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The effect of ECB monetary policy shocks on the Dutch stock market

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Preface and acknowledgements

The idea of writing my bachelor thesis about the effect of ECB monetary policy shocks came to mind when I was reading the Dutch financial newspaper *Financieel Dagblad.* That day the newspaper reported that on March 18, 2020, the European Central Bank (ECB) announced a temporary asset purchase program of private and public sector securities with an overall envelope of €750 billion (European Central Bank, 2020). On the same day, the Euro Stoxx 50 recorded a negative return of -5.71%, suggesting that the purchase program did not inject enough confidence in the European stock market. This article piqued my curiosity in knowing the actual effect of an ECB monetary policy announcement on the Dutch stock market.

Lastly, I would like to thank my thesis supervisor, Y. Li, who helped me to refine my research as much as possible.

Abstract

This study aims to examine the effect of the ECB's unexpected monetary policy changes on several indices and portfolios of the Dutch stock market. The examined portfolios are based on industry and exchange rate exposure, while the indices are based on size and sector. The results show that the unexpected conventional monetary policy changes have a positive significant impact on the majority of Dutch portfolios and indices during a crisis period, while they have an insignificant effect during a non-crisis period. Furthermore, the size of the firms and the durability of the goods produced by the industry do not play a significant role in the effect of monetary policy shocks on the Dutch stock market. Finally, the portfolio containing stocks with a negative exchange rate exposure has an opposite reaction on monetary policy shocks compared to the Dutch market index (AEX).

Keywords: Monetary policy, Dutch stock market, Effect, Crisis, Conventional

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1. Introduction

On March 18, 2020, the European Central Bank (ECB) announced a temporary asset purchase program of private and public sector securities with an overall envelope of €750 billion (European Central Bank, 2020). On the same day, the Euro Stoxx 50 recorded a negative return of -5.71%, suggesting that the purchase program did not inject enough confidence in the European stock market. This policy is part of the ECB's pandemic emergency purchase program (PEPP) and is classified as an unconventional monetary instrument.

Unconventional monetary policies are applied whenever the effect of the conventional policies is not efficient enough to achieve the ECB's monetary objectives. Generally, the main task of the conventional monetary policies is to regulate the inflation in the euro area by increasing or decreasing the short-term interest rate, since a lower interest rate increases the aggregate demand and a higher interest rate does the opposite. The ECB does not regulate the short-term interest rate directly, but through instruments like open market operations, the discount rate, and reserve requirements. These three tools are classified as conventional monetary policies, whereas any other instruments are classified as unconventional monetary policies.

The effect of the monetary policy is also transmitted to the financial markets and, following the dividend discount model of equity valuation of Gordon and Shapiro (1956), there are two ways through which the ECBs monetary decisions affect the stock prices. First, a change in interest rate means a change in the discount rate for future cash flows of a firm. Second, since the monetary policy affects the aggregate demand of the market, it also influences the level of output in the short to medium term and thus the expected cash flows of the firms (Kontonikas and Kostakis, 2013).

According to the Efficient Market Hypothesis (EMH), the stock prices reflect all available information, suggesting that only the unexpected part of the monetary policy, i.e the monetary policy shock, affects the stock market. Bernanke and Kuttner (2005) and Kontonikas et al. (2013) analysed the impact of monetary policy shocks and found empirical evidence for a significant effect of a monetary policy shock on the asset market. More specifically, they report that an unexpected increase (decrease) in the policy rate is associated with a decrease (increase) in stock prices. However, the findings concerning the exact relationship between unexpected monetary policy changes and stock prices differ depending

on the methodology used and the specific stock market which is analysed (Bredin et al., 2009; Angeloni and Ehrmann 2003; Haitmsa et al., 2016).

It is therefore important to analyze the reaction of individual stock markets since within the European Union sovereign fundamentals may vary and therefore the transmission of monetary policy into the stock markets may also vary. Following the transmission differences, this study aims to examine the effect of an unexpected monetary policy change on the Dutch stock market. More precisely, the research question of this paper is:

How does the Dutch stock market react to the ECB unexpected monetary policy changes during the period 1999-2020?

The sample period includes the Financial crisis period, which implies that while under normal circumstances monetary easing will increase stock prices, in times of crisis a decrease in the policy rate may signal to investors that future economic conditions are worse than expected. If that is the case, stock returns may decrease (Kontonikas et al., 2013). This research therefore examines separately the effect of ECB monetary policy in a crisis and non-crisis period.

Furthermore, to get a deeper insight into the impact of the ECB monetary policies on the Dutch Stock market, the size and the industry of the firms are taken into account by creating different portfolios. The effect of the monetary policy may differ among firms of different sizes since it is assumed that small firms have a higher degree of asymmetric information in lending relationships than large firms. As a result, large firms can more easily finance themselves directly on financial markets and are less dependent on banks. This study examines whether this is the case for the Dutch stock market.

Besides the difference in size, this research examines if the effect of the ECB monetary policy varies across Dutch industries. Previous studies have shown that the response to monetary policy surprises differs across sectors (Bernanke and Kuttner, 2005; Haitsma et al., 2016). For instance, Bernanke and Kuttner (2005) report that high-tech, telecom, and durable goods stocks respond quite strongly to unanticipated Fed policies, whereas energy, utilities, and nondurables stocks only show a mild reaction.

Lastly, this study examines the relationship between monetary policy shocks and returns of portfolios based on the exchange rate exposure of the stocks. In fact, the study of Eichenbaum and Evans (1995) reports that an unexpected U.S. interest rate increase leads to a significant appreciation in U.S. nominal and real exchange rate. The exchange rate, in turn,

influences the stock prices (Kurihara and Fukushima, 2014; Fauziah and Moeljadi, 2015). Findings concerning the exact relationship between an exchange rate change and the stock prices are mixed and therefore this study wants to determine if Dutch stock portfolios have different reactions to a monetary policy shock depending on their exchange rate exposure.

In brief, this study contributes to the literature in four ways. First, it examines the impact of ECB monetary policy surprises on Dutch stock prices since the start of the ECB common monetary policy. Second, it distinguishes between the effect of unexpected conventional and unconventional monetary policy decisions. Third, it shows that the impact of monetary policy shocks on Dutch stock portfolios and indices is not constant across time but differs across the crisis and non-crisis period. Finally, it analyses the impact of changes in the ECB policies on returns of several indices based on size and sector, and of portfolios sorted on industry and exchange rate exposure. The latter is a portfolio from which the relationship with the unexpected monetary policy changes has not been analyzed before.

This study is relevant from a social point of view since it illustrates that a change in monetary policy, especially during a crisis, does not only have important effects on the real economy, but it is also transmitted to financial markets, particularly if they are unexpected. Therefore, policymakers in central banks, as well as financial market investors, have a great interest in understanding this transmission mechanism. Since the transmission effect is not the same for every stock (Haitsma et al., 2016), it is also important to look at the reaction of specific stock portfolios. For this reason, this study provides an analysis of Dutch stock portfolios that are based on the size, industry, and exchange rate exposure of the stocks. Investors can now take into account a more accurate estimate of the Dutch stock market's reaction to an unexpected monetary policy, when trading or investing in the Euronext Amsterdam.

The paper is organized as follows: Section 2 reports previous findings of the impact of monetary policy shocks. Section 3 shows the portfolios and regression that are used. Section 4 presents the main results. In Section 5 the results are discussed and a general conclusion is drawn.

2. Background

2.1 ECB monetary policy instruments

The ECB's conventional policy uses three main instruments: open market operations, standing facilities, and minimum reserve requirements for credit institutions (European Central Bank, 2020a). This research focuses on one of the five types of open market operations and the standing facilities since they are related to the three key interest rates. The three interest rates are adjusted every six weeks to keep the price stability in the euro area. This study examines the reaction of the Dutch stock market when the ECB announces a confirmation or change of the key interest rates.

