 0.003 | 0.008 | 0.649 | -0.021 | 0.013 | 0.124 | -0.056 | 0.037 | 0.137 |
| **Solvency 1** | M | 0.854 | 0.077 | (0.000) | 0.716 | 0.038 | (0.000) | 0.709 | 0.034 | (0.000) |
| | S | -0.001 | 0.011 | 0.912 | -0.018 | 0.008 | **0.025**** | -0.047 | 0.017 | **0.007***** |
| **Solvency 2** | M | 0.647 | 0.049 | (0.000) | 0.561 | 0.040 | (0.000) | 0.582 | 0.041 | (0.000) |
| | S | 0.022 | 0.012 | **0.076*** | -0.001 | 0.013 | 0.932 | 0.013 | 0.021 | 0.539 |
| **Solvency 3** | M | 0.691 | 0.049 | (0.000) | 0.596 | 0.033 | (0.000) | 0.588 | 0.033 | (0.000) |
| | S | -0.001 | 0.010 | 0.899 | -0.010 | 0.011 | 0.369 | 0.005 | 0.020 | 0.808 |
| **Solvency 4** | M | 0.681 | 0.049 | (0.000) | 0.613 | 0.041 | (0.000) | 0.570 | 0.047 | (0.000) |
| | S | -0.002 | 0.011 | 0.841 | -0.003 | 0.010 | 0.763 | 0.017 | 0.018 | 0.358 |
| **Solvency 5** | M | 0.712 | 0.040 | (0.000) | 0.645 | 0.040 | (0.000) | 0.624 | 0.044 | (0.000) |
| | S | -0.009 | 0.016 | 0.585 | 0.014 | 0.008 | 0.092 | 0.026 | 0.021 | 0.229 |
| **Profitability 1** | M | 0.822 | 0.063 | (0.000) | 0.781 | 0.049 | (0.000) | 0.794 | 0.056 | (0.000) |
| | S | 0.007 | 0.011 | 0.508 | -0.007 | 0.012 | 0.552 | -0.024 | 0.026 | 0.360 |
| **Profitability 2** | M | 0.826 | 0.059 | (0.000) | 0.705 | 0.032 | (0.000) | 0.697 | 0.032 | (0.000) |
| | S | 0.013 | 0.011 | 0.262 | -0.018 | 0.010 | **0.084*** | -0.047 | 0.023 | **0.043**** |
| **Profitability 3** | M | 0.656 | 0.048 | (0.000) | 0.578 | 0.039 | (0.000) | 0.540 | 0.041 | (0.000) |
| | S | 0.002 | 0.010 | 0.809 | 0.001 | 0.015 | 0.970 | 0.026 | 0.028 | 0.348 |
| **Profitability 4** | M | 0.615 | 0.060 | (0.000) | 0.515 | 0.044 | (0.000) | 0.517 | 0.049 | (0.000) |
| | S | 0.001 | 0.013 | 0.924 | 0.002 | 0.008 | 0.804 | 0.006 | 0.014 | 0.643 |
| **Profitability 5** | M | 0.664 | 0.050 | (0.000) | 0.550 | 0.049 | (0.000) | 0.518 | 0.055 | (0.000) |
| | S | -0.019 | 0.015 | 0.230 | 0.006 | 0.010 | 0.542 | 0.051 | 0.030 | **0.088*** |

The data sample from 4th March 1999 to 5th August 2010 contains following observations: 68 for Eonia, 78 for Euribor 1 week, 68 for Euribor 1 month. Coefficients are for the regression $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis

The final dissection is channeled into nonlinearity checking and reported in tables 21 and 22. The parameters $\beta_1$ and $\beta_2$ denotes linear dependence and second-order nonlinear dependence of surprise, respectively. Market betas are not reported. Weak signs of nonlinearity are observed in five portfolios for negative surprises. Two of them does not have significant $\beta_1$ coefficient. Positive surprises generate weak significance for nonlinearity only in two portfolios. Thus suggestive support is found that stock prices behave nonlinearly.

For negative surprises, the $\beta_2$ coefficients have negative signs which indicate that the effect of additional marginal surprise decreases as the magnitude of surprise increases. This is consistent with the prospect theory framework. Negative nonlinearity can be interpreted as following: the level of illogicality of negative $\beta_1$ coefficient decreases as surprise component increases. However, the coefficients are uncommon large (above all -21.795 in profitability 5 portfolio).

