Transmission Channels of Quantitative Easing

Double Master's Thesis

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8 July 2016

Degree program: Economics and Business
Study programs: International Economics, Financial Economics

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Abstract

This paper aims to study the transmission channels of quantitative easing, particularly the relative importance of the interest rate channel, the credit channel and the risk-taking channel of the policy. It does so by first estimating the effect of quantitative easing on the interest rate, the external finance premium and risk tolerance, after which the effects of the interest rate, the external finance premium and risk tolerance on output are estimated. These three variables are assumed to be analogous to the interest rate, credit and risk-taking channels, and thus in this way quantitative easing is traced through the channels. It is found that the relative importance of the three transmission channels fluctuates over time. Furthermore, the interest rate channel is found to be generally the most influential transmission channel of quantitative easing, followed by the credit channel. The risk-taking channel is found to usually be the least influential transmission channel of quantitative easing. Finally, extended periods of quantitative easing are found to be a prelude for an increase in the importance of the interest rate channel and a decrease in the importance of the credit channel.

JEL classification: E, F, G

Keywords: quantitative easing, transmission channels, monetary policy, interest rate channel, credit channel, risk-taking channel

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1 Introduction

First implemented by Japan in the early 2000s (Bank of Japan, 2001), followed by three rounds in the United States starting in 2008 (Federal Reserve System, 2008), the United Kingdom in 2009 (Bank of England, 2009) and also implemented in the European Monetary Union since 2015 (European Central Bank, 2015), quantitative easing seems to be central banks' go-to policy of last resort for stalling economies. It is, however, still regarded as an unconventional policy measure. Quantitative easing involves a central bank buying long-term government bonds on the open market. This decreases the yield on these bonds, as well as the long-term interest rate and at the same time it increases the money supply. This is expected to increase inflation, with the intention of bringing it back to its target. To get a sense of the scale of such a quantitative easing program: at the time of writing, the European Central Bank is buying €80 billion worth of euro-area bonds, monthly (European Central Bank, 2016).

As with most monetary policy measures, its aims are clear. However, its ways are not. Regarding monetary policy in general, there is a long-lasting debate in economic literature about the so-called transmission channels of monetary policy. These are mechanisms through which monetary policy affects the economy, which are often not exactly clear. Bernanke & Gertler (1995) have used the analogy of a black box: monetary policy goes through a black box, in which the transmission channels reside, before it impacts the economy. Both sides of the debate generally agree on the existence of an interest rate channel, whereby a policy induces a change in short-term interest rates which affects output by changing the price level. However, the debate is focused on the hypothesized existence of a credit channel, which is broadly defined as the mechanism of a changing credit supply caused by monetary policy that affects the real economy. Other transmission channels are also often hypothesized, such as the risk-taking channel, which describes policy-induced changes in risk attitude of economic agents which impact the economy (Borio & Zhu, 2012).

Not many of the studies of transmission channels investigate quantitative easing. This paper strives to fill that gap in the existing research. Evidence of the existence of a credit and risk-taking channel is looked for, yet the main goal of this paper is to study the relative importance of these channels. So, the following research question is formulated.

What is the relative importance of the interest rate channel, the credit channel and the risk-taking channel of quantitative easing?

This is researched by first estimating the effect quantitative easing has on the interest rate, the external finance premium and risk tolerance, in a United States sample. These three variables are assumed to be analogous to the interest rate channel, the credit channel and the risk-taking channel, respectively. The effect quantitative easing has on these three variables is referred to as quantitative easing *entering*

the respective transmission channel. Then the effect these three variables have on output is estimated. This is referred to as quantitative easing *exiting* the respective transmission channel. These metaphors of entering and exiting the transmission channels is used throughout this paper.

These estimations are done using four types of models, or estimation techniques. These are autoregressive distributed lag models, error correction models, vector autoregressive models and vector error correction models. Also, two candidates for the interest rate variable are used, as well as four candidates for the quantitative easing variable and four proxies for the external finance premium variable. The estimations are done for every combination of variables/proxies using all four types of models. The estimation results are then interpreted on their significance and their relative magnitude.

Since both the money and credit view of monetary policy agree on the existence of the interest rate channel, this channel is assumed to exist ex ante. Yet, the credit view makes a compelling case regarding the existence of a credit channel. Also, it seems very credible that changing risk attitudes as a result of monetary policy have their impact on the economy[1]. So, the following alternative hypotheses are formulated.

- H_a^1: There is a credit channel of quantitative easing.
- H_a^2: There is a risk-taking channel of quantitative easing.

The corresponding null hypotheses are as follows.

- H_0^1: There is no credit channel of quantitative easing.
- H_0^2: There is no risk-taking channel of quantitative easing.

Since one of the aims of quantitative easing is to adjust the interest rate, it is hypothesized that the interest rate channel is the most important transmission channel of quantitative easing. It is also expected that buying long-term government bonds from commercial banks increases the availability of credit in the economy, thereby decreasing the external finance premium. Derived from this is the hypothesis that the credit channel is the second most important transmission channel of quantitative easing. After having controlled for the interest rate channel and the credit channel, it is expected that a changing risk attitude as a result of quantitative easing has a minor impact. Formally, the following two alternative hypotheses are specified.

- H_a^3: Quantitative easing is transmitted more through the interest rate channel than through the credit channel.
- H_a^4: The risk-taking channel is the least important transmission channel of quantitative easing.

[1] A study by Moody's Analytics stated that the European Central Bank's quantitative easing program has fueled housing bubbles in Europe (Zabrodzka, 2015).

The corresponding null hypotheses are as follows.

- H_0^3: Quantitative easing is not transmitted more through the interest rate channel than through the credit channel.
- H_0^4: The risk-taking channel is not the least important transmission channel of quantitative easing.

The relevance of this study is clear. Since the 2007 crisis, many economies across the globe are still struggling and in a considerable amount of these economies quantitative easing is either being conducted, or has been conducted in the past. A better understanding of the dynamics of quantitative easing can help central banks make better decisions on how and when to implement such a policy. This ultimately benefits society. Yet, this study is not only socially relevant, but also scientifically. Transmission channels of monetary policy have spiked the interests of many researchers, but not many of them have investigated the transmission channels of quantitative easing. A study into this area adds new information to the debate and can help it move forward.

Results obtained in the present paper contribute to the existing body of research. Interestingly, the paper finds that the relative importance of the transmission channels changes over time. This means that the timing of implementation of quantitative easing matters. In times of crisis, the credit channel is the most prevailing transmission channel of quantitative easing, as opposed to the interest rate channel in calmer times. A fascinating insight that follows from this is that, when implementing quantitative easing to mitigate an economic crisis, the economy benefits from the policy more due to its loosening effects on credit than due to the downward pressure it exerts on longer-term interest rates.

The rest of this paper is structured as follows. Section 2 elaborates upon underlying theories and explains related concepts. Section 3 reviews existing literature on the topic. Section 4 describes the dataset used and conducts some preliminary tests on the data. Then, section 5 begins the actual empirical methodology by estimating the effects of quantitative easing entering and exiting the transmission channels separately. In this section, the channels are estimated in isolation, using autoregressive distributed lag models and error correction models. Following, in section 6 the effects of quantitative easing entering and exiting the transmission channels are estimated simultaneously, while the channels are not isolated from each other. Section 7 reports and interprets the results, and section 8 concludes.

2 Concepts and theory

This section explains and elaborates upon several key concepts and theories used in this paper.

2.1 Quantitative easing

Quantitative easing, or *QE*, is a form of expansionary monetary policy. Typically, expansionary monetary policy involves a central bank buying short-term government bonds to lower short-term interest rates (European Central Bank, 2011). In the quantitative easing case however, a central bank purchases longer-term bonds from commercial banks, lowering their yield and increasing their price, which increases the money supply. Quantitative easing is usually exercised in order to increase inflation, or to make sure inflation does not fall below a target (Bank of England, 2009). The regular expansionary monetary policy method of buying short-term government bonds no longer works when short-term interest rates approach zero. While a central bank can adopt a negative target interest rate (European Central Bank, 2014), it is highly unconventional. If the economy still needs stimulating at times of a near-zero, or negative, interest rate, a central bank may opt for quantitative easing as the policy of choice, since quantitative easing lowers longer-term interest rates as opposed to short-term rates (Bernanke, 2009).

The long-term bond purchases under quantitative easing are conducted with electronically created money (Bank of England, 2009). Therefore, quantitative easing can be seen as a modern form of printing money. Receivers of this new money are typically agents that do not want to hold on to this money, such as commercial banks, pension funds, insurance companies or other private financial institutions (Bullard, 2010). For this reason, it is thought they will most likely purchase other assets, such as corporate bonds and shares, which lowers longer-term borrowing costs. Also, it encourages issuing spending-stimulating equities and bonds. The general idea of quantitative easing is to facilitate an increase in private bank lending, which increases the money supply[2]. This effect may even spillover to other countries. Moreover, if the central bank purchases not only government bonds but also riskier assets, the interest yield of those assets decreases.

In the United States, three rounds of quantitative easing have been implemented. The first one started in November 2008, when the Federal Reserve announced it would be buying $600 billion in mortgage-backed securities (Federal Reserve System, 2008). In November 2010, the Federal Reserve announced the second round of quantitative easing, committing to buy another $600 billion in longer-term Treasury securities, at about $75 million a month (Federal Reserve System, 2010). In September 2011, a slightly different type of policy was announced, yet related to quantitative easing: Operation Twist.

[2] Without increased bank lending, the broad money supply would still be increased.

The program planned to purchase $400 billion of bonds with maturities ranging from 6 to 30 years and sell bonds with maturities less than 3 years (Federal Reserve System, 2011). This would extend the average maturity of the Federal Reserve's own portfolio. The program's aim was to 'twist' the yield curve: lowering long-term rates while raising short-term rates. It was later extended throughout 2012 (Federal Reserve System, 2012). The third and last round of quantitative easing was announced in September 2012. It was an open-ended commitment to buying $40 billion in agency mortgage-backed securities monthly, until the labor market had improved substantially (Federal Reserve System, 2012). The quantitative easing program was eventually halted in October 2014, after the Federal Open Market Committee judged that "there has been a substantial improvement in the outlook for the labor market" (Federal Reserve System, 2014).

2.2 Interest rate channel

Monetary policy conducted by a central bank has several *transmission channels* through which the policy affects the real economy. Several possible channels have been identified, but there is no widespread agreement on which channels are dominant, nor on how they interact (Freixas & Rochet, 2008, p. 196).

When analyzing the monetary history of the United States, Friedman and Schwartz (1963) found a high positive correlation between money supply and output. This correlation was especially evident during the Great Depression. This resulted in the consensus that the money supply was the key financial aggregate. In this view, banks only matter to the extent that they create money. This is known as the *money view* of monetary policy and it is the traditional (even conventional, if you will) view.

The main transmission channel of monetary policy in the money view is the *interest rate channel*. Expansionary (contractionary) monetary policy decreases (increases) the real interest rate, which lowers (raises) the cost of capital. This causes a rise (drop) in investment spending and consumption, leading to a rise (drop) in aggregate demand and an increase (decrease) in output (Mishkin, 1996). Other macroeconomic variables affected by the interest rate channel are income (through net interest payments), wealth (through capital gains or losses) and exchange rates (Freixas & Rochet, 2008, p. 198).

This can be illustrated using a simple model as in Freixas & Rochet (2008, pp. 199-200). Consider production input x, which is converted into output by the representative firm using production function $f(x)$. Prices of input and output are assumed to be 1. Buying the input requires a loan L, with interest rate r. Together with the firm's wealth W, the total amount of input the firm can buy is $x = L + W$. To maximize its profit, the firm will choose L according to:

$$\max_L f(L+W) - (1+r)L$$

which gives the following first order condition:

$$f'(L+W) = 1+r$$

This shows investment $L+W$ and output $f(L+W)$ only depend on the interest rate $1+r$, which is equal to the firm's marginal cost of capital. If W decreases, L would increase without any effect on the firm's investment $L+W$ or its output $f(L+W)$.

2.3 Credit channel

In his research on the Great Depression, Fisher (1933) found that the poor performance of the financial system was the cause of the economic downturn. Moreover, the Gurley-Shaw (1955) theory states financial intermediaries are key in the circulation of loanable funds between borrowers and savers. Goldsmith (1969) found a positive correlation between the level of sophistication of a country's financial sector and its economic growth.

It was not until much later that the financial system started to appear in macroeconomic research again. Bernanke (1983) found that monetary forces alone could not explain the Great Depression's severity and identified the collapse of the financial system to be an important factor. It seemed the decline in money supply was not as important as Friedman and Schwartz (1963) argued it to be and that the Depression was better explained when the (imperfect) financial system was introduced. This gave rise to a new perspective on the transmission channels of monetary policy: the *credit view*.

The main transmission channel of monetary policy according to the credit view is the *broad lending channel* (or *credit channel*). It states that monetary policy affects the amount of credit commercial banks issue, which in turn affects the real economy. The broad lending channel considers the *external finance premium*, which is defined as the difference between the cost of internal capital for firms (i.e. retained earnings) and the cost of external capital (e.g. equity or debt), as an essential concept. As long as the external financing is not fully collateralized, meaning the expected payoff of the project in the worst-case scenario is sufficient to fully repay the loan, the external finance premium will exist (Bernanke & Gertler, 1989). Expansionary (contractionary) monetary policy decreasing (increasing) the short-term interest rate, decreases (increases) the size of the external finance premium which increases (decreases) the amount of credit available in the economy. The external finance premium thus amplifies the monetary policy. This is called the *financial accelerator effect* (Freixas & Rochet, 2008). To be clear, the credit view does not argue there is no interest rate channel. Rather, it states there is an additional channel, the credit channel, which amplifies or accelerates the interest rate

channel. The credit channel works through two sub channels: the *balance sheet channel* and the *bank lending channel*.

The balance sheet channel states an inverse relationship between a borrower's net worth and the size of the external finance premium (Bernanke & Gertler, 1989). High net worth agents are more likely to use internal capital as financing. Moreover, they have greater collateral to put up against any borrowed external capital. Banks, as lenders, react to a decrease in a firm's net worth (and its ability to collateralize loans) by decreasing the amount lent to the firm (Freixas & Rochet, 2008).

The bank lending channel states that monetary policy might change the amount of loanable funds available to banks and thus affect the amount of loans they can provide (Bernanke & Blinder, 1988). Firms dependent on bank credit for their business operation will either not obtain the necessary credit or incur additional search costs to find the credit elsewhere, in the event of contractionary monetary policy. This increases the external finance premium, reducing economic activity.

This can be analyzed in the model of Freixas & Rochet (2008, pp. 199-200). Consider the case where the representative firm is only able to obtain a fully collateralized loan. Then, the following constraint should be satisfied: $(1+r)L \leq qK$, where K is the value of the firm's assets and q their price. This is maximization under a constraint. When the constraint is binding $\left(L = \frac{qK}{1+r}\right)$, it can be solved by formulating the following Lagrange expression.

$$\mathcal{L} = f(L+W) - (1+r)L - \lambda\left(L - \frac{qK}{1+r}\right)$$

This leads to the following first order conditions.

$$\frac{\partial \mathcal{L}}{\partial L} = f'(L+W) - (1+r) - \lambda = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = L - \frac{qK}{1+r} = 0$$

These can be rewritten as follows.

$$f'(L+W) = (1+r) + \lambda$$

$$L = \frac{qK}{1+r}$$

This shows that output $f(L+W)$ not only depends on the interest rate $1+r$, but also on λ, the external finance premium. In this case, the firm's marginal cost of capital is not equal to the interest rate:

$$f'(L+W) = f'\left(\frac{qK}{1+r} + W\right) > 1 + r.$$

This means an external finance premium $\lambda > 0$ exists. When the firm's assets qK decrease, the loan L decreases and thus the external finance premium λ increases. When the interest rate increases, it not only increases the cost of capital (as it does in the money view), but it is also likely to decrease the price of the firm's assets q, increasing the external finance premium and thus decreasing the firm's borrowing capacity. In the next period, the firm's wealth W will be lower since it depends on the interest rate of the previous period. This shows the persistent nature of these effects.