Firstly, the main refinancing operations (MRO) rate is the interest rate banks pay when they borrow liquidity against collateral from the ECB for one week. Secondly, if banks want to borrow money from the ECB overnight, they borrow at the marginal lending facility rate which is higher than the MRO rate. The latter implies that it is cheaper for banks to borrow from the ECB for one week compared to a loan in the overnight market. The third key interest rate is the deposit facility rate, which is used by banks to make overnight deposits with the national central banks at a predetermined rate. The marginal lending rate and the deposit facility rate form the standing facilities instrument of the ECB, while the MRO rate is a component of the open market operations instrument.

In normal times the ECB is not involved in direct lending to the private sector or the government, nor in outright purchases of government bonds, corporate debt or other types of debt instruments. With the key interest rates the ECB manages the liquidity conditions in money markets and ensures price stability over the medium term. This has proved to be a reliable way of providing sufficient monetary stimulus to the economy during downturns and containing the inflation level during upturns.

In a crisis period conventional monetary policy instruments are insufficient to achieve the ECB´s objectives. This is the case when an economic shock is so heavy that the nominal interest rate has to be brought down to zero. At that point, in order to give an economic stimulus, the central bank has to use the unconventional monetary instruments since cutting the interest rate below zero is not possible (European Central Bank, 2009). The unconventional monetary policies are also necessary when the transmission mechanism is impaired, even if the interest rate level is above zero.

Unconventional monetary measures can be defined as policies that directly target the cost and availability of external finance to banks, companies and households. These sources of finance can be in the form of central bank liquidity, loans, fixed-income securities or equity. Since the cost of external finance is generally at a premium over the short-term interbank rate on which monetary policy normally leverages, unconventional measures may be seen as an attempt to reduce the spreads between various forms of external finance, thereby also affecting stock prices.

2.2 Previous studies

2.2.1 The impact of unexpected monetary policies on the stock market

When analyzing the reaction of the stock prices it is important to separate the expected monetary policy change from the unexpected change. In fact, according to the Efficient Market Hypothesis (EMH), the stock prices reflect all available information, suggesting that only the unexpected part of the monetary policy affects the stock market.

Many studies tried to show in which way the unexpected ECB monetary policy decisions affect the stock market, but the results are mixed. Several studies (Bohl et al., 2008; Hussain, 2011; Hayo and Niehof, 2011; Haitsma et al., 2016) report that an unexpected ECB interest rate decrease, i.e monetary easing, increases the stock prices, while an unexpected interest rate increase by the ECB, i.e monetary tightening, is followed by a decrease in stock prices. These results are in line with the dividend discount model of equity valuation which suggest two ways through which monetary policy affects stock prices (Gordon and Shapiro, 1956). First, if the ECB increases (decreases) the interest rate, the discount rate for future cash flows will increase (decrease), which in turn decreases (increases) the stock prices. Second, as monetary easing (tightening) can potentially increase (decrease) output in the short to medium term, it may increase (decrease) expected cash flows themselves, which consequently increase (decrease) the stock prices (Patelis, 1997; Kontonikas and Kostakis, 2013). On the other side, the risk premium hypothesis of Cornell (1983) predicts a negative relation between the money supply and the stock prices. The risk premium hypothesis states that, with a precautionary motive for holding real balances, money demand will be an increasing function of risk aversion and risk. An unexpected money supply increase reveals that, for a given level of real income, aggregate risk aversion and risk is higher than previously. Under these circumstances investors will require a higher risk premium, causing equity prices to fall.

In line with the two opposite hypotheses, there are several studies which do not report a significant relationship between the unexpected monetary policy changes and the stock

prices. For instance, Bredin et al. (2009) report that the German stock market does not respond to monetary policy surprises of the German central bank and the ECB. Likewise, Fiordelisi et al. (2014) conclude that between 2007-2012 interest rate decreases do not produce a statistically significant effect on several stock indices (MSCI Switzerland, MSCI Japan, MSCI EMU, MSCI UK and MSCI USA).

Since the effect of the monetary policy shocks may differ among stock markets, the objective of this research is to specifically examine the reaction of the Dutch stock market. Like discussed in Section 2.1, the ECB uses unconventional monetary policies when the conventional policies are not efficient enough. It is therefore important to separate the two policies when analysing the effect of unexpected monetary policies on the stock market. Like for the conventional policies, previous studies report mixed results for the effect of unconventional policies. For instance, Rogers et al. (2014) find that the announcements of unconventional monetary policy of the ECB led to positive stock reactions during the crisis, while Hosono and Isobe (2014) conclude that stock markets in the euro area reacted negatively to ECB unconventional monetary policy surprises.

2.2.2 Distinction between the crisis and non-crisis period

Besides the distinction between unconventional and conventional monetary policies, this research separates the effect of the unexpected policies into a crisis and non-crisis period. Also in this case, previous studies which consider whether stock market reactions to policy surprises differ between the pre-crisis and the crisis period, report mixed results. For instance, Jardet and Monks (2014) report that the effect of ECB monetary policy on the EURO STOXX 50 index during the crisis has not changed significantly compared to the pre-crisis period. Analogously, Hayo and Niehof (2011) concluded that there is not a significant difference between the crisis and pre-crisis period when looking at several European markets. In contrast, Wang and Mayes (2012) report that instead of the negative response to a surprise policy rate increase before the crisis, during the crisis stock markets responded positively to such changes, especially when interest rates were close to the zero lower bound. A possible explanation for the findings of Wang and Mayes (2012) is that during a crisis an increase in the policy rate may signal to investors that future economic conditions are better than expected, causing stock prices to increase (Kontonikas et al., 2013; Hosono and Isobe, 2014).

2.2.3 Size effect

Furthermore, this research examines if the size of a firm plays a role in the impact of the unexpected monetary policy changes on the Dutch stock market. Previous studies have analysed the role of size, but again with mixed results. Thorbecke (1997) reports that monetary policy shocks cause an important and statistically significant effect on the return of small firms, while large firms are less affected by unexpected interest rate changes. A possible explanation for this difference may be the higher degree of asymmetric information problems in lending relationships of the small firms. In fact, agency costs are assumed to be smaller for large firms because of the economies of scale in collecting information about their situation, which facilitates large firms to finance themselves directly on financial markets without being too dependent on banks. Besides this, greater diversification of large firms can also be reflected in a smaller external finance premium. On the other side, the results of Haitsma et al. (2016) suggest that during the pre-crisis period monetary policy surprises only have a weakly significant influence on the European large and mid-cap stocks, while no significant effect on the small-cap stocks. In the crisis period, Haitsma et al. (2016) reported no significant effect of the ECB unexpected monetary changes on the large, mid, and small-cap stocks. Considering that the results concerning the size effect are mixed, it is relevant to establish whether this effect plays a significant role in the Dutch stock market.

2.2.4 Industry effect

Some previous studies also examine whether the response to unexpected policy changes differs across sectors (Angeloni and Ehrmann 2003; Bredin et al., 2009; Bernanke and Kuttner (2005)). Again the results are inconsistent. On one hand, researchers like Angeloni and Ehrmann (2003) find that stock prices of telecommunications, consumer goods, technology and finance firms seem most sensitive to policy surprises. Likewise, Bernanke and Kuttner (2005) report that high-tech, telecom and durable goods stocks respond quite strongly to unanticipated Fed policies, whereas energy, utilities and nondurables stocks only show a mild reaction. Overall these studies suggest that the durability of the output produced by the sector is an important determinant of the impact of monetary policy shocks on stock prices. A possible explanation for these findings is that sectors with a strong dependence on bank funding will be more affected by monetary policy surprises, which is the case for capital-intensive sectors producing durable goods (Peersman and Smets, 2005; Dedola and Lippi, 2005).

On the other side, Bredin et al. (2009) find that the sectoral indices of the German stock market do not respond significantly to an unexpected change in policy rates of the ECB, while the sectoral indices in the U.K do.

Again, the divergent results of previous studies show the importance of analysing the country specific reaction of the different sectors on an unexpected monetary policy change.