The same holds for positive surprises. The $\beta_1$ coefficients have illogical sign in all statistically significant cases except in profitability 5 portfolio in table 22. Both statistically significant $\beta_2$ coefficients are positive and indicate that as surprise component increases the stock markets illogical response increases too. This is just opposite direction than the prospect theory framework assumes.

**Table 21.** Nonlinearity checking for negative surprises.

| | | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | $\beta_1$ | -0.173 | 0.102 | 0.102 | -0.119 | 0.086 | 0.173 | -0.222 | 0.440 | 0.616 |
| | $\beta_2$ | -1.060 | 0.860 | 0.227 | -1.003 | 0.632 | 0.120 | -16.671 | 20.083 | 0.411 |
| **Size 2** | $\beta_1$ | -0.137 | 0.082 | 0.106 | -0.032 | 0.070 | 0.654 | -0.166 | 0.322 | 0.608 |
| | $\beta_2$ | -0.704 | 0.730 | 0.342 | -0.395 | 0.481 | 0.416 | -8.510 | 12.775 | 0.509 |
| **Size 3** | $\beta_1$ | -0.105 | 0.086 | 0.231 | -0.048 | 0.047 | 0.306 | -0.268 | 0.283 | 0.349 |
| | $\beta_2$ | -0.543 | 0.792 | 0.498 | -0.478 | 0.332 | 0.157 | -12.012 | 9.931 | 0.233 |
| **Size 4** | $\beta_1$ | -0.135 | 0.063 | **0.041**** | -0.039 | 0.040 | 0.336 | -0.298 | 0.280 | 0.293 |
| | $\beta_2$ | -1.087 | 0.527 | **0.048**** | -0.320 | 0.293 | 0.281 | -10.864 | 9.286 | 0.248 |
| **Size 5** | $\beta_1$ | 0.036 | 0.038 | 0.339 | -0.015 | 0.034 | 0.674 | -0.182 | 0.232 | 0.437 |
| | $\beta_2$ | 0.367 | 0.243 | 0.142 | -0.052 | 0.239 | 0.828 | -6.684 | 7.068 | 0.350 |
| **Solvency 1** | $\beta_1$ | -0.133 | 0.108 | 0.225 | -0.057 | 0.070 | 0.420 | -0.264 | 0.380 | 0.492 |
| | $\beta_2$ | -0.939 | 0.887 | 0.298 | -0.386 | 0.431 | 0.376 | -2.322 | 13.342 | 0.863 |
| **Solvency 2** | $\beta_1$ | -0.067 | 0.073 | 0.364 | -0.075 | 0.049 | 0.135 | -0.369 | 0.275 | 0.187 |
| | $\beta_2$ | -0.505 | 0.587 | 0.397 | -0.580 | 0.332 | **0.088*** | -15.589 | 9.453 | 0.106 |
| **Solvency 3** | $\beta_1$ | -0.075 | 0.063 | 0.244 | -0.042 | 0.055 | 0.441 | -0.244 | 0.297 | 0.416 |
| | $\beta_2$ | -0.234 | 0.503 | 0.645 | -0.405 | 0.383 | 0.296 | -14.198 | 11.468 | 0.222 |
| **Solvency 4** | $\beta_1$ | -0.151 | 0.079 | **0.066*** | -0.019 | 0.068 | 0.786 | -0.146 | 0.277 | 0.601 |
| | $\beta_2$ | -0.858 | 0.704 | 0.232 | -0.265 | 0.527 | 0.618 | -12.356 | 11.332 | 0.282 |
| **Solvency 5** | $\beta_1$ | -0.087 | 0.069 | 0.220 | -0.066 | 0.067 | 0.328 | -0.081 | 0.311 | 0.795 |
| | $\beta_2$ | -0.557 | 0.713 | 0.440 | -0.674 | 0.470 | 0.159 | -9.776 | 14.169 | 0.494 |
| **Profitability 1** | $\beta_1$ | -0.103 | 0.081 | 0.215 | -0.033 | 0.053 | 0.536 | -0.303 | 0.339 | 0.376 |
| | $\beta_2$ | -0.305 | 0.758 | 0.690 | -0.315 | 0.376 | 0.407 | -8.689 | 12.328 | 0.485 |
| **Profitability 2** | $\beta_1$ | -0.090 | 0.100 | 0.372 | -0.048 | 0.057 | 0.407 | -0.289 | 0.329 | 0.385 |
| | $\beta_2$ | -0.357 | 0.822 | 0.667 | -0.325 | 0.377 | 0.395 | -9.858 | 10.675 | 0.361 |
| **Profitability 3** | $\beta_1$ | -0.086 | 0.081 | 0.300 | -0.067 | 0.050 | 0.183 | -0.217 | 0.327 | 0.510 |
| | $\beta_2$ | -0.497 | 0.680 | 0.470 | -0.691 | 0.387 | **0.082*** | -13.489 | 12.334 | 0.280 |
| **Profitability 4** | $\beta_1$ | -0.090 | 0.062 | 0.158 | -0.038 | 0.048 | 0.431 | 0.145 | 0.231 | 0.532 |
| | $\beta_2$ | -0.799 | 0.701 | 0.263 | -0.316 | 0.285 | 0.273 | 0.107 | 10.408 | 0.992 |
| **Profitability 5** | $\beta_1$ | -0.151 | 0.068 | **0.034**** | -0.079 | 0.083 | 0.351 | -0.430 | 0.304 | 0.165 |
| | $\beta_2$ | -1.226 | 0.560 | **0.036**** | -0.685 | 0.607 | 0.266 | -21.795 | 12.760 | **0.095*** |