2.3.1 Tobin's q

Related to the model discussed above, is Tobin's q. It is defined by Brainard & Tobin (1968) as a firm's or market's ratio of market value of capital to the replacement cost of that capital.

$$q = \frac{market\ value\ of\ capital}{replacement\ cost\ of\ capital}$$

The replacement cost is the cost of replacing a firm's capital with newly bought commodities (e.g. a firm's production machinery). It is thus the prevailing market price for a firm's assets. If this is normalized to 1, Tobin's q is the same q as used in the model above. When a firm's q is between 0 and 1, the firm is said to be undervalued. That is, the market values the company's assets less than it would cost to replace them. A q higher than 1 means the firm is being overvalued. Thus the market values the company's assets more than it would cost to replace them. Undervaluation and overvaluation can be interpreted as the market's opinion on whether the company uses its assets successfully to generate a sufficient rate of return. When a firm is being overvalued, it can issue shares and use their proceeds to invest in capital. So a higher q leads to a lower external finance premium. When a firm is being undervalued, it cannot issue shares without diluting them. Furthermore, undervaluation means a firm's assets (qK) are worth less, lowering a firm's collateral and thus lowering the amount a firm can borrow L. This thus means its external finance premium increases when q decreases. The external finance premium and Tobin's q are clearly negatively related.

2.3.2 External finance premium

As described above, the external finance premium is a key concept in the theory of the credit channel. It is broadly defined as the wedge between external and internal financing costs, which is generally positive.

$$external\ finance\ premium = external\ financing\ costs - internal\ financing\ costs$$

The external financing costs, and therefore the external finance premium itself, is inversely related to borrowers' net worth (Bernanke & Gertler, 1989). Since financially strong investors have more '*skin in*

the game', they have incentives to make well-informed investment choices and ensure good financial outcomes of investments (Bernanke, 2007). This means high net worth borrowers need not be monitored as much as low net worth ones, which lowers the agency costs for the lender. Also, it is positively related to the credit supply, as more supply means cheap credit. This follows from standard supply and demand rules.

$$external\ financing\ costs = \alpha_0 \cdot credit\ supply - \alpha_1 \cdot borrowers'\ net\ worth + \varepsilon$$

The relationships are captured by parameters α_0 and α_1. Any other influencing factors are captured by ε.

The internal financing costs can be regarded as the opportunity costs of internal financing, i.e. the next best investment opportunity forgone (Bernanke, 2007).

$$internal\ financing\ costs = riskfree\ rate + risk\ premium$$

Where the risk premium is that of the chosen investment opportunity.

There are a few problems with the external finance premium. It differs across firms and countries, for example. The biggest problem, however, is that it is unobservable (De Graeve, 2008).

2.4 Risk-taking channel – an extension to finance

While risk is central to the behavior of financial intermediaries and, more generally, to all economic agents, it is usually treated differently in the fields of finance and economics. In finance, risk plays a great role in decision-making and therefore in the existing literature. The field often seeks to measure risk, explain how it is priced and how it should be priced. Techniques to measure risk include the *value-at-risk* measure and stress testing, among others. The field of economics, however, assigns a much smaller role to risk. It is often treated as exogenous, and the influence on behavior risk is allowed to have in the various models is usually limited. However, risk, and the (changing) attitude towards it, may very well influence behavior and subsequently the economy. Be it the decision-making process of banks, firms or consumers, risk is likely to affect it.

Therefore, Borio & Zhu (2012) suggest a *risk-taking channel* of monetary policy, defined as the impact of changes in monetary policy on either risk-perceptions or risk-tolerance. This, in turn, affects the riskiness of portfolios and the pricing of assets. The authors suggest that the risk-taking channel may operate similarly to the credit channel, as both are regarded to be accelerators of monetary policy. Lower interest rates, for example, increase asset values, collateral values, incomes and profits. This may reduce risk perception / increase risk tolerance. In turn, this encourages investment and position-taking (Borio & Zhu, 2012). Firms might take on riskier projects, while banks might be more lenient in

the provision of funding. In this way, monetary policy can influence the economy through a different transmission channel: the risk-taking channel.

The inclusion of the risk-taking channel should be seen as an extension of this paper to the field of finance.

3 Review of existing literature

This section documents several existing works of research related to the present paper.

Bernanke (1983) examines the effects of the Great Depression on output, focusing on credit-related aspects of the financial sector. He does so by first regressing output on monetary shocks. It is found that the resulting equations capture no more than half of the decline in output during 1930-1933. Monetary shocks alone thus seem quantitatively insufficient to explain output, at least during that period. Then Bernanke includes proxies for non-monetary financial impacts, namely deposits of failing banks and liabilities of failing businesses. Current and lagged first differences have the expected sign and are jointly highly significant, while the magnitude of the monetary variables did not change much. This gives some confirmation of the existence of the credit channel.

In another paper, Bernanke (1986) investigates the existing correlation between money and income. He uses VAR methodology based on work by Blanchard & Watson (1984) to test the hypothesis that credit shocks explain nothing of the money-income correlation. Evidence is found against this hypothesis. The author also states that money and credit are parallel forces of approximately equal importance.

King (1986) studies predictors for real economic activity, in particular measures of money, credit and interest rates. He does so using a simple model of bank behavior examining credit rationing. Limited support is found for the equilibrium credit rationing hypothesis, or for the more general credit view of monetary policy transmission.

Romer & Romer (1990) research the monetary transmission mechanism. They criticize previous empirical work. The authors state that these empirical studies make no effort to address the problem of endogeneity. Since both money and credit are affected by economic activity, it may very well be the case that output is actually causing effects in money and credit, rather than the other way around. In both cases, high correlation would be found. The only exception is Bernanke & Blinder (1992), who focus on simple correlations of growth rates of money and output and of credit and output and on regressions of output on money and lending. The strategy of Romer & Romer (1990) is to study large shifts in monetary policy undertaken by the Federal Reserve that were essentially independent of real economic developments, such as the Volcker disinflation of 1979-1982[3]. They find more support for the traditional money view, than for the credit view.

[3] In the United States, in the years prior to 1980, inflation had been dramatically rising, but when Paul Volcker became chairman of the Federal Reserve System in August 1979, disinflationary policy managed to first contain the rising inflation, and then reverse it (Goodfriend & King, 2005).

When studying the Federal funds rate, Bernanke & Blinder (1992) show that it is extremely informative about future movements of real macroeconomic variables and a good indicator of monetary policy. Then, they use innovations to the funds rate to show that monetary policy works at least partly through affecting the composition of bank assets, also known as the credit channel.

Ramey (1993) studies the relative importance of the credit channel in transmission of monetary policy. She does so by analyzing the significance of three credit variables in a model which includes M2 money and its velocity. The credit variables are total bank loans, bank holdings of securities relative to loans and the difference in the growth rate of short-term debt of small and large firms. She finds a mostly insignificant role for these credit variables in the impact of monetary policy on output.

Brunner and Kamin (1998) distinguish two kinds of financial effects of monetary policy in their research on the 1990-1993 economic downturn in Japan: loan demand effects and loan supply effects. These are analogous to the balance sheet channel and the bank lending channel respectively. The authors modify a traditional IS/LM model[4] by allowing bank loans to affect economic pace through the aggregate demand curve and by using movements in equity prices as a proxy for changes in balance sheet conditions of firms, households and banks. They find significant effects of their proxies for financial effects in the loan standards, loan demand and aggregate demand equations. This indicates the existence of a credit channel. Furthermore, strong evidence is found that financial factors played a significant role in the 1990-1993 economic downturn in Japan.

The bank lending channel, one of the sub-channels of the credit channel, is studied by Farinha & Marques (2001) using micro bank data from Portugal. The authors directly estimate the loan supply schedule. This is in contrast with previous work that is based on estimating a model for credit, which, according to the authors, “may be interpreted as the reduced form equation of the market for bank loans”. The results support the existence of a bank lending channel in Portugal. Capitalization of banks seems to be significantly negatively correlated to the incidence of the channel, while bank size and liquidity appear not to be significant. This means the importance of the bank-lending channel is found to be larger for less capitalized banks.

Suzuki (2008) notes that the credit channel is usually researched in a closed-economy context, while banks make international loans in reality. The author studies the case where a monetary policy shock originating in one country spreads abroad through banks’ reallocation of funds between its branches and or subsidiaries in the two countries, by means of a VAR model. The two countries specifically studied are New Zealand and Australia. It is found that unanticipated money tightening in Australia

[4] For a brief explanation, see subsection 5.2.1.

leads to a shift left in the supply curve of loans (a decrease in quantity and an increase in lending rate) in New Zealand. The unanticipated money tightening in Australia is also found to decrease real GDP in New Zealand, indicating the effectiveness of Australian monetary policy in New Zealand.

Krishnamurthy & Vissing-Jorgensen (2011) use an event-study methodology on data of the first two rounds of quantitative easing in the United States to research the effects of quantitative easing on the interest rates. They find that studying only the effects on Treasury rates is not sufficient, as quantitative easing works through many channels. Furthermore, they find that quantitative easing is negatively related to interest rates.

The effectiveness of the different transmission channels of monetary policy is researched by Cevik & Teksoz (2012) in the perspective of the Gulf Cooperation Council (GCC) countries. The authors use a structural VAR model to do so. They find the interest rate channel and the bank lending channel have a significant influence on real (non-hydrocarbon) output and prices.

Apergis & Alevizopoulou (2012) investigate the effect on the bank lending channel in Europe when different interest rate rules are used as an indicator for monetary policy. Specifically, a backward-looking, a Taylor-type and a forward-looking rule are considered. Under all three types, the bank lending channel is apparent. The greatest response of loan supply is found to be caused by monetary policy indicated as a forward-looking interest rate rule. In other words, the bank lending channel operates better in the case of the forward looking rule.

The effect of the presence of the zero lower bound interest rate constraint on the operation of the bank lending channel is studied by Apergis & Christou (2014). When no zero lower bound is present, the bank lending channel is operative, however in the zero lower bound case it is not. Monetary policy does not influence bank loans at all in the zero lower bound case, according to the authors' findings. This is a prime motive for quantitative easing, because it operates without a central bank having to lower policy rates.

Examining the bank lending channel in Russia using annual bank balance sheet data, Ono (2015) finds that it does exist. Three explanatory variables are identified: size, liquidity and capitalization. The log of loans outstanding is then regressed on these variables and a few dummies. It is suggested that size is negatively, and liquidity and capitalization are positively correlated with banks' loan portfolio size. Furthermore, capitalization seems to be negatively correlated with monetary policy shocks.

Ciccarellia, Maddalonia & Peydró (2015) use bank lending surveys by central banks to investigate the credit channel in the US and the Euro area. The authors argue that identification of the broad credit channel is normally difficult since it is unobserved. According to them, the bank lending surveys,

however, do contain reliable information about demand for loans and the broad credit channel. The responses to these surveys are used to construct credit channel variables. These variables are then used together with macroeconomic variables to construct a VAR model. They find that monetary policy shocks on output and prices are amplified through the credit channel. This happens through the balance sheets of households, firms and banks. In the Eurozone, all three balance sheet channels are important in the transmission of monetary policy shocks, with the bank lending channel being the most significant. In the US, on the other hand, the bank lending channel is not significant. There, monetary policy transmission mainly happens through the firm balance sheet channel. The authors conclude by saying their findings are consistent with policy measures taken during the crisis in both the Euro area and the US, as the European Central Bank mainly targeted banks while the Federal Reserve also targeted the non-financial sector.

Borio & Zhu (2012) theorize the existence of another transmission channel: the *risk-taking channel* of monetary policy. The authors define it as the impact of changes in monetary policy on the risk attitude of economic agents. This, in turn, affects the riskiness of portfolios held by these agents and the pricing of assets. The risk-taking channel may operate similarly to the credit channel, since lower interest rates increase asset values, collateral values, incomes and profits making agents less risk averse. This encourages investment and position-taking. Firms might take on riskier projects, while banks might be more lenient in the provision of funding. This shows that there could be a different transmission channel through which monetary policy can influence the economy: the risk-taking channel.

Gambacorta (2009) investigates the link between low interest rates and risk-taking behavior of banks. Banks' perception of and attitude towards risk can be influenced by monetary policy through a search-for-yield process, or by the impact of interest rates on valuations, incomes and cash flows. This, in turn, can change how banks measure risk. Using an econometric model which relates microeconomic bank data (expected default frequencies and other bank-specific characteristics) to macroeconomic conditions of the country where the financial intermediary has its head office, the paper finds that low interest rates over an extended period of time can cause an increase in banks' risk-taking. So, the paper provides evidence of the existence of a risk-taking channel of monetary policy.

Montesa & Peixoto (2014) study the so-called 'paradox of credibility' in Brazil. This is the paradox a central bank faces when implementing monetary policy. On the one hand, it is important for a central bank to be credible in order for its policy to have any effect. On the other hand, however, if a central bank is too credible, it can stimulate the creation of bubbles in credit and assets markets through greater risk-taking, i.e. the risk-taking channel. In an empirical study, the authors find evidence for the existence of the credit channel and the risk-taking channel in Brazil.

It seems that estimating a (VAR) model is a popular strategy in researching the transmission channels of monetary policy, with Bernanke (1986), King (1986), Ramey (1993), Brunner and Kamin (1998), Suzuki (2008), Cevik & Teksoz (2012), Ciccarellia, Maddalonia & Peydró (2015) and Gambacorta (2009) all going down this route. Several other authors, Bernanke (1983), Romer & Romer (1990), Bernanke & Blinder (1992), Farinha & Marques (2001), Apergis & Alevizopoulou (2012), Apergis & Christou (2014) and Ono (2015), have come up with a more original method.

4 Dataset & preliminary tests

This section describes the data used in the following sections of this paper, and conducts some preliminary tests. The sample consists of USA data, ranging from January 2003 to February 2016. This is constrained by data availability. Only the *size of the Fed's balance sheet* series is available from a later date, namely starting July 2007. Most data are of monthly frequency, either originally or converted by taking daily or weekly averages. Quarterly data is analyzed at quarterly frequency and is thus not converted. For more information about the data, refer to Appendix A.

4.1 Variables & proxies

4.1.1 Interest rate

Two interest rate variables are used, both of which are risk-free. One is the *10-year bond yield* (long-term) and the other is the *13-week Treasury Bill rate* (short-term). It is expected that these rates are significantly influenced by monetary policy (Bernanke, 2007).

4.1.2 External finance premium

The problem with the external finance premium is that it is unobservable. One possible proxy is the spread of the yield curve between, for example, the 10 year yield and the 3 month yield. Also, De Graeve (2008) mentions various other readily available proxies. The present paper attempts the following three. The BBB-AAA corporate bond spread and the high yield spread (≤CCC-AAA) are selected as credit spread proxies. The debt-to-GDP ratio is selected as an alternative, non-interest rate proxy. De Graeve (2008) shows that the debt-to-GDP ratio has very similar cycles as his estimated external finance premium.

4.1.3 Risk tolerance

The risk-taking channel works through changes in risk perception / tolerance (hereafter used interchangeably) due to changes in monetary policy. Risk tolerance is proxied by the *equity risk premium*. Absolute Strategy Research estimates a composite equity risk premium series for the United States by combining estimates from 9 different models, and hence this one is used.