2.2.5 Exchange rate exposure effect

The study of Eichenbaum and Evans (1992) reports that an expansionary U.S. monetary policy shock leads to sharp, persistent depreciation in U.S. nominal and real exchange rates. Likewise, a study of Zettelmeyer (2004) shows that a 100 basis point contractionary monetary policy shock will appreciate the exchange rate by 2-3 percent on impact. A possible explanation beyond these results is that if the interest rate of a country decreases due to monetary easing, the returns on domestic investment decline relative to the returns on foreign investment. Consequently, this cash outflow provokes an exchange rate depreciation. Likewise, an exchange rate appreciation occurs when a monetary tightening takes place.

Furthermore, an exchange rate fluctuation may lead to substantial gains or losses for firms that have a significant exchange rate exposure. The gains or losses are related to three types of risk caused by currency volatility. First, the transaction exposure refers to the amount of payments that a company has to make or receive in a foreign currency. For instance, export-oriented firms benefit more from an exchange rate depreciation than import-oriented companies. Second, the translation exposure arises from the effect of currency fluctuations on a company's consolidated financial statements, particularly when it has foreign subsidiaries. Third, the operating exposure is caused by the effect of unexpected currency fluctuations on a company's future cash flows. In fact, even if a company does not operate or sell overseas, the currency fluctuations influence its competitive position in the market (Luehrman, 1991). For example, a U.S. furniture manufacturer who only sells locally still has to contend with imports from Asia and Europe, which may get cheaper and thus more competitive if the dollar appreciates.

The degree to which companies are exposed to the risks caused by currency volatility, can be estimated as the slope of stock returns on the exchange rate change with the market returns as control variable (Booth and Rotenberg (1990) and Bodnar and Gentry (1993).
The combination of the significant impact of unexpected monetary shocks on the exchange rates reported in the studies of Eichenbaum and Evans (1992) and Zettelmeyer (2000), and the

significant impact of exchange rate changes on stock prices reported in the study of Kurihara and Fukushima, 2014, brought me to the last hypothesis. Namely, if stock portfolios with a significant negative or positive exchange rate exposure have a different reaction to monetary policy shocks compared to the general stock market reaction. Following the results of previous studies (Zettelmeyer 2000; Kurihara and Fukushima, 2014), I expect that the positive exchange rate exposure portfolio has a positive relation with unexpected monetary changes, while the second portfolio has a negative relation with the monetary policy shocks.

3. Data and Methodology

3.1 Data

3.1.1 Time period

This study looks at the effect of the unexpected ECB monetary policy changes on the Dutch stock market during the period 1999-2020. More specifically, I consider all the conventional and unconventional monetary policy decisions (European Central Bank, 2020b) that have been announced between 4 March 1999 and 23 January 2020 (see Table A1 in the Appendix). The first date refers to the first monetary policy announcement of the ECB, while the second date refers to the last policy that did not mention the coronavirus. I decided to not consider the pandemic crisis that started in March 2020 since there are not enough observations to measure the effect of this new crisis, and few observations would produce unreliable results. Besides this, I do not pool the few observations of the pandemic crisis with the observations of the financial crisis and the European debt crisis, since the nature of the crisis is too different.

The research distinguishes two periods: crisis and non-crisis. The crisis period refers to the financial crisis, which started in 2007 and ended in 2011, and the European debt crisis, which started in 2009 and ended in mid-2014. Since it is difficult to define the exact beginning and end of a crisis, I take the first unconventional monetary policy announcement on 22 August 2007 as the beginning of the crisis. The monetary policy that concludes the crisis period of this sample has been announced on 3 July 2014. I based this choice on the July 14th, 2014 statement of ECB then-president Mario Draghi, which states, for the first time, that the moderate economic recovery is expected to continue (European Central Bank, 2014). Consequently, the non-crisis period of this study is between 4 March 1999 and 22 August 2007, and 3 July 2014 and 23 January 2020.

The conventional announcement dates are provided by the ECB official site, while the unconventional monetary policy measures are provided by Haitsma et al. (2016). If the ECB announced a conventional and unconventional monetary policy on the same day, the research does not include it as observation since it is too hard to measure and separate the two effects on the Dutch stock market. Lastly, this research does not consider the unconventional monetary policies that took place after the crisis since there are not reliable methods to measure their impact on the stock market. Table A.1 in the Appendix gives an overview of the monetary policy announcement dates that are used in this research.

3.1.2 Identification of the unexpected conventional monetary policy

In order to achieve a valid analysis of the relation between ECB monetary policies and the Dutch stock market, the policy changes have to be decomposed in an expected and unexpected part. This method is in line with theories based on the efficient markets hypothesis (Fama, 1970), which suggest that only unexpected changes in monetary policy should have an impact on stock prices, since the expected component is already priced into the stock prices prior to the monetary policy announcement. The most frequently used method in the literature to obtain the unexpected part of a conventional monetary policy change is based on futures market data. In fact, it is the most accurate measure in terms of capturing the market expectation of monetary policy (Kuttner, 2001; Bernanke and Kuttner, 2005). Gürkaynak et al. (2007). Bernanke and Kuttner (2005) use federal fund futures to measure the market expectations regarding the monetary policy announcement. There exists no comparable future instrument in the Euro area, therefore I use interest rate futures contracts that are likely to be strongly influenced by the market expectations of future policy rates. More specifically, Bernoth and Hagen (2004) find that the 3-month Euribor futures rate is an unbiased and reliable predictor of ECB monetary policy changes. Following this evidence and the study of Bredin et al. (2009), I detect the expected changes in the ECB policy rate by changes in the 3-month Euribor futures rate, during the period 1999-2020. The data is retrieved from Datastream. The change in the 3-month Euribor futures rate is the difference between the rate on the day that ECB announces the monetary policy and the rate on the day before the announcement:

$$\Delta r_t^u = f_{s,t} - f_{s,t-1} \qquad (1)$$

where Δr_t^u represents the unexpected component of the conventional monetary policy at day *t*. The difference between the futures spot rate at day t and the prior rate at the day before the announcement, $t-1$, is represented by $f_{s,t} - f_{s,t-1}$. The futures rates are calculated by subtracting the daily settlement price from 100, which provides the implied expectation for the policy rate (Haitsma et al. 2016).

Following Haitsma et al. (2016), the research holds into account the expected part of the conventional monetary policy change. The use of this variable is in contrast with the efficient market hypothesis, which states that the expected component of policies is already incorporated in the price. This theory has been confirmed by the study of Kuttner (2001)

based on the U.S stock market, but I decided to use the expected component since it was significant in the more recent study of Haitsma et al. (2016) and Fausch and Sigonius (2018). The expected part of the policy change (Δr_t^e) can be represented by the difference between the actual rate change (Δr_t) and the unexpected part (Δr_t^u):

$$\Delta r_t^e = \Delta r_t - \Delta r_t^u \qquad (2)$$

3.1.3 Identification of the unexpected unconventional monetary policy

Another crucial aspect of the research is how to measure unexpected unconventional monetary policies. Some studies use survey data from professional forecasters (Ehrmann and Fratzscher (2004) for the US), while Rosa (2012) measures expectations based on newspaper articles judging whether actual Fed and Bank of England policy measures were more expansionary or restrictive than prior articles expected. However, most studies measure unexpected unconventional policy surprises utilizing asset prices. Hosono and Isobe (2014) use the changes in daily prices of 10-year German government bond futures, but as stated by Rogers et al. (2014) this is not the most correct methodology. In fact, several unconventional policies of the ECB during the crisis were aimed at reducing intra-euro area sovereign spreads, especially between lower rated euro-area government debt issuers like Greece, Italy and Portugal, and higher rated nations like Germany. For this reason I follow Rogers et al. (2014) and Fausch and Sigonius (2018), who identify unconventional monetary policy surprises using the yield spread between German and Italian 10-year government bonds at the day of an ECB policy announcement. If the spread increases following a monetary policy announcement it implies that monetary policy is tighter than expected and vice versa. The ECB continued to use unconventional monetary measures also after the crisis, but they are not included in this research since they were not applied with the aim to reduce the spread in the Eurozone between the lower and higher rated nations. Consequently, there is no data which allows the after-crisis unexpected unconventional policy to be measured. The unexpected part of the unconventional monetary policy changes is computed as follows:

$$\Delta r_t^{u,un} = (y_{s,t}^I - y_{s,t}^G) - (y_{s,t-1}^I - y_{s,t-1}^G) \qquad (3)$$

where rtu,un represents the unexpected unconventional monetary policy change, while $y_{s,t}^I - y_{s,t}^G$ represents the spread between the Italian 10-year government bond yield and the

German 10-year government bond yield, at day *t*. In order to obtain the unexpected part of the unconventional policy the difference between the spread at day *t* and the day before ($t-1$) is taken. The 10-government bond yields of Germany and Italy are retrieved from Datastream.