The data sample from 4th March 1999 to 5th August 2010 contains following observations: 35 for Eonia, 46 for Euribor 1 week, 48 for Euribor 1 month. Coefficients are for the regression $r_{i,t} = \alpha + \beta_0 M_t + \beta_1 S_t + \beta_2 S_t^2 + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Index-coefficients are not reported.

**Table 22.** Nonlinearity checking for positive surprises.

| | | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | $\beta_1$ | -0.022 | 0.069 | 0.746 | -0.043 | 0.056 | 0.448 | -0.017 | 0.101 | 0.869 |
| | $\beta_2$ | 0.100 | 0.415 | 0.810 | 0.188 | 0.283 | 0.510 | 0.250 | 0.997 | 0.803 |
| **Size 2** | $\beta_1$ | 0.034 | 0.052 | 0.516 | -0.024 | 0.040 | 0.539 | 0.018 | 0.069 | 0.791 |
| | $\beta_2$ | -0.218 | 0.281 | 0.440 | 0.181 | 0.210 | 0.392 | -0.038 | 0.759 | 0.961 |
| **Size 3** | $\beta_1$ | 0.007 | 0.047 | 0.889 | -0.006 | 0.042 | 0.895 | 0.042 | 0.062 | 0.503 |
| | $\beta_2$ | -0.002 | 0.294 | 0.995 | 0.048 | 0.219 | 0.827 | -0.334 | 0.637 | 0.601 |
| **Size 4** | $\beta_1$ | -0.045 | 0.037 | 0.229 | 0.028 | 0.035 | 0.424 | 0.116 | 0.075 | 0.128 |
| | $\beta_2$ | 0.317 | 0.231 | 0.175 | -0.144 | 0.185 | 0.439 | -1.016 | 0.776 | 0.195 |
| **Size 5** | $\beta_1$ | -0.031 | 0.028 | 0.269 | -0.058 | 0.028 | **0.046**** | -0.104 | 0.059 | **0.081*** |
| | $\beta_2$ | 0.217 | 0.161 | 0.181 | 0.228 | 0.150 | 0.133 | 0.576 | 0.842 | 0.496 |
| **Solvency 1** | $\beta_1$ | 0.033 | 0.051 | 0.522 | 0.022 | 0.031 | 0.481 | 0.010 | 0.068 | 0.878 |
| | $\beta_2$ | -0.215 | 0.285 | 0.454 | -0.248 | 0.168 | 0.145 | -0.690 | 0.704 | 0.331 |
| **Solvency 2** | $\beta_1$ | -0.032 | 0.040 | 0.429 | -0.030 | 0.046 | 0.517 | 0.007 | 0.079 | 0.929 |
| | $\beta_2$ | 0.343 | 0.241 | 0.160 | 0.175 | 0.236 | 0.460 | 0.071 | 0.819 | 0.931 |
| **Solvency 3** | $\beta_1$ | -0.013 | 0.039 | 0.731 | -0.074 | 0.032 | **0.026**** | -0.035 | 0.054 | 0.526 |
| | $\beta_2$ | 0.077 | 0.204 | 0.707 | 0.390 | 0.171 | **0.025**** | 0.474 | 0.588 | 0.423 |
| **Solvency 4** | $\beta_1$ | -0.030 | 0.048 | 0.529 | -0.012 | 0.036 | 0.740 | 0.007 | 0.071 | 0.920 |
| | $\beta_2$ | 0.178 | 0.287 | 0.537 | 0.053 | 0.175 | 0.761 | 0.117 | 0.703 | 0.869 |
| **Solvency 5** | $\beta_1$ | -0.013 | 0.047 | 0.775 | -0.011 | 0.042 | 0.791 | 0.054 | 0.071 | 0.449 |
| | $\beta_2$ | 0.030 | 0.331 | 0.929 | 0.156 | 0.225 | 0.491 | -0.340 | 0.715 | 0.636 |
| **Profitability 1** | $\beta_1$ | -0.026 | 0.045 | 0.564 | -0.002 | 0.042 | 0.954 | -0.006 | 0.087 | 0.943 |
| | $\beta_2$ | 0.212 | 0.259 | 0.415 | -0.031 | 0.224 | 0.892 | -0.217 | 0.939 | 0.818 |
| **Profitability 2** | $\beta_1$ | 0.024 | 0.042 | 0.569 | -0.023 | 0.038 | 0.556 | -0.048 | 0.065 | 0.466 |
| | $\beta_2$ | -0.072 | 0.259 | 0.782 | 0.029 | 0.197 | 0.882 | 0.008 | 0.738 | 0.991 |
| **Profitability 3** | $\beta_1$ | -0.042 | 0.041 | 0.312 | -0.050 | 0.036 | 0.163 | -0.072 | 0.065 | 0.268 |
| | $\beta_2$ | 0.279 | 0.221 | 0.212 | 0.310 | 0.203 | 0.132 | 1.182 | 0.664 | **0.080*** |
| **Profitability 4** | $\beta_1$ | -0.048 | 0.047 | 0.318 | 0.002 | 0.043 | 0.963 | 0.008 | 0.064 | 0.903 |
| | $\beta_2$ | 0.309 | 0.279 | 0.272 | 0.000 | 0.217 | 0.998 | -0.017 | 0.631 | 0.978 |
| **Profitability 5** | $\beta_1$ | 0.029 | 0.047 | 0.544 | -0.020 | 0.041 | 0.634 | 0.159 | 0.083 | **0.060*** |
| | $\beta_2$ | -0.300 | 0.310 | 0.337 | 0.157 | 0.238 | 0.512 | -1.288 | 0.802 | 0.113 |