4.1.4 Quantitative easing

The United States had three rounds of quantitative easing, nicknamed QE1, QE2 and QE3 respectively. The programs generally amounted to the Federal Reserve buying Treasury securities and mortgage-backed securities. So, in order to model quantitative easing, *Treasury Securities held by the Federal Reserve*, m*ortgage-backed Securities held by the Federal Reserve*, their sum, as well as the *size of the Fed's balance sheet* are examined. The balance sheet is used as a proxy, because in a broad definition, every asset of the central bank can be considered as part of the quantitative easing program.

In the next two sections, the relative importance of the interest rate channel, the broad lending channel and the risk-taking channel is analyzed using different types of models. However, before that, it seems wise to study the data more thoroughly.

4.2 Tests

4.2.1 The order of integration

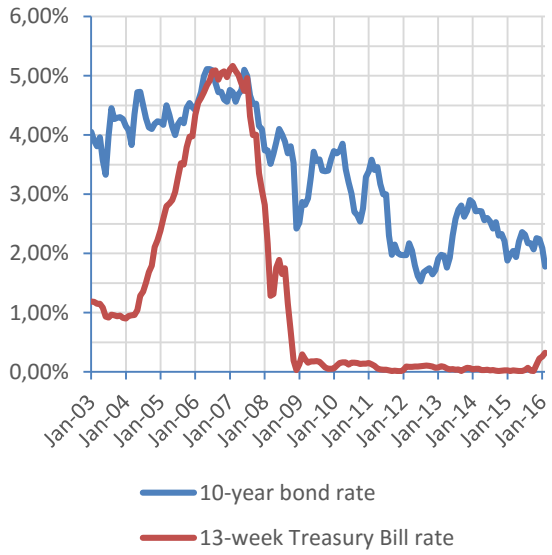
To start, an Augmented Dickey-Fuller test on the time series is performed in order to get a sense of their integration order. The result of this test is displayed in Table 1.

Series	Levels		First difference		Integration Order
	Exogenous	P-value	Exogenous	P-value	
10-year bond rate	Constant, Trend	0.0780	Constant	0.0000	1
13-week Treasury Bill rate	Constant	0.5884	Constant	0.0009	1
10-year – 3-month yield	Constant	0.4088	Constant	0.0000	1
BBB-AAA corp. bond spread	Constant	0.2253	Constant	0.0000	1
≤CCC-AAA corp. bond spread	Constant	0.0668	Constant	0.0000	1
Debt-to-GDP ratio*	Constant, Trend	0.2678	Constant	0.0040	1
Equity risk premium	Constant	0.2353	Constant	0.0000	1
Treasury securities held	Constant, Trend	0.5540	Constant	0.0130	1
Mortgage-backed sec. held	Constant, Trend	0.0590	Constant	0.1018	>1
Treasury + Mortgage-backed	Constant, Trend	0.3786	Constant	0.0347	1
Balance sheet Fed	Constant, Trend	0.6209	Constant	0.0000	1
Real GDP*	Constant, Trend	0.4777	Constant	0.0008	1

Table 1 | Augmented Dickey-Fuller test results, together with the integration order implied. Series denoted with an asterisk (*) are quarterly.

It is clear that none of the series is stationary in levels. A quick fix to this would be to use first differences. However, using first differences causes valuable long-run information to get lost, and using first differences of interest rate series is rather controversial (Ramey, 1993).

Since interest rates are all derived from a base rate (e.g. the Federal Funds rate in the US) that is fixed at a certain level by the central bank, one might argue that interest rates are actually stationary (conditional on the central bank's base rate policy). When looking at the *10-year bond rate*, it can be seen that it is almost trend-stationary at the 5% significance level. This could be explained by the fact that a long-term interest rate is generally not influenced as much by an underlying base rate as a short-term interest rate. This can also be seen when looking at Graph 1 and the data plots in Appendix A.3. The *10-year*



Graph 1 | Interest rates over time

bond rate is, however, still regarded non-stationary by the Augmented Dickey-Fuller test. The *13-week Treasury Bill rate* seems rather stationary in its plot, except for the financial crisis period. However, the Augmented Dickey-Fuller test still shows the series as being non-stationary. Moreover, it is odd that the Augmented Dickey-Fuller test indicates that the *10-year – 3-month yield curve rate spread*, the *BBB-AAA corporate bond spread* and the *≤CCC-AAA corporate bond spread* are non-stationary, since these are all interest rate spreads of which the non-stationary component (the Federal Funds rate) cancels out. These examples illustrate that the Augmented Dickey-Fuller test should not always be trusted blindly. It is included here for completeness, but is not followed strictly.

To estimate a regression without using first differences, there are two options. One can estimate a model in levels and include a time trend to capture the non-stationarity, or one can estimate an error correction model. In both cases, however, it is necessary to know if any cointegrating relationships exist in the data.

4.2.2 Cointegration

To see whether there are cointegration relationships present, a Johansen Cointegration test is performed. Since the goal is to estimate the effect of quantitative easing on the interest rate, the external finance premium and risk tolerance, the Johansen test is performed on pairs of these variables only (i.e. *real GDP* is left out, for now). Pairs consist of, on the one hand, an interest rate, external finance premium or risk tolerance proxy, and, on the other, of a quantitative easing proxy.

The Augmented Dickey-Fuller test indicated that some of the variables are trend stationary (see Table 1), so the cointegration equation is assumed to have an intercept and a trend. The lag interval of the Johansen test is based on the minimum number of lags for which a cointegrating relationship can be found, with a maximum of 12 lags (for monthly data) considered.

Table 2 shows the resulting Trace statistics for the null hypothesis of no cointegrating relationships between the variables. If this is rejected (denoted by one or more asterisks), the two variables are found to be cointegrated. If no cointegrating relationship is found, the maximum Trace statistic is reported.

It is clear from Table 2 that only *Treasury securities held by the Fed* together with the *10-year bond rate*, *BBB-AAA corporate bond spread* and the *equity risk premium* are not cointegrated. The Trace statistics reported in these three cells is the maximum Trace statistic found when testing for 1 up to and including 12 lags.

IR/EFP/ERP proxy→ QE proxy↓	Interest rate		External finance premium				Risk tolerance
	Bond rate	Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity premium
Treasury securities	22.11 [3]	28.51** [2]	20.84 [3]	25.42* [4]	28.66** [11]	28.24** [1]	20.03 [3]
Mortgage-backed securities	68.45*** [1]	30.71** [1]	97.34*** [1]	68.70*** [1]	70.99*** [1]	50.03*** [2]	61.15*** [1]
Treasury & mortgage-backed securities	27.25** [5]	33.69*** [1]	33.47*** [1]	27.98** [1]	30.39** [8]	34.98*** [1]	23.61* [3]
Balance sheet Fed	29.57** [10]	47.05*** [1]	27.71** [5]	48.43*** [4]	26.75** [1]	29.68** [2]	23.84* [5]

Table 2 | Trace statistics of Johansen Cointegration tests on pairs of variables, testing the null hypothesis of no cointegrating relationships. The number of lags used is reported in brackets [ ].
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

5 Separate estimation in two steps

In this section the relative importance of the interest rate channel, the broad lending channel and the risk-taking channel is analyzed in an isolated setting. This means no interplay between the channels is allowed. This can be illustrated in an influence diagram, in Figure 1 below.

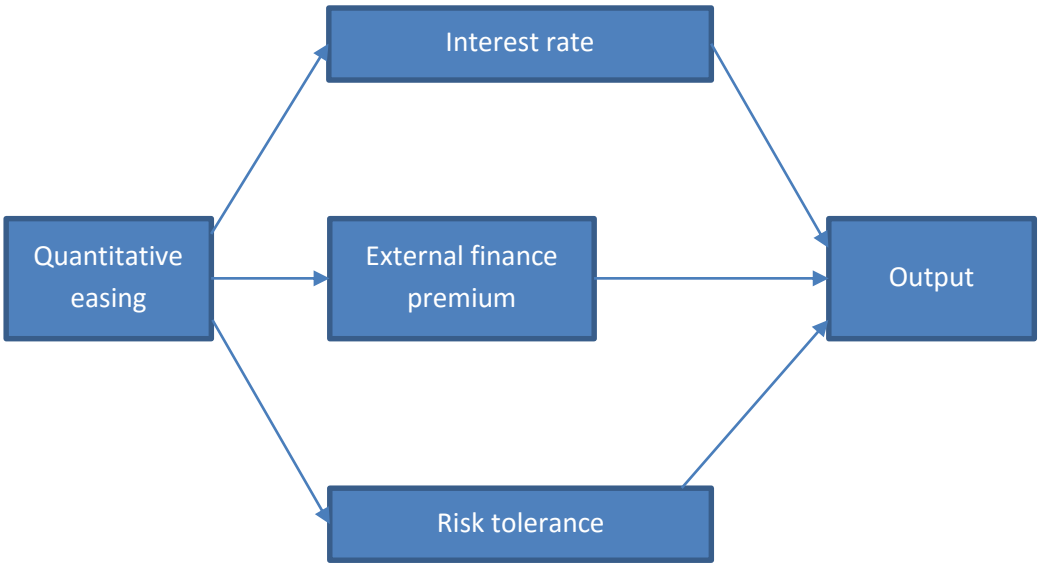


Figure 1 | Influence diagram illustrating the dynamics of quantitative easing, the interest rate, the external finance premium, risk tolerance and output, according to an isolated setting.

The interest rate, the external finance premium and the risk tolerance are considered to be analogous to the interest rate channel, the credit channel and the risk-taking channel respectively. So the three transmission channels are depicted in the three rows of Figure 1.

First, the effect of quantitative easing on the interest rate, the external finance premium and risk tolerance are estimated in three bivariate regressions using autoregressive distributed lag (ARDL) and error correction (EC) models, in subsections 5.1.1 and 5.1.2 respectively. This is hereafter referred to as quantitative easing *entering* the respective transmission channels. The equations to be estimated are as follows.

$$IR_t = \alpha_1 + \sum_{q=0}^{Q_1} \beta_{1,1,q} \cdot QE_{t-q} + \sum_{p=1}^{P_1} \beta_{1,2,p} \cdot IR_{t-p} + \varepsilon_{1,t}$$

$$EFP_t = \alpha_2 + \sum_{q=0}^{Q_2} \beta_{2,1,q} \cdot QE_{t-q} + \sum_{p=1}^{P_2} \beta_{2,2,p} \cdot EFP_{t-p} + \varepsilon_{2,t}$$

$$RT_t = \alpha_3 + \sum_{q=0}^{Q_3} \beta_{3,1,q} \cdot QE_{t-q} + \sum_{p=1}^{P_3} \beta_{3,2,p} \cdot RT_{t-p} + \varepsilon_{3,t}$$

Where IR, EFP, RT and QE denote the interest rate, the external finance premium, risk tolerance and quantitative easing respectively.

As the equations demonstrate, quantitative easing enters with multiple lags. To find an overall effect of quantitative easing on the interest rate, the external finance premium and on risk tolerance, the long-run multiplier is derived from the equations in subsections 5.1.1.3 and 5.1.2.3.

In the second step, the effect of the fitted values of the first step on output are estimated using a multivariate regression, effectively estimating the effect of quantitative easing *through* the interest rate, external finance premium and risk tolerance in that way. This second step is hereafter referred to as quantitative easing *exiting* the respective transmission channels. It is assumed that quantitative easing can take up to two years to influence output. The equation to be estimated is displayed below.

$$\ln GDP_t = \alpha_4 + \sum_{l=0}^{L_1} \beta_{4,1,l} \cdot \widehat{IR}_{t-l} + \sum_{l=0}^{L_2} \beta_{4,2,l} \cdot \widehat{EFP}_{t-l} + \sum_{l=0}^{L_3} \beta_{4,3,l} \cdot \widehat{RT}_{t-l} + \varepsilon_{4,t}$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.

This equation shows that the fitted values of the interest rate, the external finance premium and risk tolerance enter with multiple lags. To find an overall effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output, the long-run multipliers are derived from the equations in subsections 5.2.1.3 and 5.2.2.3.

5.1 Step 1 – channel entry

In this subsection, the effect of quantitative easing on the interest rate, the external finance premium and on risk tolerance is estimated, in order to gain insight in how quantitative easing enters the interest rate channel, credit channel and risk-taking channel respectively. This is done using several bivariate regressions, with various proxies for each variable.

Since the purchase of government bonds by a central bank is usually undertaken in order to lower interest rates, it is expected that quantitative easing has a negative effect on the interest rate (Bernanke, 2009). Krishnamurthy & Vissing-Jorgensen (2011) obtain this result as well. The external finance premium is expected to decrease following an increase in the quantitative easing program, mainly through the bank lending channel. This means, a negative coefficient is expected. Also, an increase in quantitative easing can lower interest rates, stimulate investment and lower risk perception / increase risk tolerance, which decreases the equity premium and would lead us to expect a negative coefficient for the effect on risk tolerance. However, Dell'Ariccia, Laeven & Marquez (2010) and De Nicolò, Dell'Ariccia, Laeven & Valencia (2010) suggest that its effect can be ambiguous, so caution is advised.

5.1.1 Autoregressive distributed lag models – long-run dynamics

Since it is known that the data is cointegrated, it is possible to estimate autoregressive distributed lag (ARDL) models in levels, which represents long-run relationships in the data (Giles, 2013). It is not necessary to worry about spurious regression results, because of the cointegrating relationships present (see Table 2 and Table 4). First, ARDL models with quantitative easing as independent variable and the interest rate, the external finance premium and risk tolerance as dependent variables are estimated (subsection 5.1.1.1) using every combination of proxies (outlined in subsection 4.1). Then, these models are interpreted (subsection 5.1.1.2). Lastly, the long-run multipliers are computed from the models (subsection 5.1.1.3) so as to be able to interpret an overall effect of quantitative easing on the interest rate, the external finance premium and risk tolerance.

5.1.1.1 Estimation

So to investigate how quantitative easing enters the interest rate channel, the credit channel and the risk-taking channel, its effect on, respectively, the interest rate, the external finance premium and on risk tolerance is estimated in several bivariate ARDL regressions, using Ordinary Least Squares estimation. As discussed above, this can be denoted in the following equations.

$$IR_t = \alpha_1 + t + \sum_{q=0}^{Q_1} \beta_{1,1,q} \cdot QE_{t-q} + \sum_{p=1}^{P_1} \beta_{1,2,p} \cdot IR_{t-p} + \varepsilon_{1,t} \qquad 5.1.1$$

$$EFP_t = \alpha_2 + t + \sum_{q=0}^{Q_2} \beta_{2,1,q} \cdot QE_{t-q} + \sum_{p=1}^{P_2} \beta_{2,2,p} \cdot EFP_{t-p} + \varepsilon_{2,t} \qquad 5.2.1$$

$$RT_t = \alpha_3 + t + \sum_{q=0}^{Q_3} \beta_{3,1,q} \cdot QE_{t-q} + \sum_{p=1}^{P_3} \beta_{3,2,p} \cdot RT_{t-p} + \varepsilon_{3,t} \qquad 5.3.1$$

Where IR, EFP, RT and QE denote the interest rate, the external finance premium, risk tolerance and quantitative easing respectively. t denotes the time trend.

The estimations are done using every combination of the proxies. That means equation 5.1.1 is estimated 8 times, for the 2 interest rate variables (the *10-year bond rate* and the *13-week Treasury Bill rate*), combined with all of the 4 quantitative easing proxies (*Treasury securities held by the Fed*, *mortgage-backed securities held by the Fed*, *Treasury & mortgage-backed securities held by the Fed* and the *size of the Fed's balance sheet*). Equation 5.2.1 is estimated 16 times, for the 4 external finance premium proxies (*BBB-AAA & ≤CCC-AAA corporate bond spreads*, the *10-year – 3-month yield curve rate spread* and the *debt-to-GDP ratio*), combined with all of the 4 quantitative easing proxies. Lastly, equation 5.3.1 is estimated 4 times, for the 1 risk tolerance proxy (the *equity risk premium*), combined with all of the 4 quantitative easing proxies.