3.1.4 Dutch stock indices and portfolios

In order to analyze the effect of unexpected monetary policy changes on the Dutch stock market we look at the returns of the stock on the announcement day of the policy. The returns are computed as follows:

$$R_t^i = ln\frac{P_t^i}{P_{t-1}^i} \qquad (4)$$

where P_t^i represents the closing price of stock *i* at day *t*. The stock prices are retrieved from Datastream and adjusted for stock splits and similar corporate actions.

In order to understand the general reaction of the Dutch stock market to an unexpected monetary policy change, we look at the Amsterdam Exchange Index (AEX). The AEX Index is a market-value-weighted index whose components constitute the 25 companies with the largest capitalization of the Dutch stock market. In order to detect a size effect in the reaction of the Dutch stock market on monetary policy shocks, we take into account also the Amsterdam Midkap Index (AMX) and the Amsterdam Small Cap Index (AMsC). The AMsC exists since March 2005, so the observations regarding this small cap index are less than the observations for the large and mid-cap index.

With the aim of detecting the reaction of different industries in the Dutch stock market, this paper analyses two kinds of industry portfolios. First, it creates industry related portfolios of firms that are available on the Dutch stock market at least since the first common monetary policy announcement of the ECB (1999), so that the study benefits from the maximum possible observations. Table A1 in the Appendix gives an overview of the industry portfolios with its constituents. Every portfolio contains a total of ten firms and is equally weighted, so that every included stock has the same impact and the biggest firms do not influence excessively the portfolio returns. The second kind of industry portfolios are the sector indices available on the Euronext Amsterdam (see Table A.3 in the Appendix), which provide additional Dutch sectors to analyse. However, these indices have fewer observations with respect to the self-made portfolio since they were created in 2001, after the ECB already

announced several monetary policy changes. Besides this, they also contain an inconstant amount of stock components over the time and their returns have a free float market capitalization subject to 15% weighting cap. Due to the structural differences between the sector indices and sector portfolios, the effect of unexpected monetary changes may also produce different results. It is therefore important to analyse both results to understand better the reaction of the different Dutch industries.

In order to examine the effect of unexpected monetary policies on Dutch stock market portfolios with a different exchange rate exposure, I look at the reaction of the stocks on currency fluctuations between the U.S dollar ($) and the euro (€), and the renminbi (RMB) and the euro (€). The choice of the two exchange rates relies on the fact that the U.S and China are the only non-EU nations in the list containing the ten most frequent destinations (origin countries) of the Dutch goods exports (import) (CBR, 2018). The exchange rate exposure can be estimated as the relation between the stock returns available on the Euronext Amsterdam and the $/€ exchange rate changes:

$$R_t^i = \alpha + \beta_1(\$/€_t) + \beta_2(AEX_t) + \varepsilon_t \qquad (5)$$

where the R_t^i represents the returns of stock *i* at day *t*. β_1 shows the exposure of the returns of stock *i* at day *t* to the change of the $/€ rate at day *t*, while β_2 represents the effect of the control variable (AEX returns) on the returns of stock *i* at day *i*.
In order to compute the effect of a RMB/€ rate change on the stock returns the following equation is used:

$$R_t^i = \alpha + \beta_1(RMB/€_t) + \beta_2(AEX_t) + \varepsilon_t \quad (6)$$

After the exposure has been computed (Table 4), two different portfolios are built. First, a portfolio containing stocks that have a significant positive relation with changes in both exchange rates. Second, a portfolio containing stocks that have a significant negative relation with changes in both exchange rates.

3.2 Methodology

A crucial issue in empirical research of the impact of monetary policy surprises on stock prices is endogeneity, since monetary policy can react to stock market developments (Cooper, 1974). However, as pointed out by Kontonikas et al. (2013), the problem of endogeneity does not exist when daily data are used with an event study methodology. In fact, monetary policy is unlikely to be affected by changes in asset prices on the same day, so that the possibility that the results are disrupted by reverse causality running from stock prices to changes in monetary policy is minimal (Erhmann and Fratzscher (2004). For this reason the research uses an event study methodology based on daily data.

After all the necessary portfolios are built, it is possible to analyse the reaction of the Dutch stock portfolios on conventional and unconventional monetary policy shocks with two separate regressions. First, the effect of conventional ECB monetary policy changes on Dutch stock portfolios during a crisis and non-crisis period, can be computed with the following regression:

$$R_t^i = \alpha + \beta_1(1 - C_t)\Delta r_t^u + \beta_2(1 - C_t)\Delta r_t^e + \beta_3 C_t \Delta r_t^u + \beta_4 C_t \Delta r_t^e + \beta_5 MSCI_t + \varepsilon_t \qquad (7)$$

This regression follows partly the methodology of the studies of Ehrmann and Fratzscher (2004) and Haitsma et al. (2016). R_t^i represents the returns on day t of a certain stock index or portfolio i (see Section 2.1.4), and α is a constant. C_t is a dummy that takes a value of zero in a non-crisis period and the value of one in a crisis period. Δr_t^u and Δr_t^e are respectively the unexpected conventional monetary policy change and the expected conventional policy rate change on day t. The control variable *MSCI* represents the MSCI World Index (excluding Europe) to control for economic movements in the rest of the world on day t, while εt is the error term on day t. β_1 represents the effects of the monetary policy surprise on stock returns during a non-crisis period, whereas β_3 shows the effects in a crisis period. Even though the efficient market hypothesis would suggest that the expected change in the policy rate should not lead to a stock market response, following Kutnner (2001) I control for any possible response to expected changes. β_2 represents the effects of the expected monetary policy changes on stock returns during a non-crisis period, whereas β_4 shows the effects in a crisis period. Last, β_5 shows the effects of general economic movements outside Europe on Dutch stocks returns.

In order to compute the effect of unexpected unconventional monetary policies on Dutch stock portfolio returns in a crisis period, the following regression is used:

$$R_t^i = \alpha + \beta_1 \Delta r_t^{u,un} + \beta_2 MSCI_t + \varepsilon_t \qquad (8)$$

where like in *Eq. (7)*, the R_t^i represents the returns on day *t* of a certain stock index or portfolio *i*, α is a constant and ε_t is the error term at day *t*. Furthermore, β_1 shows the effect of an unexpected unconventional monetary policy change on stock returns during a crisis period, and β_2 represents the effect of general economic movements outside Europe on stock returns.

4. Results

This section reports the estimates of *Eq. (7)* and *Eq. (8)*. The data of this research is homoskedastic, since the Breusch-Pagan test does not detect heteroskedasticity. Furthermore, following the Variance Inflation Factor (Table A.5 in the Appendix) we can assume that the regression models do not suffer from multicollinearity. Note that since the ECB usually decreases or increases the key interest rates with a 0.25%-point cut or raise, the results of the conventional monetary policy effects are interpreted with a 0.25%-point surprise cut. Instead, the results of the unconventional monetary policy effects are interpreted with a decrease in the German-Italian yield spread of 0.06%-points, which refers to the average change on event days (Haitsma et al. 2016).