The data sample from 4th March 1999 to 5th August 2010 contains following observations: 68 for Eonia, 78 for Euribor 1 week, 68 for Euribor 1 month. Coefficients are for the regression $r_{i,t} = \alpha + \beta_0 M_t + \beta_1 S_t + \beta_2 S_t^2 + \varepsilon$ , where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. Regression is applied with White heteroskedasticity-consistent standard errors and covariance. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis

## 8. CONCLUSIONS

This thesis is focused on stocks' asymmetric reactions to the ECB's monthly decisions about the level of key interest rate in European stock markets. The main purpose is to find out whether there exist unequal price responses among classified portfolios based on firm characteristics. Second purpose is to investigate what role plays nonlinearity and positive and negative surprise components separately.

Assuming that stock prices react only to unanticipated information, the surprise component of the Governing Council's decisions is required to define. For that purpose, five different short-term market rate measures are applied. The stock market reactions are measured by using stocks of the EURO STOXX index. The stock characteristics under consideration are firm size, financial standing and profitability. Portfolio returns are then calculated on policy announcement days and regressed on surprise component measure.

The empirical results of this thesis show weak evidence that a reaction to monetary policy surprise depends on the size of a firm underlying the stock. Results are not robust for different models or surprise measures to generalize hypothetical price behavior. Weak signs are found that small firms gain relatively more from surprises than large firms. Further, small and midsize stocks seem to react significantly to negative surprises (when Eonia rates are used). In contrast to the previous studies, Gertler and Gilchrist (1994), Thorbecke (1997), Perez-Quiros and Timmermann (2000), Thorbecke and Coppock (2001) and Guo (2004) agree that as the firm size becomes smaller the more the stock price suffer on tightening monetary policy. However, the results suggest that the firm size is not important factor in this context in the euro area.