When selecting the appropriate values for the number of autoregressive terms *P* and distributed lags *Q* for an ARDL(*P*,*Q*) regression, three approaches are used. The first two approaches involve manually selecting the number of distributed lags (*Q*) and autoregressive terms (*P*). For the amount of distributed lags (*Q*), the initial number for monthly data is 12. That means *Q = 12*. Note that the *debt-to-GDP ratio* external finance premium proxy is quarterly, so in that case the initial number of distributed lags (*Q*) is 4. For the number of autoregressive terms (*P*), the partial autocorrelation function is considered. If partial correlation is present at the first two lags, for example, then *P = 2*. The Durbin-Watson statistic[5] is also kept in mind. If this statistic indicates possible autocorrelation, an extra autoregressive term is added. In practice, this means the initial model is almost always an ARDL(2,12) model. In the first approach, all variables of which the coefficients have the wrong sign and are statistically insignificant are deleted from the model one by one. So significant coefficients with the wrong sign might still be present in the model. In the second approach, all coefficients with the wrong sign are removed one by one. So no coefficient with the wrong sign is present in the model, irrespective of significance. In these first two approaches, the resulting model might not have consecutive lags, since intermediate lags are removed. In other words, these two approaches might result in a model with, for example, lags 1, 3 and 5 instead of lags 1 through 5.

The third approach is quite different altogether. Every combination of consecutive lags for *P* and *Q* is estimated, up to and including *P = 12* and *Q = 12* for monthly data and *P = 4* and *Q = 4* for quarterly data. For all of these combinations, the long-run effect of the distributed lags is calculated, together with its Wald statistic of joint significance. The model with the highest joint significance (Wald statistic) and the correct sign of the long-run effect is chosen. If the correct sign is not found, the model with the highest joint significance is chosen. This is done for every combination of proxies. All this is done using a computer script[6]. Note that in this third approach, the resulting models will always include consecutive lags. So a model can never only include, for example, lags 1, 3 and 5 but will in that case always include lags 1 through 5.

As discussed above, equation 5.1.1 is estimated 8 times, equation 5.2.1 is estimated 16 times and equation 5.3.1 is estimated 4 times, leading to 28 final specifications per approach. The first estimation approach requires approximately 8 attempts before arriving at a specification, while the second approach adds another 4 attempts on average. This means the first approach attempts $28 \times 8 = 224$ possible specifications, and the second approach attempts $28 \times 4 = 112$ possible specifications. The

[5] The Durbin-Watson statistic ranges from 0 to 4. A value close to 2 indicates no autocorrelation (Durbin & Watson, 1950).

[6] For the interested reader, this computer script (for the EViews statistical package) is reported in Appendix E.1. It is undocumented, albeit with a few comments in the code.

third approach, however, involves a lot more attempts as it evaluates every possible order of *P* and *Q* lags, up to *P = Q = 12* for monthly data and *P = Q = 4* for quarterly. Only 1 of the 4 external finance premium proxies is quarterly, meaning that 4 specifications of equation 5.2.1 are quarterly. This means that the third approach attempts $24 \times 12^2 + 4 \times 4^2 = 3520$ possible specifications. So, a total of $224 + 112 + 3520 = 3856$ specifications are attempted before arriving at the final 3 times 28 specifications.

5.1.1.2 Interpretation

The resulting models are reported in Appendix B.1. Subsection B.1.1 contains the models including significant coefficients that have the wrong sign (approach 1). Subsection B.1.2 contains the models where all coefficients with the wrong sign have been removed (approach 2). Subsection B.1.3 contains the models with the best F-statistic of a Wald test of joint significance (approach 3).

Looking at the interest rate models (subsections B.1.1.1, B.1.2.1 and B.1.3.1), caution should be taken when interpreting the models combining the *10-year bond rate* interest rate proxy with the *Treasury securities held by the Fed* quantitative easing proxy. Since no cointegration has been found between these variables, the regression may be spurious. It is notable that the coefficient of the time trend in most models is significant, but always very small. For the *10-year bond rate*, the trend coefficient is mostly negative. This indicates that the interest rate tends to decrease as time progresses, regardless of quantitative easing. This might be explained by the Federal Funds rate, which has been set lower over time by the Federal Reserve, from which United States interest rates are generally derived (also discussed in subsection 4.2.1). For the *13-week Treasury Bill rate*, the effect of the trend is more ambiguous. The constant is almost always positive, which is to be expected. Only in the case of the *13-week Treasury Bill rate* coupled with *Treasury securities held by the Fed* and *mortgage-backed securities held by the Fed* under approach 1 (subsection B.1.1.1) the constant is negative, which is odd[7]. Regarding the number of quantitative easing lags included, it is noticeable that under approaches 1 and 2 (subsections B.1.1.1 and B.1.2.1) the resulting models indicate a delayed effect, meaning that the lags that have remained in the model are of high order. Under approach 3 (subsection B.1.3.1) this delayed effect also surfaces, since, in most cases, a high number of consecutive lags is included and the later lags are the most significant. Only in the case of *mortgage-backed securities held by the Fed* the effect seems rather direct (under approach 3). The autoregressive terms, i.e. the lags of the interest rate, increase the explanatory power of the models a great deal, as reflected in the high R^2. In the

[7] Theoretically, there used to be a *zero lower bound* for interest rates. In June 2014, the European Central Bank introduced a negative interest rate for their overnight deposit facility for commercial banks (European Central Bank, 2014). It is unlikely that the negative constant found in the United States data indicates a negative interest rate policy, however, since the underlying data is strictly positive.

models of approach 2 (subsection B.1.2.1), two of them do not have any quantitative easing coefficient left. Most of them include only one or two quantitative easing coefficients, which are often insignificant. These models seem a lot less strong as compared to the models of approach 1 (subsection B.1.1.1). When comparing the Akaike Information Criterion, which is a relative measure of information lost in the model[8] (Akaike, 1974), and R^2 values of the models, approach 3 (subsection B.1.3.1) is generally statistically the weakest approach. However, since it only allows for consecutive lags and the joint effect of quantitative easing is restricted to the correct sign where possible, it is the easiest approach to interpret economically. Approach 3 also seems to distinguish the long-run from the short-run in that the long-run interest rate (the *10-year bond rate*) models always includes the same or more quantitative easing lags than the short-run interest rate (the *13-week Treasury Bill rate*) models.

The external finance premium models are reported in the Appendix in subsections B.1.1.2, B.1.2.2 and B.1.3.2. A lot of the same things apply for the external finance premium models as they do for the interest rate models, such as the caution that is to be taken when interpreting the models combining the *BBB-AAA corporate bond spread* with *Treasury securities held by the Fed* as no cointegration between these variables was found and the results may thus be spurious. Yet, the coefficient of the time trend is generally small and significant, but more often positive than negative. This means that, generally, there is slight *up*wards pressure on the external finance premium as time progresses, regardless of quantitative easing. Only in the case of the *debt-to-GDP ratio* proxy is the coefficient of the trend slightly greater (in absolute sense), but this can probably be attributed to the fact that the *debt-to-GDP ratio* is not an interest rate variable. The constant is small and usually positive in the cases of the *BBB-AAA corporate bond spread* and the *10-year – 3-month yield curve rate spread*. It can take on some more extreme values (both positive and negative) in the cases of the *high yield (≤CCC-AAA) corporate bond spread* and the *debt-to-GDP ratio*. A positive constant indicates that, in the absence of quantitative easing or any external finance premium in previous periods, there is a (small) premium to be paid by firms for external financing. A negative constant is slightly strange to interpret. It would indicate that, without taking into account quantitative easing or any external finance premium in previous periods, external financing is cheaper for firms than using retained earnings. This seems unrealistic. The number of quantitative easing lags in the models varies a lot between proxy combinations and approaches. Note that the maximum number of lags in the case of the *debt-to-GDP ratio* proxy is 4, due to its quarterly nature. Approach 1 (subsection B.1.1.2) includes a lot of the lags. Especially in the corporate bond spread cases, very few lags are removed. Under approach 2

[8] The Akaike Information Criterion (AIC) can only be used to assess the relative quality of models. So in this paper, one should only compare AIC values of models that use the same combination of proxies in the same sample size. This is not always possible. Since it is a relative measure of information lost, the model with the lower AIC is the better model (Akaike, 1974).

(subsection B.1.2.2) the quantitative easing lags seem to be scattered randomly. For the corporate bond spreads, this approach seems to indicate a more direct effect, with most models including not more than two lags. The models using the *debt-to-GDP ratio* proxy happen to be equal in approaches 1 and 2. Approach 3 (subsection B.1.3.2) seems to suggest a delayed effect, just as in the interest rate case, due to the high number of lags included in a lot of the models. The autoregressive terms, added to combat autocorrelation, increase the explanatory power of the models a lot. The different approaches seem to compare similarly as in the interest rate case. Thus, Approach 1 (subsection B.1.1.2) seems to be the most statistically sound approach. However, approach 3 (subsection B.1.3.2) overtakes approach 2 (subsection B.1.2.2) on the basis of R^2 and Akaike Information Criterion. The Durbin-Watson statistic seems slightly worse. Approach 3 remains the best model in terms of interpretation.

The risk tolerance models are reported in the Appendix in subsections B.1.1.3, B.1.2.3 and B.1.3.3. The only proxy for risk tolerance used is the equity risk premium. The models using *Treasury securities held by the Fed* as quantitative easing proxy should be interpreted with caution, as the regression may be spurious due to the lack of cointegration. The coefficient of the trend is in most models slightly positive but almost never significant. This means there is no upwards nor downwards pressure on the equity risk premium as time progresses. The constant is in most cases small and positive, which is expected as it means that the rate on equity is a few percentage points above the risk free rate, in the absence of quantitative easing or any equity premium in previous periods. Only under approach 1 (subsection B.1.1.3), when using *mortgage-backed securities held by the Fed* as quantitative easing proxy, the constant seems inexplicably high. When looking at the quantitative easing lags that have remained in the models, it is noticeable that under approach 1 (subsection B.1.1.3) the direct effect (time *t*) is in all four models. Approach 2 (subsection B.1.2.3) seems to have only a few random insignificant lags. Approach 3 (subsection B.1.3.3) has a lot more significant lags, but the number of lags varies a lot between the different quantitative easing proxies. The effect seems to be more long term when using *Treasury securities held by the Fed* or *size of the Fed's balance sheet* as quantitative easing proxy, and more short term when using *mortgage-backed securities held by the Fed* or the sum of *Treasury & mortgage-backed securities held by the Fed*. Comparing the models on R^2, Akaike Information Criterion and Durbin-Watson statistic sees approach 1 (subsection B.1.1.3) come out on top, with approach 3 (subsection B.1.3.3) following second. Approach 3, however, is again the easiest to interpret due to its consecutive lags.

5.1.1.3 Deriving the long-run effect

The long-run effect (or multiplier) of quantitative easing on the interest rate, the external finance premium and risk tolerance can be calculated from these models. This long-run effect can be seen as

an overall effect of quantitative easing on the interest rate, the external finance premium and the equity risk premium. This is done in order to ease interpretation of the found effects. The procedure is as follows. Consider the following sample equation.

$$y_t = c + \alpha_0 y_{t-1} + \alpha_1 y_{t-2} + \beta_0 x_{t-1} + \beta_1 x_{t-2} + \varepsilon_t$$

To obtain the long-run effect of x on y, one computes:

$$\frac{\beta_0 + \beta_1}{1 - \alpha_0 - \alpha_1}.$$

That is, divide the sum of x coefficients by 1 minus the sum of y coefficients. A detailed explanation of this procedure is reported in Appendix B.1.4. This is calculated for every model in Appendix B.1. The obtained long-run effects are reported in Table 3, below. These effects can be interpreted as how quantitative easing 'enters' the interest rate channel, credit channel and risk-taking channel respectively, in total and over time.

Just as when interpreting the models individually, one should be careful interpreting the long-run effects in Table 3 that result from regression that may be spurious due to a lack of cointegration. These particular values are indicated by an '×' in the top-left corner.

It is obvious from Table 3 that, in the interest rate channel case, the models under approaches 2 and 3 agree a lot better on the long-run effect of quantitative easing than the models under approach 1. The numbers resulting from approach 2 and 3 seem a lot closer to each other than the numbers resulting from approach 1. It is noticeable that the effect of quantitative easing on the short-term *13-week Treasury Bill rate* is usually greater (in absolute sense) than the effect on the long-term *10-year bond rate*. This is to be expected as the short-term interest rate is usually higher than the long-term one. When comparing the long-term interest rate with the short-term one under approach 1, using *Treasury & mortgage-backed securities held by the Fed* as quantitative easing proxy, an interesting result emerges. In this case, quantitative easing has a positive effect on the short-term rate, but a negative effect on the long-term. This might be an indication of Operation Twist, a policy conducted in the United States that aimed to lower long-term rates and increase short-term rates, so as to 'twist' the yield curve. Another indication that it is indeed Operation Twist emerging in this particular case is the strongly significant, negative effect of quantitative easing on the *10-year – 3-month yield curve rate spread*.

←Approach	IR/EFP/RT proxy→ / QE proxy↓	Interest rate channel: 10-year bond rate	Interest rate channel: 13-week Treasury Bill rate	Credit channel: BBB-AAA spread	Credit channel: ≤CCC-AAA spread	Credit channel: 10y – 3m yield spread	Credit channel: Debt-to-GDP ratio[1]	Risk-taking channel: Equity risk premium[2]
	Negative and significant positive coefficients							
1	Treasury securities	× 0.12 (3.61)***	4.85 (5.77)***	× -2.43 (6.69)***	-9.00 (11.94)***	-3.90 (4.76)***	-63.64 (9.11)***	× 2.25 (3.63)***
	Mortgage-backed securities	1.28 (2.67)*	243.78 (1.57)	0.58 (1.46)	-27.15 (1.94)*	1.58 (3.23)**	531.94 (20.26)**	-2.87 (3.69)**
	Treasury & mortgage-backed securities	-0.38 (2.31)**	7.40 (3.80)***	-2.11 (4.86)***	-13.94 (7.87)***	-6.23 (4.23)***	101.39 (5.73)***	-1.55 (2.37)**
	Balance sheet Fed	1.02 (4.64)***	-0.64 (20.50)***	-3.46 (23.64)***	-15.76 (24.42)***	1.26 (4.23)***	-24.62 (4.41)**	1.23 (6.43)***
	Only negative coefficients							
2	Treasury securities	× -0.13 (0.05)		× -2.14 (11.54)***	-10.72 (4.94)**	-3.33 (3.40)*	-63.64 (9.11)***	× -1.07 (0.78)
	Mortgage-backed securities	-0.49 (3.27)*	-0.48 (1.17)			-0.46 (2.68)	-11.42 (0.40)	
	Treasury & mortgage-backed securities	-0.41 (0.66)		-2.25 (13.81)***	-14.68 (13.80)***	-4.99 (3.32)**	101.39 (5.73)***	-1.05 (1.09)
	Balance sheet Fed	-0.79 (0.27)	-1.35 (17.82)***	-2.99 (2.96)*	-49.73 (7.40)***	-0.40 (0.11)		-2.57 (0.96)
	Negative long-run effect							
3	Treasury securities	× 0.85 (2.05)**	-0.02 (3.74)***	× -2.36 (4.60)***	-8.38 (5.65)***	-2.85 (3.17)***	146.59 (20.54)***	× 2.70 (2.67)***
	Mortgage-backed securities	-0.84 (0.73)	-1.41 (8.49)***	-0.85 (27.76)***	-11.12 (15.14)***	1.83 (3.82)***	-8.99 (3.42)*	2.14 (9.22)***
	Treasury & mortgage-backed securities	-0.17 (1.35)	-4.34 (5.56)***	-2.26 (3.76)***	-22.00 (12.68)***	-6.10 (2.83)***	31.96 (19.06)***	-1.45 (4.86)***
	Balance sheet Fed	-1.48 (4.27)***	-1.50 (15.87)***	-0.09 (8.30)***	-39.25 (19.67)***	-0.03 (4.18)***	54.58 (8.44)***	1.49 (6.29)***

*Table 3 | Long-run effect of quantitative easing (QE) on the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) using various proxies for all variables. 3 approaches are used, as outlined in subsection 5.1.1. The underlying models are reported in Appendix B.1. The long-run effect is calculated using the method explained in Appendix B.1.4. An 'x' in the top-left corner indicates the value originates from a model for which no cointegration was found (Table 2). F-statistics of a Wald test of joint significance are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

[1]: The debt-to-GDP ratio column refers to quarterly data.