First, Table 1 shows the results for the AEX Index, which represents the Dutch stock market. While during a non-crisis period the conventional monetary policy shock is insignificant, it has a highly significant positive effect during a crisis period. This finding is in line with the results of Wang and Mayes (2012) and Haitsma et al (2016) for the European stock market. More specifically, a 0.25%-point surprise cut in the policy rate leads to a decrease in the AEX Index of 4.31%-point. The insignificant relationships during a non-crisis period reflects the findings of Bredin et al. (2009). In line with the study of Haitsma et al. (2016), but contrary to the EMH hypothesis (Fama, 1970), also the effect of the expected conventional policy change is highly positively significant in a crisis period, but not in a non-crisis period (Table 1). As Table 1 and 2 show, the expected monetary policy changes variable is significant in several cases, but it will not be discussed in an extensive way since it is not the main variable of interest. Lastly, the unexpected unconventional policy changes do not have a significant effect on the Dutch stock market, represented by the AEX Index (see Appendix Table A.6).

As anticipated in Section 2.2.3, beside the big cap (AEX), also the mid cap (AMX) and small (AMsC) indices of the Dutch stock market are considered, in order to examine the presence of a size effect. For the non-crisis period both the unexpected and expected conventional monetary policy changes are insignificant. Instead, during a crisis period the big, mid and small-cap indices all have a highly positive significant reaction to the unexpected monetary policy changes. Contrary to the study of Thorbecke (1997) which reports a size effect in the reaction to monetary policy shocks, the coefficients of the Dutch small cap index (AMsC) are not higher than the coefficients of the Dutch big cap or mid cap indices. More

precisely, a 0.25%-point surprise cut in the policy rate leads to a decrease in the mid-cap Index of 3.67%-point, while a 0.25%-point surprise cut in the policy rate leads to a decrease in the small-cap Index of 3.31%-point. Besides the Dutch big cap index, also the mid and small-cap indices do not have a significant relationship with unexpected unconventional monetary policy changes (see Appendix Table A.6).

Table 1

Regression output of the large (AEX), mid (AMX) and small-cap (AMsC) indices. The regression model is given by *Eq. (7*) and measures the effect of conventional policies. The MSCI is the control variable. The R2 is the coefficient of determination, i.e the proportion of the variance in the dependent variable that is predictable from the independent variables.

	Unexp. Conv. Non-Crisis	Exp. Conv. Non-Crisis	Unexp. Conv. Crisis	Exp. Conv. Crisis	MSCI	R2
AEX	-0.03	-0.001	0.172***	0.026***	0.729***	36.64%
	(-1.00)	(-1.26)	(3.40)	(2.59)	(10.05)	
AMX	0.001	-0.003	0.147***	0.033***	0.467***	26.77%
	(0.01)	(-0.42)	(3.18)	(3.70)	(7.08)	
AscX	0.003	-0.009	0.132***	0.009	0.353***	20.44%
	(0.11)	(-1.20)	(3.48)	(1.16)	(5.91)	

*** Denotes significance at the 1%.

Table 2 shows the results for the self-made sector portfolios and the Euronext Amsterdam sector indices. In line with the European industrial index (Haitsma et al. 2016), neither conventional or unconventional monetary shocks have a significant effect during a crisis and non-crisis period on the Dutch industrial portfolio. This may be an indication that the durability of the goods produced by the sector, discussed in Section 1.2.4, does not play a significant role in the Dutch stock market. Furthermore, none of the Dutch sector portfolios has a significant relationship with conventional monetary policy shocks during a non-crisis period. During a crisis period, only the financial and technology portfolios have a significant relationship with conventional policy changes. More precisely, a 0.25%-point surprise cut in the policy rate leads to a highly significant increase in the financial portfolio returns of 3.53%-point, and a significant increase in the technology portfolio returns of 4.29%-point.

Table 2

Regression output of the Dutch industry portfolios constructed by myself, and the sector indices retrieved from the Euronext Amsterdam. The regression model is given by *Eq. (7)* and measures the effect of conventional policies. The MSCI is the control variable. The R2 is the coefficient of determination, i.e the proportion of the variance in the dependent variable that is predictable from the independent variables

	Unexp. Conv. Non-Crisis	Exp. Conv. Non-Crisis	Unexp. Conv. Crisis	Exp. Conv. Crisis	MSCI	R2
Industrials Portfolio	-0.006	-0.007	0.067	0.013	0.344***	16.36%
	(-0.26)	(-1.1)	(1.65)	(1.61)	(5.89	
Consumer Goods	0.001	0.004	0.029	0.018*	0.218	7.80%
Portfolio	(0.02)	(0.51)	(0.61)	(1.92)	(3.25	
Consumer Services	-0.011	0.001	0.091	0.020*	0.254***	7.12%
Portfolio	(-0.32)	(0.12)	(1.58)	(1.74)	(3.11)	
Technology Portfolio	-0.023	-0.011	0.172***	0.027*	0.524***	15.07%
	(-0.56)	(-1.01)	(2.45)	(1.92)	(5.24)	
Financials Portfolio	-0.004	0.001	0.142***	0.020**	0.318***	12.42%
	(-0.12)	(0.02)	(2.47)	(1.98)	(4.31)	
Basic Materials	4.323**	0.500	0.361	-0.627	4.265	3.09%
Index	(1.99)	(0.77)	(0.12)	(-1.02)	(0.83)	
Consumer	-3.167**	1.936***	0.258	0.111	1.593	13.21%
Discretionary Index	(-2.03)	(4.16)	(0.12)	(0.25)	(0.43)	
Energy Index	-0.382	1.533***	-1.616	0.843	-5.10	4.12%
	(-0.17)	(2.33)	(-0.52)	(1.35)	(-0.98)	
Financials Index	0.229	1.399***	0.109	-0.235	8.611***	15.17%
	(0.20)	(4.04)	(0.07)	(-0.72)	(3.14)	
Health Care Index	-1.937	1.196**	0.08	-0.12	7.541	5.39%
	(-0.96)	(1.99)	(0.03)	(-0.21)	(1.59)	
Industrials Index	-2.117	0.582	0.275	0.067	-4.555	1.39%
	(-0.97)	(0.89)	(0.09)	(0.11)	(-0.88)	
Technology Index	-3.740*	1.588**	2.851	0.085	0.168	6.54%
	(-1.76)	(2.5)	(0.95)	(0.14)	(0.03)	
Telecom Index	-0.675	0.366	0.675	0.097	7.828**	3.48%
	(-0.41)	(0.75)	(0.29)	(0.21)	(2.03)	

* Denotes significance at 10%, ** denotes significance at 5%, and *** denotes significance at 1%.

When looking at the effect of the unconventional monetary surprises (Table 3), only the consumer goods and financial portfolio react significantly. An unconventional monetary policy surprise that causes a decrease in the German-Italian yield spread of 0.06%-points

causes a highly significant decrease in the consumer goods portfolio returns of almost 0.14%-point, and a weakly significant increase in the financial portfolio returns of almost 0.19%-point.

Table 3

Regression output of the Dutch industry portfolios constructed by myself, and the sector indices retrieved from the Euronext Amsterdam. The regression model is given by *Eq. (8)* and measures the effect of unconventional policies. The MSCI is the control variable. The R2 is the coefficient of determination, i.e the proportion of the variance in the dependent variable that is predictable from the independent variables.