There is evident difference that reaction intensity depends on equity ratio. Indebted firms seem to suffer more from surprises in every case and those firms react convincingly even after controlling different models and surprise measures. Firms with the highest equity ratio do not react statistically significantly to surprises. The results show much more negative coefficients for more indebted firms compared to self-financing firms. The Wald test rejects the hypothesis of equal parameters of portfolios with different debt-level. This is opposite to Ehrmann and Fratzscher's (2004) finding that highly indebted firms react similar to the average firm but firms out of debt react the most. Also, the evidence challenges the study of Lamont et al. (2001) in which the reactions of financial constrained firms to monetary policy do not differ from unconstrained ones. In

addition, using 1 month Euribor measure, the most indebted portfolio is susceptible to both positive and negative surprises but more to negative ones. Average-debted firms react only to negative surprises using Eonia rate.

The estimated coefficients of profitability-portfolios behave similarly with solvency-portfolios. Thus the evidence confirms also the hypothesis about the importance of profitability of a firm. More often average-profitable portfolios are statistically significant than the far portfolios. Still, the Wald test rejects the equal susceptibility of the far portfolios credibly. There is inconclusive evidence about the importance of the sign of surprise. The least profitable and average profitable firms seem to react little to negative surprises using Eonia and 1 week Euribor rates. Instead, the second least profitable and the most profitable portfolio reacts to positive ones using 1 week and 1 month Euribor rates.

The financial markets tend to have more often pessimistic consensus towards the ECB's monetary policy decisions. Positive surprises occur quantifiable much more than negative ones. The results indicate that negative surprises have more sense which is quite opposite to former understanding.

Only weak signs of nonlinearity are observed in three portfolios for negative surprises. Positive surprises generate weak significance for nonlinearity only in one portfolio. Thus suggestive support is found that stock prices behave nonlinearly but maybe in a trivial sense. However, only negative surprises generate logical nonlinearity in accordance with the prospect theory framework.

The empirical results are disconnected for the large part. The estimated coefficients and statistical significances are mobile to the regression model and selected explanatory variable. In some studies, some kind of rules of thumb is offered how much stock market moves if given degree of surprise occur. Bernanke and Kuttner (2005), Basistha and Kurov (2008) and Farka (2009) all conclude that theoretical 100 basis points target rate surprise leads to 4–6 percent movement in the aggregate U.S stock market. The quantitative interpretations are not possible to do similarly with the euro area data because regression models coefficients and standard errors are both in general unrealistic.

The results may arise from several reasons. Some problems are noticed to find indicator which measure validly and reliably monetary policy surprises. Also, high-frequency data would allow excluding other released market news during announcement days.

The conclusion is still that the Governing Council's monetary policy decisions are forecasted quite faithfully in stock markets. Since the ECB's transparency is increased already during the last decade, the surprise shocks in stock market are naturally slight. Still, the sense of credit channel is noticeable in the euro area. The evidence implies that in fact, against the preconception, small firms are in relatively better situation (as compared to large firms) when surprises about the interest rate level take place. In addition, profitability of a firm may be as important characteristic as financial standing.

These findings arouse some new interests. Firstly, it would be valuable to dissect how dissimilar are the lending practices in banking sector of the U.S. and the euro area and examine whether this fact have an influence to the dissimilar empirical results implemented by similar ways. Secondly, if this kind of pecking order appear in the stock markets and it reflects real economic effects originated from asymmetric information, government officials should try to weaken the effects which are not firms' own fault.

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# APPENDICES

## **Appendix 1.** Formulas of financial ratios.

$$Tobin's\ q = \frac{Market\ value\ of\ installed\ capital}{Replacement\ cost\ of\ capital}$$

Tobin (1969) estimated that company's market value should be averagely the same than the replacement value of company's capital.

This equation gives the ratio which can be derived into three categories:

| | |
|---|---|
| Underpriced stock: | $0 < q < 1$ |
| Precisely priced stock: | $q = 1$ |
| Overpriced stock: | $q > 1$ |

In the case of underpriced stock the replacement value of company's capital is higher than company's market value. Then the investments do not yield as much as ought from investors' point of view. In the case of overpriced stock, company is worth to redouble investments because their market value will become higher than their book value.