[2]: For the equity risk premium under approach 3, no sign restriction is used.

In the credit channel case, Table 3 shows less differences between the different approaches than in the interest rate channel case. Especially when using *Treasury securities held by the Fed* or the sum of

Treasury & mortgage-backed securities held by the Fed as quantitative easing proxy or when using the *BBB-AAA corporate bond spread* as external finance premium proxy, the results are almost exactly equal across the approaches. Although the *debt-to-GDP ratio* columns have some extreme values, this is due to this proxy not being an interest rate (derived) variable. The variance of the *BBB-AAA corporate bond spread* column under approach 2 is quite low and, irrespective of the choice in quantitative easing proxy, significant. This would indicate that the long-run effect of quantitative easing on the external finance premium lies somewhere between -2.99 and -2.14. Overall, the *BBB-AAA corporate bond spread* seems promising as external finance premium proxy. Also under approach 3, the *BBB-AAA corporate bond spread* has significant, credible values. Irrespective of the proxy chosen, every value under approach 3 is significant, and only a few have the wrong sign. This indicates the usefulness of this estimation approach.

In the risk-taking channel case, the desired long-run effect is unknown as it is theorized by Dell'Ariccia, Laeven & Marquez (2010) and De Nicolò, Dell'Ariccia, Laeven & Valencia (2010) that the effect of monetary policy on the equity risk premium is ambiguous. Under the first approach, when not restricting the coefficients to be negative, the majority of long-run effects found is negative. When we do restrict the coefficients to be negative in approach 2, however, none of the long-run effects is significant. For this reason, no sign restriction is in place under approach 3. The models are solely selected on their Wald statistic of joint significance of the quantitative easing coefficients, irrespective of their sign. The result is that every long-run effect found is highly significant, as is to be expected. Also, almost exactly opposite effects are found. *Treasury securities held by the Fed* is with a long-run effect of -2.70 almost the exact opposite of *mortgage-backed securities held by the Fed*, which has a long-run effect of 2.14. Moreover, *Treasury & mortgage-backed securities held by the Fed* has a long-run effect of -1.45, while the *size of the Fed's balance sheet* has a long-run effect of 1.49. The fact that exactly as many positive as negative coefficients are found seems in accordance with the ambiguity of the relationship found by Dell'Ariccia, Laeven & Marquez (2010) and De Nicolò, Dell'Ariccia, Laeven & Valencia (2010).

Thus, while the approach 2 models themselves seem weaker than the approach 1 models, the approach 2 ones show better results when extracting the long-run effects. Approach 3 seems to have the best of both worlds, with statistically sound underlying models and coherent results for the long-run effect. The quantitative easing proxy of the sum of *Treasury & mortgage-backed securities held by the Fed* has very similar results across the 3 approaches, which indicates it is a useful proxy.

5.1.2 Error correction models – short-run dynamics

Besides estimating in levels, cointegrated data also allows for estimation of error correction models, which represents short-run relationships in the data (Giles, 2013). Each model is estimated using Ordinary Least Squares, with the number of lags equal to the number reported in Table 2, the number for which cointegration was found. This same number of lags is used to compute cointegrating equations between the various proxies. These are presented in Table 4, in 4 sections.

QE proxy↓	Dep. variable→	Bond rate	Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity premium
Treasury securities held by the Fed	$\ln QE_t$		93.54 (4.84)***		7.35 (2.56)**	-1.89 (-1.57)	-45.52 (-5.77)***	
	$trend$		-1.07 (-4.64)***		-0.09 (-2.61)***	0.02 (1.61)	0.26 (0.97)	
	$constant$		-571.57		-49.23	8.02	542.86	
QE proxy↓	Dep. variable→	Bond rate	Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity premium
Mortgage-backed securities held by the Fed	$\ln QE_t$	-3.62 (-11.53)***	0.57 (4.92)***	2.39 (12.47)***	21.69 (9.49)***	-3.60 (-11.82)***	-25.37 (-3.68)***	7.08 (10.56)***
	$trend$	0.06 (12.99)***	-0.005 (-2.69)***	-0.01 (-4.12)***	-0.19 (-5.63)***	0.06 (13.08)***	1.25 (3.68)***	-0.08 (-8.51)***
	$constant$	5.17	-4.68	-26.62	-171.49	5.91	208.22	-43.55
QE proxy↓	Dep. variable→	Bond rate	Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity premium
Treasury & mortgage-backed securities held by the Fed	$\ln QE_t$	1.66 (3.21)***	13.13 (5.63)***	3.32 (5.07)***	6.92 (2.18)**	-14.02 (-4.40)***	-25.66 (-10.51)***	-1.32 (-1.74)*
	$trend$	-0.01 (-0.67)	-0.19 (-4.92)***	-0.06 (-5.18)***	-0.13 (-2.42)**	0.22 (4.22)***	-0.001 (-0.01)	0.004 (0.35)
	$constant$	-22.92	-58.57	-10.48	-20.58	45.19	282.38	11.82
QE proxy↓	Dep. variable→	Bond rate	Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity premium
Balance sheet size of the Fed	$\ln QE_t$	-54.49 (-3.83)***	1.57 (3.11)***	-17.36 (-4.01)***	13.16 (2.58)**	-4.33 (-5.16)***	-65.11 (-2.82)***	25.70 (3.22)***
	$trend$	0.63 (2.95)***	-0.02 (-2.14)**	0.25 (3.48)***	-0.22 (-2.48)**	0.07 (4.84)***	4.28 (3.05)***	-0.33 (-2.51)**
	$constant$	362.55	-11.30	82.29	-53.53	14.06	718.90	-153.68

*Table 4 | Cointegrating equations of the various cointegrating pairs. Each column in a section is an equation. The numbers represent coefficients. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

Each section in Table 4 belongs to a quantitative easing proxy, as independent variable. This is then regressed on each interest rate, external finance premium and risk tolerance proxy. As before, the natural logarithm is taken of every quantitative easing proxy. When taking, for example, Treasury securities as quantitative easing proxy (independent variable) and the Treasury Bill rate as interest rate proxy (dependent variable), we get the following cointegrating equation:

$$Treasury\ Bill\ rate_t = -571.57 + 93.54 \cdot \ln Treasury\ securities_t - 1.07 \cdot t.$$

A negative coefficient for quantitative easing in the cointegrating equation implies a negative interest rate, external finance premium or equity risk premium, since the quantitative easing series takes on strictly positive values. This is very unconventional[9]. Furthermore, it is very unlikely that external financing is cheaper for firms than using retained earnings, which is what a negative external finance premium implies. Lastly, a negative equity risk premium signifies rates on equity that are below the risk-free rate, which is very unrealistic.

These cointegrating equations are used to compute *error correction terms*, by subtracting the constant, independent variable and trend from both sides of the equals sign. Proceeding with our previous example, the error correction term would then become:

$$ECT_t = Treasury\ Bill\ rate_t + 571.57 - 93.54 \cdot \ln Treasury\ securities_t + 1.07 \cdot t.$$

These error correction terms are included in the regression, together with the lags of dependent and independent variables, as discussed earlier. Because of the cointegrating relationships in the data, it is not necessary to worry about spurious results. The approach of removing insignificant lags was attempted as well, but this led very often to models without any quantitative easing lags.

First, error correction models with quantitative easing as independent variable and the interest rate, the external finance premium and risk tolerance as dependent variables are estimated (subsection 5.1.2.1) using every combination of proxies (outlined in subsection 4.1). Then, these models are interpreted (subsection 5.1.2.2). Lastly, the long-run effects are derived from the models (subsection 5.1.2.3) so as to be able to interpret an overall effect of quantitative easing on the interest rate, the external finance premium and risk tolerance.

5.1.2.1 Estimation

Investigating how quantitative easing enters the interest rate channel, the credit channel and the risk-taking channel is done in this section by estimating error correction models relating a quantitative easing proxy (the independent variable) to an interest rate, external finance premium or risk tolerance proxy (the dependent variable), using Ordinary Least Squares estimation. Every model includes an error correction term derived from Table 4 (as explained before), which is denoted by ECT_{t-1}. Error correction models are estimated in first differences. The expected sign of the coefficients is the same as in the case of ARDL models in levels (subsection 5.1.1). So a negative relation between quantitative easing and the interest rate and external finance premium is expected, and no specific sign is expected

[9] For the interest rate see footnote 7 on page 29.

ex ante for the relationship between quantitative easing and risk tolerance. The equations are now formulated as follows.

$$\Delta IR_t = \alpha_1 + ECT_{1,t-1} + \sum_{p=1}^{P_1} \left[\beta_{1,1,p} \cdot \Delta QE_{t-p} + \beta_{1,2,p} \cdot \Delta IR_{t-p}\right] + \varepsilon_{1,t} \quad 5.1.2$$

$$\Delta EFP_t = \alpha_2 + ECT_{2,t-1} + \sum_{p=1}^{P_2} \left[\beta_{2,1,p} \cdot \Delta QE_{t-p} + \beta_{2,2,p} \cdot \Delta EFP_{t-p}\right] + \varepsilon_{2,t} \quad 5.2.2$$

$$\Delta RT_t = \alpha_3 + ECT_{3,t-1} + \sum_{p=1}^{P_3} \left[\beta_{3,1,p} \cdot \Delta QE_{t-p} + \beta_{3,2,p} \cdot \Delta RT_{t-p}\right] + \varepsilon_{3,t} \quad 5.3.2$$

Where IR, EFP, RT and QE denote the interest rate, the external finance premium, risk tolerance and quantitative easing respectively. Δ denotes the first difference is used. ECT denotes an error correction term.

The lag order *P* is the lag order for which the Johansen Cointegration tests found cointegration for the specific combination of variables (Table 2). For this reason, not more specifications were estimated than the final ones. The estimations are done using every combination of variables, except for the ones for which no cointegration was found. Since no cointegration was found for 3 combinations of variables, $28 - 3 = 25$ specifications were estimated. The estimated equations are reported in Appendix B.2.

5.1.2.2 Interpretation

In error correction models, the coefficient of the error correction term ECT_{t-1} should be negative, and ideally larger than -1. To illustrate this, the estimated equation relating the *13-week Treasury Bill rate* to the *size of the Fed's balance sheet* is formulated, including the error correction term from Table 4.

$$\Delta IR_t = -0.02 - 0.13(IR_{t-1} - 1.57 \cdot \ln QE_{t-1} + 0.02 \cdot t + 11.30) + 0.17 \cdot \Delta IR_{t-1} - 0.67 \cdot \Delta QE_{t-1}$$

Where IR denotes the *13-week Treasury Bill rate*, QE denotes the *size of the Fed's balance sheet*, t denotes the time trend and Δ indicates the first difference is used.

The adjustment, or error correction, coefficient of -0.13 shows how quickly the interest rate adjusts from the cointegrating error $(IR_{t-1} - 1.57 \cdot \ln QE_{t-1} + 0.02 \cdot t + 11.30)$. If the interest rate is above its equilibrium value, $IR_{t-1} > 1.57 \cdot \ln QE_{t-1} - 0.02 \cdot t - 11.30$, a negative adjustment coefficient will ensure that ΔIR falls, correcting the error (at 13% per month, in this case). A positive adjustment coefficient implies an explosive model, with an error that never corrects, but increases the first difference of the dependent variable (ΔIR). This assumes a negative coefficient of quantitative easing in the cointegrating error. All adjustment coefficients are displayed in Table 5.

None of the adjustment coefficients is larger than 1, in absolute sense. Unfortunately, some of them are positive, indicating a model of which the error never corrects. Especially the *13-week Treasury Bill*

rate interest rate proxy is problematic. The sum of *Treasury & mortgage-backed securities held by the Fed* shows some promising adjustment coefficients. Especially when combining it with the *10-year bond rate* as interest rate proxy, or with the corporate bond spreads, which have equal coefficients, as external finance premium proxy. Combining it with the *equity risk premium* results in a satisfactory coefficient as well.

	Interest rate		External finance premium				Risk tolerance
IR/EFP/R proxy→ QE proxy↓	10-year Bond rate	13-week Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity risk premium
Treasury securities		0.001 (1.50)		-0.15 (-4.38)***	-0.03 (-1.86)*	0.07 (3.97)***	
Mortgage-backed securities	-0.08 (-2.54)**	0.03 (1.41)	0.22 (3.23)***	-0.04 (-2.15)**	-0.07 (-2.20)**	-0.08 (-2.74)**	-0.08 (-3.01)***
Treasury & mortgage-backed securities	-0.05 (-1.58)	0.01 (2.09)**	-0.09 (-4.10)***	-0.09 (-2.96)***	0.01 (1.40)	0.15 (3.80)***	-0.04 (-1.67)*
Balance sheet Fed	-0.001 (-0.20)	-0.13 (-5.15)***	-0.002 (-0.22)	-0.15 (-6.37)***	-0.02 (-0.45)	-0.07 (-4.20)***	-0.02 (-2.07)**

Table 5 | Adjustment coefficients of the error correction term from the models reported in Appendix B.2. These can be interpreted as the speed at which a deviation from the long-run relationship will be corrected. Coefficients from the restricted and unrestricted error correction models are reported.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

In the interest rate models (Appendix B.2.1), the constant is generally insignificant. This can be interpreted as the absence of any fixed change happening every period, irrespective of quantitative easing or the interest rate in the previous periods. The adjustment coefficients of the *13-week Treasury Bill rate* interest rate proxy are problematic, but the *10-year bond rate* shows better results. Interpreting the coefficients of the interest rate it is noticeable that the first lag is positive and below 1 everywhere, indicating a certain persistence. If this period's first difference of the interest rate is positive (indicating an increasing interest rate), the positive coefficient of the first lag of the interest rate will ensure that next period's first difference is positive as well, albeit less so (indicating an increase at a decreasing rate). The more lags of the interest rate included, the more negative coefficients there are, indicating a more mixed effect in those models. Regarding the coefficients of the quantitative easing lags, fortunately most of them are negative. This indicates the expected effect that an increase in quantitative easing decreases the interest rate. Some of the coefficients are positive, but these are usually not significant. The model relating the *10-year bond rate* and the *size of*

the Fed's balance sheet is the only one with some serious persistence, of 10 months. It is noticeable that the (adjusted) R^2 values[10] are much lower than for the ARDL models estimated in levels.