	Unexp. Unconv.	MSCI	R2
Industrials Portfolio	-0.023	1.277***	62.69%
	(-1.18)	(3.61)	
Consumer Goods Portfolio	0.023***	0.933	72.35%
	(2.92)	(6.59)	
Consumer Services Portfolio	-0.014	0.763	60.76%
	(-1.13)	(3.46)	
Technology Portfolio	-0.013	1.556	69.05%
	(-0.71)	(4.62)	
Financials Portfolio	-0.031	0.940***	63.63%
	(-1.89)	(3.12)	
Basic Materials Index	-0.127	5.327	28.78%
	(-0.72)	(1.66)	
Consumer Discretionary Index	-0.220	12.58	19.35%
	(-0.44)	(1.37)	
Energy Index	0.218	10.191**	25.13%
	(0.91)	(2.33)	
Financials Index	-0.058	3.001**	43.46%
	(-0.84)	(2.41)	
Health Care Index	0.013	3.377***	70.52%
	(0.38)	(5.45)	
Industrials Index	0.853	25.939	2.21%
	(0.37)	(0.62)	
Technology Index	0.001	1.245	2.36%
	(0)	(0.53)	
Telecom Index	-0.025	0.317	1.79%
	(-0.3)	(0.21)	

** Denotes significance at 5% and *** denotes significance at 1%

The results of the Dutch sector indices in Table 2 and 3 are different with respect to the Dutch sector portfolios. Namely, none of the indices has a significant relationship with the unexpected conventional monetary policy changes during a crisis. Instead, the basic materials, consumer discretionary and technology indices have a significant relationship with the conventional policy shocks during a non-crisis period. More precisely, a 0.25%-point surprise cut in the policy rate leads to a significant decrease in the basic material index returns of 108%-point, and a significant increase in the consumer discretionary index returns of 79%-point. In addition, the technology index returns experience a negative reaction: a 0.25%-point surprise cut in the policy rate leads to a weakly significant increase in the technology index returns of almost 94%-point. Finally, none of the Dutch sector indices has a significant relation with the unconventional monetary policy shocks.

The underlying reasons for the differences between the self-made sector portfolios and the sector indices are out of the focus of this paper. However, the causes may be that sector indices, as discussed in Section 3.1.4, have a different stock composition, are weighted differently, and have less observations with respect to the self-made sector portfolios.

Lastly, Table 4 shows the exchange rate exposure of the stocks that constitute the two exchange rate portfolios. The results of the exchange rate exposure portfolios (Table 5) are in line with the expectation that the negative exchange rate exposure portfolio has an opposite reaction to monetary policy shocks with respect to the Dutch stock Index (AEX), while the positive exchange rate exposure portfolio has the same reaction. In fact, the portfolio containing stocks that have a positive reaction on an exchange rate shock has also a positive reaction to an unexpected monetary policy change during a crisis. This reaction is in line with the Dutch market reaction (AEX), since it is positive and significant in a crisis period, and not significant in a non-crisis period. More specifically, a 0.25%-point surprise cut in the policy rate leads to a highly significant increase in the positive exchange rate exposure portfolio returns of almost 3.25%-point. More remarkable is the reaction of the portfolio containing stocks that have a negative relationship with an exchange rate shock. In fact, contrary to the general Dutch market reaction (Table 1), during a crisis period the portfolio reacted negatively to an unexpected monetary policy change. More precisely, a 0.25%-point surprise cut in the policy rate leads to a significant increase in the negative exchange rate exposure portfolio returns of almost 82%-point. Finally, also the negative exchange rate exposure portfolio does not react significantly in a non-crisis period, and neither of the two exchange rate portfolios react significantly to an unconventional policy shock (see Appendix Table A.7).

Table 4

Regression output which measures the exchange rate exposure of the stocks. The second column reports the results of the regression model *(5)* , while the third column reports the regression model *(6)*. The AEX Index is included as a control variable. $/€ measures the currency fluctuations between the U.S dollar ($) and the euro (€), while RE/€ measures the changes in exchange rate between the renminbi (RMB) and the euro (€).

	$/€	RE/€
Aalberts	0.099**	0.094**
	(2.19)	(2.00)
Corbion	0.064*	0.062*
	(1.64)	(1.49)
Porceleyne Fles	0.115*	0.139*
	(1.65)	(1.85)
Hunter Douglas	-0.091**	-0.011**
	(-1.98)	(-2.22)
AND International	-0.447**	-0.503**
	(-2.36)	(-2.49)
Arcadis	-1.335**	-1.439**
	(-1.91)	(-2.01)

* Denotes significance at the 10%, ** denotes significance at the 5%, and *** denotes significance at the 1%.

Table 5

Regression output of the negative and positive exchange rate exposure portfolios. The regression model is given by *Eq. (7)*. And measures the effect of conventional policies. The MSCI is the control variable. The R2 is the coefficient of determination, i.e the proportion of the variance in the dependent variable that is predictable from the independent variables.

	Unexp. Conv. Non-Crisis	Exp. Conv. Non-Crisis	Unexp. Conv. Crisis	Exp. Conv. Crisis	MSCI	R2
Negative exchange rate exposure	0.027	0.04	-3.271***	-0.044	-2.259**	12.84%
	(0.07)	(0.41)	(-5.21)	(-0.35)	(-2.52)	
Positive exchange rate exposure	0.0271	0.003	0.130***	0.056***	0.248	23.23%
	(1.00)	(0.43)	(2.83)	(6.16)	(3.79)	

** Denotes significance at 5% and *** denotes significance at 1%

5. Discussion and conclusion

5.1 Discussion

The scope of this research is to estimate the effect of the unexpected monetary policies on the Dutch stock market. However, there are a few remarkable estimations that need a deeper analysis. I report some possible explanations for these results which future studies can use to find the empirical explanation.

The first remarkable finding is the difference between some results of this study and previous researches. On one side, these dissimilarities reflect the mixed results from previous studies that examined different stock markets. The heterogeneous results are partly justified by the difference in sovereign fundamentals which consequently influence the transmission of monetary policy shocks into the stock markets. However, on the other side it is remarkable that the stock markets of similar countries, like the Dutch and German stock market, do not report the same results (Fausch and Sigonius, 2018). Therefore, it is important to note that beside the difference in sovereign fundamentals the heterogeneous results may also have been influenced by the methodology of this paper. In fact, previous studies (Haitsma et al., 2016; Fausch and Sigonius, 2018) implemented a sophisticated regression equation which pooled the conventional and unconventional policies in the same equation, while this study separates the two policies into two different regression equations. Hence, the regression equation for the unconventional policies has an insufficient amount of observation to be considered reliable (see Appendix Table A.4). This methodology problem is reflected by the fact that only two out of eighteen stock indices or portfolios react significantly to an unexpected unconventional monetary policy, while in previous studies (Haitsma et al., 2016; Fausch and Sigonius, 2018) the majority of the indices or portfolios has a significant reaction.

The second remarkable result is the huge difference between the results of the Dutch sector portfolios and the Dutch sector indices. A possible explanation is that the sector indices do not have a constant stock composition over time, are weighted differently, and have fewer observations compared to the sector portfolios. Furthermore, while the sector portfolios report a reasonable reaction, the sector indices report extremely high coefficients. This difference suggests that it is better to not rely exclusively on the provided sector indices of the Euronext Amsterdam when analysing industry effects.

While analysing the results, it is important to keep in mind that the assigned values of the unexpected monetary policies do not perfectly reflect the real values. In fact, the 3-month Euribor futures rate and the yield spread between German and Italian 10-year government bonds are good estimates of the unexpected monetary policies (Rogers et al. 2014, Bernoth and Hagen (2004), but not perfect estimations. The estimations are in fact influenced by other factors that are not related to unexpected monetary policy changes, which consequently influence the estimated coefficients reported in Section 3. A relevant follow-up study would therefore be based on a more precise variable which estimates monetary policy shocks.

Besides this, future studies should use a more sophisticated regression equation which can pool the reaction to conventional and unconventional policies together in order to find more reliable results. Furthermore, to dispose of more unconventional policy observations, researches should find a financial indicator which can estimate the unexpected part of an unconventional monetary policy shock after the financial crisis. In fact, neither researcher found a reliable proxy for the unexpected reaction to unconventional monetary policies when the aim of the ECB is not to reduce the intra-euro area sovereign spreads.

Lastly, it would be interesting to analyse the reaction of the stock market on unexpected monetary policy changes during the actual pandemic crisis. The results of this paper report a significant positive reaction of most of the Dutch stock portfolios during the 2007-2014 crisis. However, since the nature of this crisis is different from the financial crisis, the effect of the monetary policy shocks on the stock market may be different during a pandemic crisis.

5.2 Conclusion

This study aims to examine the effect of ECB's unexpected monetary policy changes on several indices and portfolios of the Dutch stock market. Previous studies which analysed this effect on different stock markets report different results, suggesting that an analysis of the Dutch market is scientifically and socially relevant.