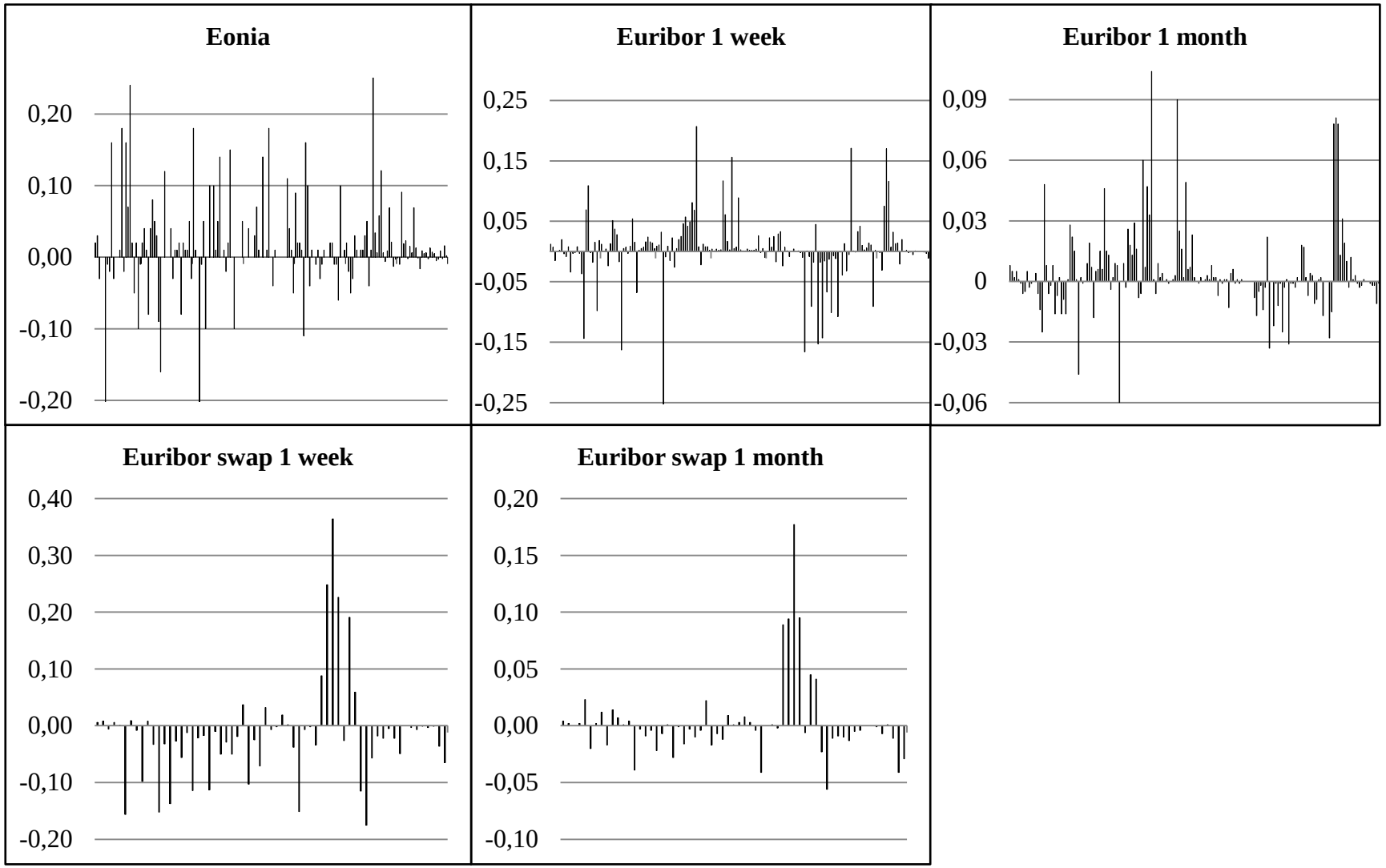
$$ROA = \frac{Earnings\ before\ interests\ and\ taxes}{Total\ assets}$$

*Return on assets* (ROA) measures how much a firm has been able to generate profits by force of both equity and leverage.

$$Equity\ ratio = \frac{Total\ equity}{Total\ assets}$$

Equity ratio measures how large proportion of total assets in balance sheet is shareholders' equity.