The external finance premium models (Appendix B.2.2) often show an insignificant constant, except for the *debt-to-GDP ratio* case. In this case the constant is positive and significant, indicating a fixed increase every period, irrespective of last period's change in external finance premium or quantitative easing. Furthermore, the adjustment coefficient is almost always significant and, fortunately, only sometimes positive. Notice that the coefficient of the first lag of the external finance premium is very often between 0 and 1, indicating the same persistence as is present in the interest rate models (Appendix B.2.1). Most models include only one or two lags, but the *10-year – 3-month yield curve rate spread* coupled with *Treasury securities held by the Fed* and the sum of *Treasury & mortgage-backed securities held by the Fed* include eleven and eight lags, respectively. This means a shock in these models resonates for eleven and eight months, which means it is highly persistent. Regarding the coefficient of the first quantitative easing lag, quite some of these are positive, unfortunately. This would indicate an increasing external finance premium when quantitative easing increases. When more lags are included, the effect is often mixed. In this case as well, the (adjusted) R^2 values are much lower than for the ARDL models estimated in levels.

The risk tolerance models (Appendix B.2.3) show a generally insignificant constant. This means there is no fixed change happening every period, irrespective of quantitative easing or the equity premium in the previous periods. All adjustment coefficients are satisfactory, as they are significantly negative and greater than -1, meaning deviations from the long-run equilibrium are corrected over time. Almost all coefficients of the equity risk premium lags are positive, indicating that any shock is persistent for some time in the models. Unfortunately, some of the coefficients of the quantitative easing lags are positive. However, the ones that are significant are negative. This is desired, as it indicates a decreasing equity premium upon an increase in quantitative easing. The (adjusted) R^2 values are much lower than for the ARDL models estimated in levels, just as is the case for the interest rate and external finance premium models.

5.1.2.3 Deriving the long-run effect

The long-run effect is again derived in order to be able to interpret an overall effect of quantitative easing on the interest rate, the external finance premium and risk tolerance. The cointegrating

[10] The R^2 is the *coefficient of determination* and it indicates the proportion of variance in the dependent variable that is explained by the independent variables (Hill, Griffiths, & Lim, 2011, p. 136). The adjusted R^2 takes account of the phenomenon of the R^2 spuriously increasing whenever an extra explanatory variable is added to the model by adjusting for the number of explanatory variables in a model relative to the number of observations (Theil, 1961).

equations in Table 4 contain this long-run effect, namely the coefficient of quantitative easing. Table 6 shows these derived long-run effects of quantitative easing on the interest rate, the external finance premium and risk tolerance.

	Interest rate channel		**Credit channel**				**Risk-taking channel**
IR/EFP/RT proxy→ QE proxy↓	10-year bond rate	13-week Treasury Bill rate	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield spread	Debt-to-GDP ratio	Equity risk premium
Treasury securities		93.54 (4.84)***		7.35 (2.56)**	-1.89 (-1.57)	-45.52 (-5.77)***	
Mortgage-backed securities	-3.62 (-11.53)***	0.57 (4.92)***	2.39 (12.47)***	21.69 (9.49)***	-3.60 (-11.82)***	-25.37 (-3.68)***	7.08 (10.56)***
Treasury & mortgage-backed securities	1.66 (3.21)***	13.13 (5.63)***	3.32 (5.07)***	6.92 (2.18)**	-14.02 (-4.40)***	-25.66 (-10.51)***	-1.32 (-1.74)*
Balance sheet Fed	-54.49 (-3.83)***	1.57 (3.11)***	-17.36 (-4.01)***	13.16 (2.58)**	-4.33 (-5.16)***	-65.11 (-2.82)***	25.70 (3.22)***

Table 6 | The long-run effect of quantitative easing on the interest rate, the external finance premium and risk tolerance, according to the error correction models.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

Comparing the long-run effects resulting from error correction models in first differences (Table 6) to the long-run effects resulting from ARDL models in levels from approach 3 (Table 3), it seems there are not many similarities. Especially since a lot of the long-run effects found in Table 6 are positive. This may be due to the fact that, in the ARDL models, the lag orders were allowed to vary, even between variables in the same equation. In the EC models, the lag order is decided by the Johansen Cointegration test and cannot differ between variables in an equation. Only for the effect on the equity risk premium, no specific sign is desired. The coefficients in this column are equal in terms of sign in both the ARDL and EC case. Other than that, the *mortgage-backed securities held by the Fed* row in Table 6 shows somewhat reasonable results. Its long-run effect on the *10-year bond rate*, *10-year – 3-month yield curve rate spread* and the *debt-to-GDP ratio* is at least negative and, with exception of the yield spread, comparable to the effects found in the ARDL models under approach 3 in Table 3. Also, the effect of the sum of *Treasury & mortgage-backed securities held by the Fed* on the yield spread resulting from the error correction models is to some extent comparable to the effect resulting from the ARDL model. Overall, it seems that the error correction models perform rather poorly in terms of deriving the long-run effect of quantitative easing on the interest rate and external finance premium. The effects found on the equity risk premium are moderately credible.

5.2 Step 2 – channel exit

Now that the effects of quantitative easing on the interest rate, the external finance premium and risk tolerance have been investigated, it is time to look into how the interest rate, the external finance premium and risk tolerance, in turn, affect output. This is done using multivariate regressions, with different proxies for each variable.

Output is proxied by real GDP, which is quarterly. That means the interest rate, external finance premium and risk tolerance variables are converted to quarterly frequency by taking averages. The natural logarithm of output is used. It is assumed that the interest rate, external finance premium and risk tolerance can take up to 2 years to affect output. These assumptions lead to a model with output as dependent variable, and the interest rate, the external finance premium and risk tolerance as independent variables. However, this is not ideal. The coefficients of the independent variables capture the complete effect of the interest rate, the external finance premium and risk tolerance on output, and we are only interested in that part of the effect caused by quantitative easing. To remedy this, the fitted values from the autoregressive distributed lag models, as estimated in subsection 5.1.1, will be used as independent variables. This is done to purge the original time series from any effect not caused by quantitative easing. In this way, only that part of the effect caused by quantitative easing is estimated.

Before proceeding, it is necessary to test the fitted values of the interest rate, external finance premium and equity risk premium for cointegrating relationships with output. Table 7 reports the results of these tests.

RT proxy→	Equity risk premium							
IR proxy→	10-year bond rate				13-week Treasury Bill rate			
EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio
QE proxy↓								
Treasury securities	33.09*** [6]	35.95*** [6]	41.12*** [6]	27.69** [5]	25.36* [3]	23.94* [3]	24.12* [5]	28.54** [5]
Mortgage-backed securities	29.18** [3]	32.72*** [3]	33.04*** [2]	30.04** [2]	45.02*** [3]	24.11* [1]	33.53*** [2]	24.28* [1]
Treasury & mortgage-backed securities	43.60*** [6]	43.92*** [6]	27.73** [5]	30.92** [5]	25.67* [3]	23.95* [3]	25.44* [5]	25.07* [5]
Balance sheet Fed	44.62*** [4]	26.97** [1]	25.60* [3]	26.22** [2]	30.62** [2]	24.14* [1]	83.22*** [4]	38.30*** [2]

Table 7 | Trace statistics of Johansen Cointegration tests on fitted values of the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and output. The null hypothesis of at most 2 cointegrating relationships is tested. When this is rejected, there are assumed to be 3 cointegrating relationships: between the respective interest rate fitted values, external finance premium fitted values, risk tolerance fitted values and output. The number of lags used is reported in

brackets [ ].
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

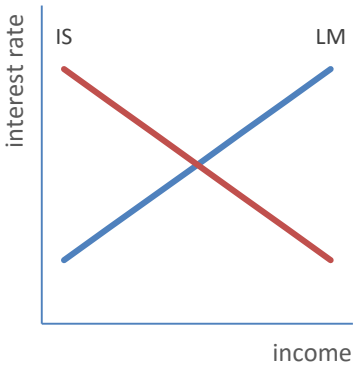
Specifically, Table 7 reports Trace statistics of Johansen Cointegration tests on four series: fitted values of the interest rate, fitted values of the external finance premium, fitted values of the equity risk premium and output. To obtain the fitted values, the models from approach 3 in subsection 5.1.1 (Appendix B.1.3) are used. These models use different proxies for both the interest rate/external finance premium and quantitative easing. These proxies are indicated in the 'IR proxy' and 'EFP proxy' rows and the 'QE proxy' column in Table 7. The risk tolerance proxy is always the equity risk premium. To illustrate, the first value in the table, 33.09, is obtained as follows. First, the fitted values of the interest rate are obtained by estimating equation 5.1.1, using the *10-year bond rate* as proxy for the interest rate and *Treasury securities held by the Fed* as proxy for quantitative easing. This model is reported in the second column in Appendix B.1.3.1 (the first model in the table). Then, the fitted values of the external finance premium are obtained by estimating equation 5.2.1, using the *BBB-AAA corporate bond spread* as proxy for the external finance premium and *Treasury securities held by the Fed* as proxy for quantitative easing. This model is reported in the second column in Appendix B.1.3.2.1 (the first model in the table). Then, the fitted values of the equity risk premium are obtained by estimating equation 5.3.1, using the *composite equity risk premium* as proxy for the equity risk premium and *Treasury securities held by the Fed* as proxy for quantitative easing. This model is reported in the second column in Appendix B.1.3.3 (the first model in the table). Lastly, the fitted values of the interest rate, of the external finance premium and of the equity risk premium are tested for cointegration together with output. The proxy for output is the natural logarithm of real GDP. The null hypothesis to be rejected is that of at most 2 cointegrating relationships. When rejected, the four series are assumed to be cointegrated with each other, with 3 cointegrating relationships.

5.2.1 Autoregressive distributed lag models – long-run dynamics

The fitted values of the interest rate, the external finance premium and the equity risk premium (from Appendix B.1.3) are now used to estimate output. The idea behind using fitted values is to sanitize the original time series of anything that is not caused by quantitative easing. This leads to a multivariate regression, with 3 independent variables. 8 lags (2 years) are taken into account for the interest rate, the external finance premium and the equity risk premium. Due to data availability, 4 lags have been used for the models using *mortgage-backed securities held by the Fed* and 6 lags for the *size of the Fed's balance sheet* as quantitative easing proxy.

Basic economic theory states that when the interest rate decreases, it incentivizes businesses to invest their money in projects, possibly even using credit. This increases the investment component of GDP, thereby increasing GDP itself. This implies a negative relationship between the interest rate and GDP.

It also follows from the standard IS-LM model[11], first developed by Hicks (1937) after Keynes' General Theory (1936) and later extended by Hansen (1953). The model states that expansive monetary policy (which quantitative easing is), shifts the LM curve downward and to the right, decreasing the interest rate while increasing GDP (income).



Graph 2 | Illustration of the IS-LM model.

For the external finance premium, it is assumed that a lower premium makes life easier for businesses, giving them more options to acquire funds. This would then lead to an increase in business activity which increases the GDP. This negative relationship is also discussed in subsection 2.3.2.

A lot of the literature investigating the relationship between the equity risk premium and GDP look for effects of GDP on the risk premium, instead of the other way around. Van Ewijk, De Groot, & Santing (2010) find a negative relation when regressing the equity risk premium on GDP (among other variables). Damodaran (2015) also finds a negative relationship using a similar regression. One article by Bowyer (2013) does make a statement about the effect of the equity premium on GDP. The author finds a negative correlation: the higher the equity risk premium, the lower the (future) gross domestic product.

First, multivariate autoregressive distributed lag models with output as dependent variable and the fitted values of the interest rate, the external finance premium and risk tolerance as independent variables are estimated (subsection 5.2.1.1) using every combination of proxies (outlined in subsection 4.1). Then, these models are interpreted (subsection 5.2.1.2). Lastly, the long-run effects are computed (subsection 5.2.1.3) so as to be able to interpret an overall effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output.

5.2.1.1 Estimation

So, output is regressed on the fitted values obtained from the models from approach 3 in subsection 5.1.1 (Appendix B.1.3). This can be denoted in the following equation.

$$\ln GDP_t = \alpha_4 + \sum_{l=0}^{L_1} \beta_{4,1,l} \cdot \widehat{IR}_{t-l} + \sum_{l=0}^{L_2} \beta_{4,2,l} \cdot \widehat{EFP}_{t-l} + \sum_{l=0}^{L_3} \beta_{4,3,l} \cdot \widehat{RT}_{t-l} + \varepsilon_{4,t} \qquad 5.4.1$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.

[11] In the model, the 'Investment – Saving' (IS) curve represents the goods and services market, while the 'Liquidity preference – Money supply' curve represents the money (or asset) market.

Equation 5.4.1 is estimated for every combination of variables, using Ordinary Least Squares estimation. With 2 interest rate variables, 4 external finance premium proxies and 1 risk tolerance proxy, which are all estimated using 4 quantitative easing proxies, the total number of final specifications for equation 5.4.1 is $2 \times 4 \times 1 \times 4 = 32$. To choose lag orders L_1, L_2 and L_3 for the equation, every possible combination of lags for the variables is estimated, with a maximum lag order of 8 for fitted values generated from equations with quantitative easing proxies *Treasury securities held by the Fed* and the sum of *Treasury & mortgage-backed securities held by the Fed*. Due to data availability, the maximum lag order for fitted values generated from equations with quantitative easing proxy *mortgage-backed securities held by the Fed* is 4, and 6 for fitted values generated from equations with quantitative easing proxy *size of the Fed's balance sheet*. The minimum lag included is 0, not 1. This means that the direct effect is included in the specifications. Afterwards, the specification for which the independent variables have the best overall F-statistic of joint significance and have a negative long-run effect is chosen. If a negative long-run effect is not found, this sign restriction is dropped. This is all done by a computer script[12]. For every regression, i.e. every combination of proxies, a lot of estimations are done. To be exact, 16 of the 32 possible combinations have a maximum lag order of 8, 8 of the 32 possible combinations have a maximum lag order of 6 and the last 8 of the 32 possible combinations have a maximum lag order of 4. Including the zeroth lag, this means $16 \times 9^3 + 8 \times 7^3 + 8 \times 5^3 = 15408$ specifications have been attempted before arriving at the 32 final equations. The resulting models are reported in Appendix C.1.

5.2.1.2 Interpretation

Looking at the models in Appendix C.1, the constant in almost every model is approximately 9.5, and highly significant. This means that, irrespective of any quantitative easing effect through the interest rate, external finance premium or risk tolerance, there is a tendency in output to be positive. Furthermore, the trend is generally significant and slightly positive, indicating that as time progresses, output experiences a small upward pressure. Most of the models that used *Treasury securities held by the Fed* or the sum of *Treasury & mortgage-backed securities held by the Fed* as quantitative easing proxy to obtain the fitted values of the interest rate, external finance premium and equity risk premium, include all 8 lags for every variable. This means that the effect of quantitative easing through the interest rate, external finance premium and risk tolerance on GDP resonates for 2 years. Due to data availability, less lags have been used for the models using *mortgage-backed securities held by the Fed* and the *size of the Fed's balance sheet* as quantitative easing proxy. In these models, the effect of quantitative easing through the 3 transmission channels generally resonates for 1 and 1.5 years

[12] For the interested reader, this computer script (for the EViews statistical package) is reported in Appendix E.2. It is undocumented, albeit with a few comments in the code.

respectively, especially when the *13-week Treasury Bill rate* is used as interest rate proxy. The (adjusted) R^2 values are very high for all the models, even without any autoregressive terms. The fact that the adjusted R^2 is generally close to the unadjusted one indicates that there are not many variables in the specifications that do not add to the explanatory power of the model, as the adjusted R^2 induces a penalty for including such variables. A high R^2 could be an indicator for a spurious regression, however all variables were found to be cointegrated (Table 7), ruling out the option of a spurious result. Unfortunately, some of the models have a very low number of observations, decreasing the model's power. Also, some have a terrible Durbin-Watson statistic, indicating possible autocorrelation.