This study uses the 3-months Euribor futures rate and the yield spread between German and Italian 10-year government bonds to proxy the unexpected component of the monetary policy change. Furthermore, it makes a distinction between the effect during a crisis and non-crisis period, and the conventional and unconventional monetary policy. The examined portfolios are based on industry and exchange rate exposure, while the indices are based on size and sector.

The results show that, in line with other euro area stock markets (Haitsma et al. 2016; Fausch and Sigonius (2018), the unexpected conventional monetary policy changes have a positive significant impact on the majority of Dutch portfolios and indices during a crisis period. Only the Dutch sector indices report a significant effect during a non-crisis, however with disputable coefficients.

In contrast with the study of Thorbecke (1997) which reports a size effect in the reaction to monetary policy shocks, the size of the firms do not play a significant role in the effect of monetary policy shocks on the Dutch stock market. In fact, in this study the small-cap index does not have higher significant coefficients than the large and mid-cap indices. However, the absence of a size effect is in congruence with the more recent study of Haitsma et al. (2016), which did not detect a size effect in the crisis and pre-crisis period.

Furthermore, in line with the reaction of the German stock market (Bredin et al., 2009), the durability of the goods produced by the industry does not play a significant role in the effect of monetary policy shocks on the Dutch stock market. In fact, industries that produce durable goods, like the industrial sector, have an insignificant reaction on monetary policy shocks.

In congruence with my prediction, the portfolio containing stocks with a negative exchange rate exposure have an opposite reaction on monetary policy shocks compared to the Dutch market index (AEX). While during a crisis the AEX has a significant positive reaction on unexpected conventional monetary policy changes, the negative exchange rate exposure

portfolio has a negative reaction on such shock. Instead, the portfolio with a positive exchange rate exposure follows the reaction of the AEX.

Remarkably, some results of this paper differ from previous studies that examined similar stock markets (Fausch and Sigonius, 2018). Besides the difference in sovereign fundamentals, these dissimilarities are also caused by the methodology of this paper, since it did not implement a regression equation which pooled the conventional and unconventional monetary policies. Therefore, the results of this paper may be considered as less reliable with respect to studies like Haitsma et al. (2016) and Fausch and Sigonius, 2018.

Beside a regression equation which allows the pooling of the unconventional and conventional monetary policies, future research could be even more accurate when a more precise proxies for the unexpected conventional and unconventional monetary policy changes are applied. Namely, the two proxies should be less affected by economic factors that are not correlated with the ECB monetary policy decisions.

However, investors do not need to rely anymore on estimations of the reaction to unexpected monetary policy that are based on other stock markets, when trading or investing in the Euronext Amsterdam. This is beneficial for investors and traders of the Dutch stock market, since the mixed results of previous studies show that the reaction to unexpected monetary policy changes can differ significantly across stock markets. Therefore, this paper avoids investment decisions in the Euronext Amsterdam based on the findings of other stock markets that are not profitable when considering the reaction of the Dutch stock market on monetary policy shocks.

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Appendices: Additional tables

Table A.1

Table containing all the ECB's monetary policy announcements between 1999 and 2020 that are used in this research.

4-3-1999	14-12-2000	10-7-2003	8-2-2007	10-5-2010	5-9-2013
18-3-1999	4-1-2001	31-7-2003	8-3-2007	10-6-2010	2-10-2013
8-4-1999	18-1-2001	4-9-2003	12-4-2007	8-7-2010	7-11-2013
22-4-1999	1-2-2001	2-1-2003	11-5-2007	5-8-2010	5-12-2013
6-5-1999	15-2-2001	6-11-2003	6-6-2007	2-9-2010	9-1-2014
20-5-1999	1-3-2001	4-12-2003	5-7-2007	7-10-2010	6-2-2014
2-6-1999	15-3-2001	8-1-2004	2-8-2007	4-11-2010	6-3-2014
17-6-1999	29-3-2001	5-2-2004	22-8-2007	2-12-2010	3-4-2014
1-7-1999	11-4-2001	4-3-2004	23-8-2007	13-1-2011	8-5-2014
15-7-1999	26-4-2001	1-4-2004	6-9-2007	3-2-2011	5-6-2014
29-7-1999	10-5-2001	6-5-2004	8-11-2007	3-3-2011	3-7-2014
26-8-1999	23-5-2001	3-6-2004	6-12-2007	7-4-2011	7-8-2014
9-9-1999	7-6-2001	1-7-2004	10-1-2008	5-5-2011	4-9-2014
23-9-1999	21-6-2001	5-8-2004	7-2-2008	9-6-2011	2-10-2014
7-10-1999	5-7-2001	2-9-2004	6-3-2008	7-7-2011	6-11-2014
21-10-1999	19-7-2001	7-10-2004	28-3-2008	4-8-2011	4-12-2014
4-11-1999	2-8-2001	4-11-2004	10-4-2008	8-9-2011	5-3-2015
18-11-1999	30-8-2001	2-12-2004	8-5-2008	6-10-2011	15-4-2015
2-12-1999	13-9-2001	13-1-2005	5-6-2008	3-11-2011	3-6-2015
15-12-1999	17-9-2001	3-2-2005	3-7-2008	8-12-2011	16-7-2015
5-1-2000	27-9-2001	3-3-2005	7-8-2008	21-12-2011	3-9-2015
20-1-2000	11-10-2001	7-4-2005	4-9-2008	12-1-2012	22-10-2015
3-2-2000	25-10-2001	4-5-2005	2-10-2008	9-2-2012	3-12-2015
17-2-2000	8-11-2001	2-6-2005	8-10-2008	28-2-2012	21-1-2016
2-3-2000	6-12-2001	7-7-2005	6-11-2008	8-3-2012	10-3-2016
16-3-2000	3-1-2002	4-8-2005	4-12-2008	4-4-2012	21-4-2016
30-3-2000	7-2-2002	1-9-2005	15-1-2009	3-5-2012	21-7-2016
13-4-2000	7-3-2002	6-10-2005	5-2-2009	6-6-2012	8-9-2016
27-4-2000	4-4-2002	3-11-2005	5-3-2009	26-7-2012	21-10-2016
11-5-2000	2-5-2002	1-12-2005	2-4-2009	2-8-2012	19-1-2017
25-5-2000	6-6-2002	12-1-2006	7-5-2009	6-9-2012	9-3-2017
8-6-2000	4-7-2002	2-2-2006	4-6-2009	4-10-2012	7-9-2017
21-6-2000	1-8-2002	2-3-2006	2-7-2009	8-11-2012	25-1-2018
6-7-2000	12-9-2002	6-4-2006	6-8-2009	6-12-2012	8-3-2018
20-7-2000	10-10-2002	4-5-2006	3-9-2009	10-1-2013	13-9-2018
3-8-2000	7-11-2002	8-6-2006	8-10-2009	7-2-2013	10-4-2019
31-8-2000	5-12-2002	6-7-2006	5-11-2009	7-3-2013	25-7-2019

14-9-2000	9-1-2003	3-8-2006	3-12-2009	22-3-2013	12-12-2019
5-10-2000	6-2-2003	31-8-2006	14-1-2010	4-4-2013	23-1-2020
19-10-2000	6-3-2003	5-10-2006	4-2-2010	2-5-2013	
2-11-2000	3-4-2003	2-11-2006	4-3-2010	6-6-2013	
16-11-2000	8-5-2003	7-12-2006	8-4-2010	4-7-2013	
30-11-2000	5-6-2003	11-1-2007	6-5-2010	1-8-2013	

Table A.2

Overview of the self-made industry portfolios with the name of the constituting firms, the year since the firms are listed in the Euronext Amsterdam, and a brief description of their economic activities.