**Appendix 2.** Measured surprise components 1999-2010 (swap rates 2005-2010).



**Appendix 3.** SUR estimates (refined data).

| | | **Eonia** | | | **Euribor 1 week** | | | **Euribor 1 month** | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value | β | SE | p-value |
| **Size 1** | S | -0.003 | 0.009 | 0.764 | 0.009 | 0.013 | 0.510 | 0.035 | 0.035 | 0.309 |
| | M | 0.459 | 0.042 | (0.000) | 0.459 | 0.042 | (0.000) | 0.460 | 0.042 | (0.000) |
| **Size 2** | S | -0.001 | 0.007 | 0.921 | 0.009 | 0.010 | 0.341 | 0.027 | 0.027 | 0.316 |
| | M | 0.562 | 0.032 | (0.000) | 0.562 | 0.032 | (0.000) | 0.562 | 0.032 | (0.000) |
| **Size 3** | S | 0.001 | 0.006 | 0.859 | 0.006 | 0.010 | 0.509 | 0.025 | 0.025 | 0.325 |
| | M | 0.645 | 0.031 | (0.000) | 0.645 | 0.031 | (0.000) | 0.645 | 0.031 | (0.000) |
| **Size 4** | S | -0.001 | 0.005 | 0.912 | 0.003 | 0.008 | 0.720 | 0.023 | 0.020 | 0.252 |
| | M | 0.744 | 0.025 | (0.000) | 0.744 | 0.025 | (0.000) | 0.745 | 0.025 | (0.000) |
| **Size 5** | S | -0.004 | 0.004 | 0.293 | -0.013 | 0.006 | **0.032**** | -0.049 | 0.016 | **0.003***** |
| | M | 1.033 | 0.020 | (0.000) | 1.031 | 0.020 | (0.000) | 1.030 | 0.020 | (0.000) |
| **Solvency 1** | S | -0.006 | 0.007 | 0.366 | -0.011 | 0.010 | 0.288 | -0.033 | 0.028 | 0.240 |
| | M | 0.768 | 0.034 | (0.000) | 0.766 | 0.034 | (0.000) | 0.766 | 0.034 | (0.000) |
| **Solvency 2** | S | 0.007 | 0.006 | 0.239 | 0.005 | 0.008 | 0.563 | 0.021 | 0.022 | 0.354 |
| | M | 0.628 | 0.027 | (0.000) | 0.629 | 0.027 | (0.000) | 0.629 | 0.027 | (0.000) |
| **Solvency 3** | S | -0.005 | 0.006 | 0.351 | 0.000 | 0.009 | 0.956 | 0.012 | 0.023 | 0.594 |
| | M | 0.661 | 0.028 | (0.000) | 0.661 | 0.028 | (0.000) | 0.661 | 0.028 | (0.000) |
| **Solvency 4** | S | 0.000 | 0.006 | 0.965 | 0.004 | 0.009 | 0.642 | 0.031 | 0.025 | 0.212 |
| | M | 0.665 | 0.030 | (0.000) | 0.665 | 0.030 | (0.000) | 0.666 | 0.030 | (0.000) |
| **Solvency 5** | S | -0.001 | 0.006 | 0.839 | 0.018 | 0.009 | **0.059*** | 0.034 | 0.025 | 0.168 |
| | M | 0.722 | 0.030 | (0.000) | 0.723 | 0.030 | (0.000) | 0.722 | 0.030 | (0.000) |
| **Profitability 1** | S | 0.001 | 0.006 | 0.873 | -0.001 | 0.009 | 0.886 | -0.011 | 0.025 | 0.654 |
| | M | 0.816 | 0.031 | (0.000) | 0.815 | 0.031 | (0.000) | 0.815 | 0.031 | (0.000) |
| **Profitability 2** | S | -0.004 | 0.006 | 0.513 | -0.011 | 0.009 | 0.218 | -0.031 | 0.024 | 0.186 |
| | M | 0.782 | 0.029 | (0.000) | 0.780 | 0.029 | (0.000) | 0.780 | 0.029 | (0.000) |
| **Profitability 3** | S | -0.004 | 0.006 | 0.542 | 0.011 | 0.009 | 0.207 | 0.032 | 0.023 | 0.160 |
| | M | 0.631 | 0.028 | (0.000) | 0.632 | 0.028 | (0.000) | 0.632 | 0.028 | (0.000) |
| **Profitability 4** | S | -0.001 | 0.006 | 0.915 | 0.001 | 0.009 | 0.871 | 0.022 | 0.024 | 0.357 |
| | M | 0.603 | 0.029 | (0.000) | 0.602 | 0.029 | (0.000) | 0.603 | 0.029 | (0.000) |
| **Profitability 5** | S | -0.001 | 0.007 | 0.868 | 0.014 | 0.010 | 0.166 | 0.052 | 0.027 | **0.058*** |
| | M | 0.622 | 0.034 | (0.000) | 0.623 | 0.033 | (0.000) | 0.624 | 0.033 | (0.000) |

The refined data sample contains 133 observations from 4th March 1999 to 5th August 2010. Coefficients are for the seemingly unrelated regressions from the model $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis.