5.2.1.3 Deriving the long-run effects

Similarly to subsection 5.1.1.3, the long-run effects of the fitted values of the interest rate, the external finance premium and the equity risk premium on output are computed from the coefficients of the estimated models, by dividing the sum of coefficients of an independent variable by 1 minus the sum of output coefficients. These long-run effects can be interpreted as an overall effect and ease interpretation in this way. These effects are reported in Table 8, which should be read as follows. The first four rows indicate the long-run effect of the fitted values of the interest rate on output, the second four the long-run effect of the fitted values of the external finance premium on output and the last four rows indicate the long-run effect of the fitted values of risk tolerance on output. It is best understood with a few examples. First, equation 5.4.1 is simplified so that it only reflects the long-run effects, as follows.

$$\ln GDP_t = \beta_1 \cdot \widehat{IR}_{t-l} + \beta_2 \cdot \widehat{EFP}_{t-l} + \beta_3 \cdot \widehat{RT}_{t-l}$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.

When output is regressed (following equation 5.4.1) on the fitted values of the *10-year bond rate*, the *BBB-AAA corporate bond spread* and the *equity risk premium* (as interest rate, external finance premium and risk tolerance proxies) and these fitted values are all generated using *mortgage-backed securities held by the Fed* as quantitative easing proxy (following equations 5.1.1, 5.2.1 and 5.3.1) the long-run coefficients of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.001, -0.001 and -0.001. Filling in these coefficients in the above equation yields:

$$\ln GDP_t = -0.001 \cdot \widehat{IR}_t - 0.001 \cdot \widehat{EFP}_t - 0.001 \cdot \widehat{RT}_t.$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.

$\widehat{IR}$ is obtained from equation 5.1.1, with the *10-year bond rate* as interest rate variable, and *mortgage-backed securities held by the Fed* as quantitative easing proxy.

$\widehat{EFP}$ is obtained from equation 5.2.1, with the *BBB-AAA corporate bond spread* as external finance premium proxy, and *mortgage-backed securities held by the Fed* as quantitative easing proxy.

$\widehat{RT}$ is obtained from equation 5.3.1, with the *equity risk premium* as risk tolerance proxy, and *mortgage-backed securities held by the Fed* as quantitative easing proxy.

When instead using the *size of the Fed's balance sheet* as quantitative easing proxy to generate the fitted values used as independent variables on which output is regressed, the long-run effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.003, -0.004 and -0.004 (two cells down from the previous ones, in Table 8). The above equation becomes:

$$\ln GDP_t = -0.003 \cdot \widehat{IR}_t - 0.004 \cdot \widehat{EFP}_t - 0.004 \cdot \widehat{RT}_t.$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.
$\widehat{IR}$ is obtained from equation 5.1.1, with the *10-year bond rate* as interest rate variable, and the *size of the Fed's balance sheet* as quantitative easing proxy.
$\widehat{EFP}$ is obtained from equation 5.2.1, with the *BBB-AAA corporate bond spread* as external finance premium proxy, and the *size of the Fed's balance sheet* as quantitative easing proxy.
$\widehat{RT}$ is obtained from equation 5.3.1, with the *equity risk premium* as risk tolerance proxy, and the *size of the Fed's balance sheet* as quantitative easing proxy.

When regressing output on the fitted values of the *13-week Treasury Bill rate* instead of the *10-year bond rate* as interest rate proxy (still using the *size of the Fed's balance sheet*), the long-run effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.176, -0.029 and -0.005 (one cell to the right of the previous ones, in Table 8). The equation becomes:

$$\ln GDP_t = -0.176 \cdot \widehat{IR}_t - 0.029 \cdot \widehat{EFP}_t - 0.005 \cdot \widehat{RT}_t.$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.
$\widehat{IR}$ is obtained from equation 5.1.1, with the *13-week Treasury Bill rate* as interest rate variable, and the *size of the Fed's balance sheet* as quantitative easing proxy.
$\widehat{EFP}$ is obtained from equation 5.2.1, with the *BBB-AAA corporate bond spread* as external finance premium proxy, and the *size of the Fed's balance sheet* as quantitative easing proxy.
$\widehat{RT}$ is obtained from equation 5.3.1, with the *equity risk premium* as risk tolerance proxy, and the *size of the Fed's balance sheet* as quantitative easing proxy.

When regressing output on the fitted values of the *10-year – 3-month yield curve rate spread* instead of the *BBB-AAA corporate bond spread* as external finance premium proxy, the long-run coefficients of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.395, -0.116 and -0.068 (four cells to the right of the previous ones, in Table 8). The equation becomes:

$$\ln GDP_t = -0.395 \cdot \widehat{IR}_t - 0.116 \cdot \widehat{EFP}_t - 0.068 \cdot \widehat{RT}_t.$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series.
$\widehat{IR}$ is obtained from equation 5.1.1, with the *13-week Treasury Bill rate* as interest rate variable, and the *size of the Fed's balance sheet* as quantitative easing proxy.

$\widehat{EFP}$ is obtained from equation 5.2.1, with the *10-year – 3-month yield curve rate spread* as external finance premium proxy, and the *size of the Fed's balance sheet* as quantitative easing proxy.
$\widehat{RT}$ is obtained from equation 5.3.1, with the *equity risk premium* as risk tolerance proxy, and the *size of the Fed's balance sheet* as quantitative easing proxy.

Note that the long-run coefficient of one independent variable, the interest rate for example, changes even when only the proxy for another independent variable, the external finance premium for example, is changed in the regression of output.

	RT proxy →	Equity risk premium							
	EFP proxy →	BBB-AAA spread		≤CCC-AAA spread		10y - 3m yield spread		Debt-to-GDP ratio	
	IR proxy →	10-year Bond rate	Treasury Bill rate	10-year Bond rate	Treasury Bill rate	10-year Bond rate	Treasury Bill rate	10-year Bond rate	Treasury Bill rat
	QE proxy ↓								
Long-run effect of the fitted values of the interest rate on output	Treasury securities	0.019 (3.44)**	-0.0003 (2.76)**	-0.002 (0.34)	-0.004 (2.05)	-0.016 (5.76)***	-0.020 (4.21)***	-0.0005 (1.31)	-0.006 (3.20)**
	Mortgage-backed securities	-0.001 (1.68)	-0.169 (0.57)	-0.002 (0.79)	-0.259 (0.77)	-0.007 (0.24)	-0.868 (8.96)**	-0.016 (4.41)*	-0.149 (0.61)
	Treasury & mortgage-backed securities	0.020 (4.86)***	-0.001 (2.99)**	-0.0001 (0.48)	-0.005 (2.17)*	-0.028 (5.69)***	-0.031 (7.50)***	-0.001 (1.49)	-0.001 (2.63)*
	Balance sheet Fed	-0.003 (1.34)	-0.176 (31.82)**	-0.001 (2.53)*	-0.374 (2.64)	-0.413 (19.83)**	-0.395 (24.08)**	-0.002 (4.05)*	-0.133 (17.25)*
Long-run effect of the fitted values of the external finance premium on output	Treasury securities	-0.038 (33.88)***	-0.031 (5.74)***	-0.002 (-3.02)***	-0.007 (9.90)***	-0.006 (36.09)***	-0.030 (5.51)***	-0.001 (45.50)***	-0.003 (5.46)***
	Mortgage-backed securities	-0.001 (0.09)	0.015 (1.02)	-0.0001 (0.46)	0.002 (0.71)	-0.002 (0.28)	-0.034 (7.52)**	-0.001 (5.41)**	-0.002 (0.95)
	Treasury & mortgage-backed securities	-0.038 (51.65)***	-0.030 (9.79)***	-0.002 (-2.51)**	-0.007 (12.99)***	-0.011 (30.05)***	-0.042 (10.32)***	-0.002 (51.17)***	-0.002 (8.52)***
	Balance sheet Fed	-0.004 (0.14)	-0.029 (28.36)**	-0.0002 (-0.33)	-0.004 (3.59)	0.306 (19.14)*	-0.116 (23.99)**	-0.001 (2.80)	-0.0004 (18.41)*
Long-run effect of the fitted values of risk tolerance on output	Treasury securities	0.009 (0.80)	-0.003 (2.03)	-0.025 (1.84)	-0.011 (6.11)***	-0.020 (10.01)***	-0.021 (9.48)***	-0.005 (-2.30)**	-0.002 (1.07)
	Mortgage-backed securities	-0.001 (-0.44)	-0.005 (2.47)	-0.005 (0.42)	-0.004 (1.66)	-0.007 (2.89)*	-0.021 (7.36)**	-0.007 (0.87)	0.002 (0.46)
	Treasury & mortgage-backed securities	0.010 (1.23)	-0.003 (2.33)*	-0.024 (1.87)	-0.010 (5.90)***	-0.026 (9.65)***	-0.027 (15.43)***	-0.001 (-0.41)	-0.004 (1.60)
	Balance sheet Fed	-0.004 (0.42)	-0.005 (44.40)**	-0.003 (0.81)	0.005 (6.35)	-0.072 (20.40)**	-0.068 (26.37)**	-0.002 (0.59)	-0.002 (14.22)*

Table 8 | Long-run effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) using various proxies for both the interest rate and the external finance premium as well as for the quantitative easing variable used to estimate the fitted values. The risk tolerance proxy is always the equity risk premium. The long-run values are calculated from ARDL models, of which the specification is based on the best overall F-statistic of a Wald test of joint significance of the three explanatory variables. These models are reported in Appendix C.1. The fitted values were estimated using the models in Appendix B.1.3.
*F-statistics of a Wald test of joint significance are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

Most of the effects of the interest rate, external finance premium and equity risk premium are very small, as expected. However, there are some larger (in absolute sense) numbers, mainly in the *size of the Fed's balance sheet* rows. Table 8 can seem a bit daunting, and it is hard to interpret such a table reporting so many numbers. Yet, note for example the *Treasury & mortgage-backed securities held by the Fed* rows. This quantitative easing proxy has shown promising results before. When it is coupled with the *10-year – 3-month yield curve rate spread* and the *10-year bond rate*, it shows that quantitative easing 'exits' the interest rate channel with a factor -0.028, the credit channel with a factor -0.011 and the risk-taking channel with a factor -0.026, all of which are highly significant. In other words, quantitative easing affects output through the interest rate, credit and risk-taking channels with factors -0.028, -0.011 and -0.026 respectively. A lot of the long-run effects of quantitative easing exiting the transmission channels (Table 8) as well as the long-run effects of quantitative easing entering the transmission channels (Table 3) are significant. This shows evidence of the existence of all 3 transmission channels for quantitative easing. Later, in section 7, information from Table 8 will be combined with information from Table 3 in order to get a better understanding how quantitative easing 'travels' through the different channels.

5.2.2 Error correction models – short-run dynamics

In this section, the fitted values of the interest rate, the external finance premium and the equity risk premium (from approach 3 in subsection 5.1.1, Appendix B.1.3) are used to estimate output, using error correction models in first differences (as opposed to autoregressive distributed lag models in levels in subsection 5.2.1). The idea behind using fitted values is to sanitize the original time series of anything that is not caused by quantitative easing. The interest rate, external finance premium and equity risk premium are still expected to be negatively related to output, as in subsection 5.2.1.

First, multivariate error correction models with output as dependent variable and the fitted values of the interest rate, the external finance premium and risk tolerance as independent variables are estimated (subsection 5.2.2.1) using every combination of proxies (outlined in subsection 4.1). Then, these models are interpreted (subsection 5.2.2.2). Lastly, the long-run effects are computed (subsection 5.2.2.3) so as to be able to interpret an overall effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output.

5.2.2.1 Estimation

Output is regressed on the fitted values obtained from the models from approach 3 in subsection 5.1.1 (Appendix B.1.3), using error correction models in first differences. This can be denoted in the following equation.

$$\Delta \ln GDP_t = \alpha_4 + \theta_{4,1} ECT_{GDP,t-1} + \theta_{4,2} ECT_{IR,t-1} + \theta_{4,3} ECT_{EFP,t-1} + \sum_{l=0}^{L} \left[\beta_{4,1,l} \cdot \Delta \widehat{IR}_{t-l} + \beta_{4,2,l} \cdot \Delta \widehat{EFP}_{t-l} + \beta_{4,3,l} \cdot \Delta \widehat{RT}_{t-l} \right] + \varepsilon_{4,t} \quad 5.4.2$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series. Δ indicates the first difference is used. ECT denotes an error correction term, of which the subscript denotes the dependent variable in the respective cointegrating equation. The error correction terms are defined as follows.

$$ECT_{GDP,t-1} = \ln GDP_{t-1} - \lambda_{1,1} \widehat{RT}_{t-1} - \lambda_{1,2} t - \upsilon_1$$
$$ECT_{IR,t-1} = \widehat{IR}_{t-1} - \lambda_{2,1} \widehat{RT}_{t-1} - \lambda_{2,2} t - \upsilon_2$$
$$ECT_{EFP,t-1} = \widehat{EFP}_{t-1} - \lambda_{3,1} \widehat{RT}_{t-1} - \lambda_{3,2} t - \upsilon_3$$

Where GDP, IR, EFP and RT denote output, the interest rate, the external finance premium and risk tolerance respectively. A hat (^) denotes a fitted series. t is a time trend and υ is a constant.

Since the regression for GDP is a multivariate one, with three independent variables and the dependent variable, there are three cointegrating relationships in equation 5.4.2. These are denoted by $ECT_{GDP,t-1}$, $ECT_{IR,t-1}$ and $ECT_{EFP,t-1}$, of which the subscript denotes the dependent variable in the respective cointegrating equation. The independent variable in the cointegrating equations is always risk tolerance. All of these cointegrating relationships are reported in Appendix C.2. These cointegrating relationships are transformed into error correction terms in similar fashion as in subsection 5.1.2. That means the constant, independent variable and trend are subtracted from both sides of the equals sign, to obtain the error correction term. Equation 5.4.2 is estimated for every combination of variables, using Ordinary Least Squares estimation. With 2 interest rate variables, 4 external finance premium proxies and 1 risk tolerance proxy, which are all estimated using 4 quantitative easing proxies, the total number of final specifications for equation 5.4.2 is $2 \times 4 \times 1 \times 4 = 32$. The lag order L is the same lag order for which cointegration was found in the Johansen Cointegration tests (Table 7). The minimum lag included is 1. Since this means no attempts had to have been made before arriving at the final 32 specifications for equation for every combination of variables, 32 equations have been estimated.

5.2.2.2 Interpretation

The 32 models are reported in Appendix C.3. Since every model now includes three error correction terms, there are also three adjustment coefficients per model. These are reported in Table 9 below. The 'IR proxy' and 'EFP proxy' rows indicate which interest rate and external finance premium proxies are used in that respective column. The GDP_{t-1}, $\widehat{IR}_{t-1}$ and $\widehat{EFP}_{t-1}$ terms indicate the error correction term. So, in the top left of Table 9, it is indicated that in the specification of equation 5.4.2 using the *10-year bond rate* as interest rate variable and the *BBB-AAA corporate bond spread* as external finance premium proxy, the adjustment coefficients of the by $ECT_{GDP,t-1}$, $ECT_{IR,t-1}$ and $ECT_{EFP,t-1}$ are -0.468, -0.002 and -0.018 respectively. In equation 5.4.2 these adjustment coefficients are denoted by $\theta_{4,1}$, $\theta_{4,2}$ and $\theta_{4,3}$.