Industry portfolio	**Firm**	**Listed since**	**Description**
Consumer services	Air France - KLM	1973	One of the world's leading airline companies
Consumer services	Ahold Delhaize	1973	One of the world leaders in retailing
Consumer services	Ajax	1998	Dutch football club
Consumer services	AND International	1996	Specializes in the development and marketing of digital road map software and data bases
Consumer services	Beter Bed	1996	Retail and wholesale organisation
Consumer services	Brill NV	1997	Specializes in book and magazine publishing
Consumer services	Sligro	1989	Specializes in food distribution
Consumer services	Snowworld	1992	Owns five indoor ski sites
Consumer services	Stern Groep	1973	Specializes in automotive distribution
Consumer services	Wolters Kluwer	1973	Specializes in publishing books, works, reviews, press, softwares and digital contents.
Consumer Goods	Accell Group	1998	European leader in the design, production and marketing of bicycles.
Consumer Goods	Amsterdam Commodities	1973	International group of companies that commercialize and distribute natural agricultural products for the food and beverage industry around the world
Consumer Goods	Corbion	1973	Food processing group
Consumer Goods	Ease2pay	1997	Payment and loyalty transaction platform with which you can turn every smartphone into a cash register and a pin terminal
Consumer Goods	FNG	1987	Specializes in the design and distribution of men, women and children's clothing and footwear

Consumer Goods	Heineken	1973	Food group that specializes in beer brewing under the brands Heineken and Amstel
Consumer Goods	Hunter Douglas	1973	World market leader in window coverings and a major manufacturer of architectural products
Consumer Goods	IEX Group	1982	Leading provider of online investment information in the Netherlands and Belgium.
Consumer Goods	Porceleyne Fles	1973	Specializes in the manufacturing and marketing of ceramics products
Consumer Goods	Unilever	1974	Leading groups worldwide specializing in the manufacture and marketing of food and care products
Industrials	Aalberts	1987	Engineers mission-critical technologies for ground-breaking industries and everyday life
Industrials	BAM Groep	1973	Building and public works group
Industrials	Boskalis Westminster	1973	Specializes in maritime infrastructure construction and improvement services
Industrials	Heijmans	1983	Building and public works group
Industrials	Hydratec	1997	Industrial holding company
Industrials	Kendrion	1973	Specializes in the design, manufacturing, and marketing of electromagnetic and mechatronic components and sub-systems for automotive applications and industrial
Industrials	Nedap	1973	Specializes in the design, manufacturing, and marketing of electronic surveillance and security solutions and systems
Industrials	Neways Eletronics	1986	International one-stop-provider of advanced integrated components, assemblies and systems
Industrials	Royal Vopak	1973	World's leading independent tank storage company
Industrials	TKH Group	1973	Focused on high-end innovative technologies in high growth markets. within three business
Technology	ASM Internationals	1996	Specializes in designing, producing, and selling equipment for use by semiconductor manufacturers
Technology	ASML Holding	1995	One of the world leaders in the manufacturing of lithography equipment for the semiconductor industry
Technology	BE Semiconductor Industries	1995	Specializes in the design, manufacturing and marketing of semiconductor assembly equipment
Technology	CTAC	1998	IT services company specialized in the design, development and implementation of SAP systems
Technology	ICT Group	1997	Specializes in developing and marketing integrated software
Technology	Lavide Holding	1998	ICT

Technology	NedSense Entreprises	1986	Specializes in developing, marketing, distributing, and maintaining computer-assisted drawing and production software
Technology	New Sources Energy	1987	Specializes in developing and operating electricity production projects from renewable energies
Technology	Ordina	1986	One of the leading computer services providers in the Netherlands
Financials	Eurocommercial	1991	Specializes in owning and managing commercial real estate
Financials	NSI	1998	Specializes in owning and managing business real estate assets.
Financials	Unibail-Rodamco-Westfield	1974	One of the world leaders in commercial real estate
Financials	VastNed Retail	1987	Property company focusing on the best retail property on the popular high streets of selected European cities with a historic city centre
Financials	Wereldhave	1973	The group invests in shopping centres in North-West Europe that are top-of-mind in their catchment areas
Financials	Aegon	1973	One of the world's largest insurance groups
Financials	Morefield Group	1984	Broker, providing external staff, primarily IT-professionals
Financials	Van Lanschot	1999	Wealth manager operating in private banking, asset management and merchant banking
Financials	Bever Holding	1982	Specializes in developing, owning, and managing real estate assets located
Financials	HAL Trust	1973	Investment company

Table A.3

Descriptive statistics of the dependent variables. The portfolio and index return statistics are in percentages.

Dependent variable	Stock Constituents	Observations	Mean	Std. Dev.	Min	Max
AEX Index	25	254	0	0.02	-0.08	0.07
AMX Index	25	254	0	0.01	-0.07	0.07
AScX Index	25	221	0	0.01	-0.06	0.05
Industrials Portfolio	10	254	0	0.01	-0.05	0.06
Consumer Goods Portfolio	10	254	0	0.01	-0.07	0.07

Consumer Services Portfolio	10	254	0	0.01	-0.09	0.08
Technology Portfolio	10	254	0	0.02	-0.08	0.08
Financials Portfolio	10	254	0	0.01	-0.14	0.06
Basic Materials Index	9	210	0	0.03	-0.16	0.10
Consumer Discretionary Index	17	210	0	0.01	-0.07	0.06
Energy Index	5	210	0	0.02	-0.08	0.04
Financials Index	19	210	0	0.02	-0.10	0.14
Health Care Index	9	210	0	0.02	-0.10	0.05
Industrials Index	23	210	0	0.02	-0.10	0.12
Technology Index	17	210	0	0.02	-0.09	0.09
Telecom Index	2	210	0	0.02	-0.07	0.07
Positive Exposure Portfolio	3	254	-0.01	0.17	-2.02	1.42
Negative Exposure Portfolio	3	254	-0	0.01	-0.07	0.04

Table A.4

Descriptive statistics of the independent variables.

Independent Variable	Observations	Mean	Std. Dev.	Min	Max
Unexpected Conventional	233	0	0.03	-0.18	0.16
Expected Conventional	233	-0.01	0.14	-0.81	0.55
Unexpected Unconventional	20	-0.07	0.2	-0.47	0.3
Crisis Dummy	254	0.37	0.48	0	1
MSCI (ex. Europe)	254	0	0.1	-0.05	0.03

Table A.5

Results of the Variance Inflation Factor (VIF) test on the independent variables.

Variable	VIF	1/VIF
Unexpected Conventional Non-Crisis	1.02	0.98
Expected Conventional Non-Crisis	1.06	0.94
Unexpected Conventional Crisis	1.08	0.93
Expected Conventional Crisis	1.13	0.88
MSCI	1.09	0.91
Mean VIF	1.08	

Variance inflation factor (VIF) is a measure of the amount of multicollinearity in a set of multiple regression variables. Mathematically, the VIF for a regression model variable is equal to the ratio of the overall model variance to the variance of a model that includes only that single independent variable. In general, a VIF of 2.5 or higher indicates a moderate correlation.

Table A.6

Regression output of the large (AEX), mid (AMX) and small-cap (AMsC) indices. The regression model is given by *Eq. (8)* and measures the effect of unconventional policies. The MSCI is the control variable. The R2 is the coefficient of determination, i.e the proportion of the variance in the dependent variable that is predictable from the independent variables.

	Unexp. Unconv.	MSCI	R2
AEX	-0.025	1.103***	58.88%
	(-1.32)	(3.15)	
AMX	-0.025	1.433***	69%
	(-1.34)	(4.17)	
AScX	-0.013	1.150***	72.61%
	(-1.01)	(4.88)	

*** Denotes significance at the 1%

Table A.7

Regression output of the negative and positive exchange rate exposure portfolios. The regression model is given by *Eq. (8)* and measures the effect of unconventional policies. The MSCI is the control variable. The R2 is the coefficient of determination, i.e the proportion of the variance in the dependent variable that is predictable from the independent variables.

	Unexp. Unconv.	MSCI	R2
Negative exchange rate	0.009	1.470***	55.03%
exposure	(0.46)	(3.99)	
Positive exchange rate	-0.073	2.764***	65.17%
exposure	(0.46)	(3.99)	

*** Denotes a significance level of 1%