**Appendix 4.** SUR estimates (refined data) (b).

| | | **Euribor swap 1 week** | | | **Euribor swap 1 month** | | |
|---|---|---|---|---|---|---|---|
| | | β | SE | p-value | β | SE | p-value |
| **Size 1** | S | 0.011 | 0.013 | 0.422 | -0.020 | 0.051 | 0.699 |
| | M | 0.904 | 0.064 | (0.000) | 0.904 | 0.065 | (0.000) |
| **Size 2** | S | 0.013 | 0.009 | 0.140 | 0.033 | 0.033 | 0.320 |
| | M | 0.902 | 0.042 | (0.000) | 0.909 | 0.042 | (0.000) |
| **Size 3** | S | 0.005 | 0.007 | 0.465 | 0.021 | 0.027 | 0.425 |
| | M | 0.943 | 0.034 | (0.000) | 0.947 | 0.034 | (0.000) |
| **Size 4** | S | -0.003 | 0.005 | 0.621 | -0.015 | 0.019 | 0.455 |
| | M | 0.933 | 0.025 | (0.000) | 0.929 | 0.025 | (0.000) |
| **Size 5** | S | -0.001 | 0.005 | 0.849 | -0.001 | 0.017 | 0.934 |
| | M | 0.987 | 0.022 | (0.000) | 0.986 | 0.022 | (0.000) |
| **Solvency 1** | S | -0.018 | 0.011 | 0.119 | -0.067 | 0.043 | 0.120 |
| | M | 1.072 | 0.055 | (0.000) | 1.057 | 0.056 | (0.000) |
| **Solvency 2** | S | 0.008 | 0.007 | 0.237 | 0.019 | 0.026 | 0.475 |
| | M | 0.843 | 0.034 | (0.000) | 0.847 | 0.034 | (0.000) |
| **Solvency 3** | S | 0.007 | 0.008 | 0.380 | 0.005 | 0.031 | 0.877 |
| | M | 0.918 | 0.038 | (0.000) | 0.920 | 0.039 | (0.000) |
| **Solvency 4** | S | 0.008 | 0.009 | 0.420 | 0.019 | 0.036 | 0.604 |
| | M | 0.933 | 0.046 | (0.000) | 0.937 | 0.046 | (0.000) |
| **Solvency 5** | S | 0.021 | 0.010 | **0.036**** | 0.042 | 0.038 | 0.269 |
| | M | 0.898 | 0.048 | (0.000) | 0.908 | 0.049 | (0.000) |
| **Profitability 1** | S | -0.009 | 0.008 | 0.269 | -0.050 | 0.030 | **0.096*** |
| | M | 1.039 | 0.039 | (0.000) | 1.029 | 0.039 | (0.000) |
| **Profitability 2** | S | 0.001 | 0.008 | 0.941 | 0.006 | 0.030 | 0.851 |
| | M | 1.067 | 0.038 | (0.000) | 1.067 | 0.038 | (0.000) |
| **Profitability 3** | S | 0.008 | 0.008 | 0.289 | 0.000 | 0.031 | 0.996 |
| | M | 0.859 | 0.038 | (0.000) | 0.860 | 0.039 | (0.000) |
| **Profitability 4** | S | 0.007 | 0.009 | 0.443 | 0.001 | 0.035 | 0.967 |
| | M | 0.859 | 0.044 | (0.000) | 0.861 | 0.045 | (0.000) |
| **Profitability 5** | S | 0.019 | 0.011 | **0.085*** | 0.064 | 0.043 | 0.135 |
| | M | 0.839 | 0.054 | (0.000) | 0.852 | 0.055 | (0.000) |

The refined data sample contains 55 observations from 7th July 2005 to 5th August 2010. Coefficients are for the seemingly unrelated regressions from the model $r_{i,t} = \alpha + \beta_i M_t + \beta_i S_t + \varepsilon$, where $r_t$ is portfolios return and $M_t$ is market index return on day t and $S_t$ is surprise component. ***, **, * denotes the statistical significance of the surprise-coefficient at 1%, 5% and 10% levels, respectively. Statistical significances of index-coefficient are in parenthesis.