RT proxy→	Equity risk premium											
IR proxy→	10-year bond rate											
EFP proxy→	BBB-AAA spread			≤CCC-AAA spread			10y – 3m yield spread			Debt-to-GDP		
Treasury securities	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-0.468 (-1.57)	-0.002 (-0.20)	-0.018 (-1.61)	-0.102 (-0.50)	-0.027 (-1.85)*	-0.002 (-1.76)*	0.124 (0.28)	-0.011 (-0.86)	0.006 (0.78)	0.581 (2.56)**	0.003 (0.44)	0.004 (3.50)***
Mortgage-backed securities	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-4.304 (-5.95)	-0.011 (-2.49)	0.012 (5.70)				-0.973 (-4.05)***	0.035 (3.21)**	-0.036 (-3.50)**	-0.17 (-0.57)	-0.002 (-0.30)	0.001 (0.58)
Treasury & mortgage-backed securities	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-0.375 (-1.54)	-0.01 (-1.08)	-0.018 (-1.84)*	0.14 (0.80)	-0.043 (-3.35)***	-0.003 (-2.61)**	-0.076 (-0.29)	-0.013 (-1.60)	0.002 (0.35)	0.534 (2.91)***	0.008 (1.37)	0.004 (4.39)***
Fed's balance sheet	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
				-0.334 (-4.51)***	-0.009 (-4.37)***	-0.0003 (-0.94)	-1.199 (-2.37)	0.034 (1.25)	-0.033 (-1.42)	-0.298 (-1.41)	-0.008 (-2.25)*	0.001 (1.32)
RT proxy→	Equity risk premium											
IR proxy→	13-week Treasury Bill rate											
EFP proxy→	BBB-AAA spread			≤CCC-AAA spread			10y – 3m yield spread			Debt-to-GDP		
Treasury securities	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-0.612 (-3.45)***	0.003 (1.58)	-0.009 (-3.33)***	-0.502 (-2.68)**	0.002 (1.08)	-0.001 (-1.94)*	-0.02 (-0.07)	-0.009 (-1.38)	-0.007 (-0.68)	-1.021 (-3.41)***	-0.002 (-1.10)	-0.002 (-2.03)*
Mortgage-backed securities	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-1.409 (-2.18)	-0.125 (-1.63)	0.014 (1.11)	-0.622 (-3.56)***	0.031 (3.02)***	0.0005 (1.06)	-0.645 (-1.95)*	0.044 (1.92)*	0.002 (0.36)	-0.528 (-3.09)***	0.023 (2.16)**	-0.0002 (-0.38)
Treasury & mortgage-backed securities	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-0.611 (-3.58)***	0.003 (1.74)*	-0.009 (-3.16)***	-0.449 (-2.50)**	0.002 (0.95)	-0.001 (-2.04)*	0.074 (0.25)	-0.009 (-1.13)	-0.006 (-0.47)	-0.964 (-2.46)**	-0.003 (-1.31)	-0.002 (-1.53)
Fed's balance sheet	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
	-0.416 (-1.25)	-0.009 (-0.57)	-0.009 (-3.59)***	-0.439 (-2.11)**	0.001 (0.19)	-0.0003 (-1.21)				-0.049 (-0.15)	-0.008 (-0.59)	0.0004 (0.65)

Table 9 | Adjustment coefficients of the error correction term from the models reported in Appendix C.3. These can be interpreted as the speed at which a deviation from the long-run relationship will be corrected.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

As discussed before, in error correction models, the coefficient of the error correction term ECT_{t-1} should be negative, and ideally greater than -1. Fortunately, most of the adjustment coefficients in Table 9 are between 0 and -1, indicating a model that corrects any deviations from the long-run equilibrium over time. There are also some bad results, however. When looking at the adjustment coefficient of the ECT_{t-1} error correction term of the model where *mortgage-backed securities held by the Fed* have been used to obtain the fitted values of the *10-year bond rate*, the *BBB-AAA corporate bond spread* and the *equity risk premium*, the coefficient of -4.304 seems very extreme. This would indicate 430% of the error is corrected in a quarter, probably leading to overshooting. Other than that, there are some positive adjustment coefficients, which are also undesirable.

In the equations (Appendix C.3), the constant in the models is usually small and positive, and often significant. This can be interpreted as a fixed increase in GDP every period. The dynamics of the models seem quite random across the models. However, a lot of models show considerable persistence of shocks, in that very often three or more lags are included, and even six lags is not rare. This indicates a shock would often resonate in the model for nine months, up to one and a half years.

5.2.2.3 Deriving the long-run effects

What is more useful for the analysis in this paper is the derivation of the long-run effects. This can then be interpreted as an overall effect of the respective independent variable on output. Since the regression for output is a multivariate one, the derivation of the long-run effect from the error correction models is different from the approach taken in subsection 5.1.2, where quantitative easing was the only independent variable. Now there are three independent variables, the fitted values of the interest rate, external finance premium and risk tolerance. Together with the dependent variable of real GDP the total number of variables is four, resulting in three cointegrating relationships per model (reported in Appendix C.2).

In order to derive the long-run effect of the three independent variables on GDP, it is necessary to combine and substitute the cointegrating relationships into one another. This approach is explained in Appendix C.2.1. The resulting long-run effects are reported below, in Table 10. A negative coefficient of the fitted values of the interest rate, the external finance premium and the equity risk premium is desired, for their effect on GDP. Unfortunately, a lot of the long-run coefficients found are positive, especially in the interest rate channel case. This may be due to the fact that, in the EC models, the lag order is decided by the Johansen Cointegration test and cannot differ between variables in an equation. The only quantitative easing proxy somewhat usable in that section is the *size of the Fed's balance sheet*.

Table 10 should be read as follows, similarly to Table 8. The first four rows indicate the long-run effect of the fitted values of the interest rate on output, the second four the long-run effect of the fitted values of the external finance premium on output and the last four rows indicate the long-run effect of the fitted values of risk tolerance on output. It is best understood with a few examples. When output is regressed (following equation 5.4.2) on the fitted values of the *10-year bond rate*, the *BBB-AAA corporate bond spread* and the *equity risk premium* (as interest rate, external finance premium and risk tolerance proxies) and these fitted values are all generated using *Treasury securities held by the Fed* as quantitative easing proxy (following equations 5.1.1, 5.2.1 and 5.3.1) the long-run coefficients of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.011, -0.109 and 0.005. When instead using the *mortgage-backed securities held by the*

Fed as quantitative easing proxy to generate the fitted values used as independent variables on which output is regressed, the long-run effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, 0.007, 0.027 and -0.004 (one cell down from the previous ones). When regressing output on the fitted values of the *13-week Treasury Bill rate* instead of the *10-year bond rate* as interest rate proxy (still using the *mortgage-backed securities held by the Fed*), the long-run effect of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.485, -0.045 and -0.004 (one cell to the right of the previous ones). When regressing output on the fitted values of the *10-year – 3-month yield curve rate spread* instead of the *BBB-AAA corporate bond spread* as external finance premium proxy, the long-run coefficients of the fitted values of the interest rate, the external finance premium and risk tolerance on output are, respectively, -0.080, 0.192 and -0.009 (four cells to the right of the previous ones). Note that the long-run coefficient of one independent variable, the interest rate for example, changes even when only the proxy for another independent variable, the external finance premium for example, is changed in the regression of output (equation 5.4.2).

To examine the effect of the fitted values of the external finance premium and equity risk premium on output, the *Treasury & mortgage-backed securities held by the Fed* rows might be promising. When that quantitative easing proxy is used to compute the fitted values of the *10-year – 3-month yield curve rate spread* and the *10-year bond rate*, its effect through the external finance premium and risk tolerance is respectively -0.067 and -0.010. This indicates that, if an equal amount of quantitative easing enters the credit and risk-taking channels, the impact it has on output through the credit channel (-0.067) is greater than through the risk-taking channel (-0.010). To obtain a complete picture of the channels, Table 10 should be combined with Table 6 to know how much of quantitative easing enters the different channels. Both tables show some significant effects, however less so than the ARDL models did. It seems the error correction models show weaker evidence of the existence of all three transmission channels for quantitative easing than the ARDL models.

	RT proxy →	Equity risk premium							
	EFP proxy →	BBB-AAA spread		≤CCC-AAA spread		10y - 3m yield spread		Debt-to-GDP ratio	
	IR proxy →	Bond rate	Treasury Bill rate	Bond rate	Treasury Bill rate	Bond rate	Treasury Bill rate	Bond rate	Treasury Bill rat
	QE proxy ↓								
Long-run effect of the fitted values of the interest rate on output	Treasury securities	-0.011 (-0.40)	0.007 (-0.21)	0.001 (0.05)	0.022 (0.77)	0.064 (4.55)***	0.025 (2.69)**	0.008 (0.24)	0.021 (3.44)***
	Mortgage-backed securities	0.007 (7.62)***	0.485 (2.85)***		0.114 (1.76)**	0.031 (4.49)***	0.080 (2.18)**	0.030 (2.05)**	0.098 (2.86)***
	Treasury & mortgage-backed securities	0.019 (1.34)	0.002 (-0.04)	0.008 (0.43)	0.025 (0.61)	0.039 (3.65)***	0.024 (2.19)**	-0.016 (-0.16)	0.022 (2.48)**
	Balance sheet Fed		0.074 (1.52)	-0.004 (-0.18)	-0.070 (-0.73)	-0.015 (-1.52)		0.020 (2.72)**	0.105 (2.19)
Long-run effect of the fitted values of the external finance premium on output	Treasury securities	-0.109 (0.21)	-0.007 (-0.21)	0.001 (0.05)	0.006 (1.30)	-0.058 (-1.96)**	-0.038 (-1.56)	-0.001 (0.24)	-0.002 (6.18)
	Mortgage-backed securities	0.027 (1.97)**	-0.045 (-2.74)**		0.009 (1.06)	0.050 (2.02)**	0.192 (0.23)	-0.002 (5.30)***	-0.002 (3.54)***
	Treasury & mortgage-backed securities	-0.043 (1.34)	-0.002 (-0.04)	0.005 (0.43)	0.005 (1.35)	-0.067 (-1.25)	-0.042 (-1.15)	0.002 (-0.16)	-0.002 (3.31)***
	Balance sheet Fed		-0.025 (-1.57)	0.005 (-0.16)	0.002 (1.08)	-0.010 (-1.79)**		-0.002 (2.72)**	-0.002 (2.48)**
Long-run effect of the fitted values of risk tolerance on output	Treasury securities	0.005 (-0.40)	0.001 (-0.21)	-0.001 (0.05)	-0.007 (1.60)	-0.022 (4.55)***	-0.026 (2.69)**	-0.003 (0.24)	-0.012 (6.18)***
	Mortgage-backed securities	-0.004 (8.89)***	-0.004 (5.53)***		-0.009 (2.94)***	-0.008 (4.96)***	-0.009 (2.78)**	-0.007 (5.30)***	-0.008 (3.54)***
	Treasury & mortgage-backed securities	-0.012 (1.34)	0.0002 (-0.04)	-0.004 (0.43)	-0.006 (1.35)	-0.018 (3.65)***	-0.026 (2.19)**	0.004 (-0.16)	-0.010 (3.31)***
	Balance sheet Fed		-0.007 (2.07)**	0.003 (-0.18)	-0.003 (1.08)	-0.010 (3.16)***		-0.008 (2.72)**	-0.009 (2.48)***

Table 10 | Long-run effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance on output using various proxies for both the interest rate and the external finance premium as well as for the quantitative easing variable used to estimate the fitted values. The risk tolerance proxy is always the 'composite equity risk premium'. The long-run values are calculated from cointegrating relationships from error correction models, of which the specification is based on the number of lags for which a Johansen cointegration test finds 3 cointegrating relationships between the 4 variables. These models are reported in Appendix C.3. The empty values originate from specifications where the number of lags for which cointegration was found resulted in an insufficient number of observations. The fitted values were estimated using the models in Appendix B.1.3.
*Since these long-run effects have been computed by combining 3 cointegrating relationships each time (approach in Appendix C.2.1), the t-statistics reported in parenthesis is the least significant one (of the 3). ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

6 Simultaneous estimation

Now that quantitative easing entering and exiting the interest rate, credit and risk-taking channels has been estimated in an isolated setting, this section will estimate this in simultaneous equations models, specifically vector autoregressive and vector error correction models. This means that all variables in the system are allowed to influence each other. The assumed influence diagram is as follows.

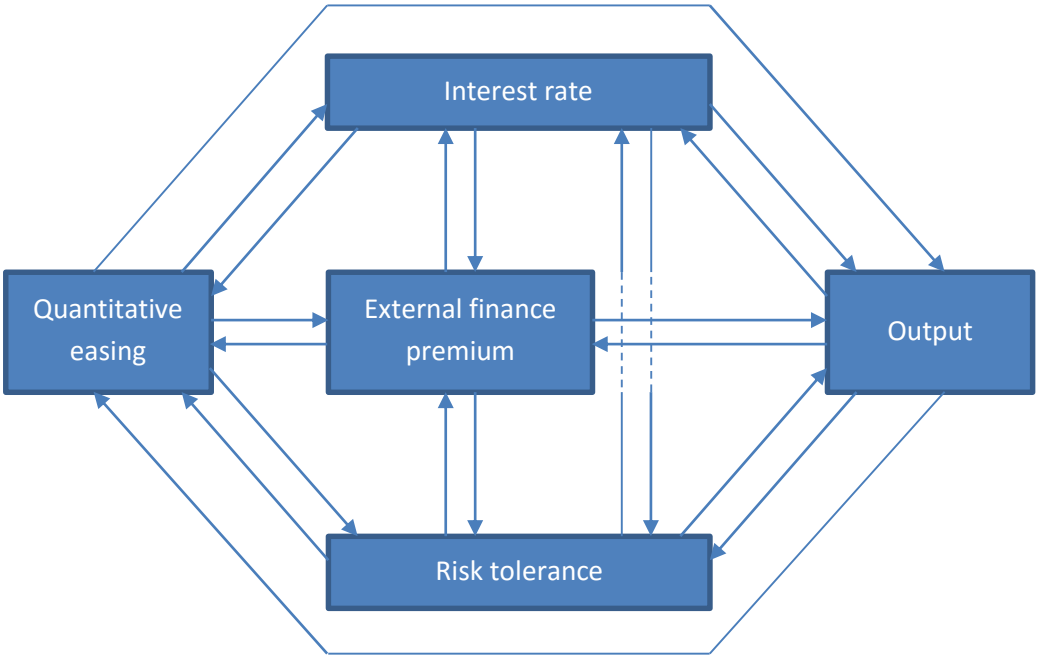


Figure 2 | Influence diagram illustrating the dynamics of quantitative easing, the interest rate, the external finance premium, risk tolerance and output, according to a simultaneous setting.

As Figure 2 illustrates, every variable in the system can now influence every other variable. This is likely to be closer to the true dynamics of these variables than the isolated effects estimated in section 5. It is not necessary to estimate entering and exiting the transmission channels separately, as both effects will be estimated in a single model. A simultaneous equations model with P lags usually estimates the following system of equations.

$$IR_t = \alpha_1 + \sum_{p=1}^{P}\left[\beta_{1,1,p} \cdot \ln GDP_{t-p} + \beta_{1,2,p} \cdot IR_{t-p} + \beta_{1,3,p} \cdot EFP_{t-p} + \beta_{1,4,p} \cdot RT_{t-p} + \beta_{1,5,p} \cdot \ln QE_{t-p}\right] + \varepsilon_{1,t}$$

$$EFP_t = \alpha_2 + \sum_{p=1}^{P}\left[\beta_{2,1,p} \cdot \ln GDP_{t-p} + \beta_{2,2,p} \cdot IR_{t-p} + \beta_{2,3,p} \cdot EFP_{t-p} + \beta_{2,4,p} \cdot RT_{t-p} + \beta_{2,5,p} \cdot \ln QE_{t-p}\right] + \varepsilon_{2,t}$$

$$RT_t = \alpha_3 + \sum_{p=1}^{P}\left[\beta_{3,1,p} \cdot \ln GDP_{t-p} + \beta_{3,2,p} \cdot IR_{t-p} + \beta_{3,3,p} \cdot EFP_{t-p} + \beta_{3,4,p} \cdot RT_{t-p} + \beta_{3,5,p} \cdot \ln QE_{t-p}\right] + \varepsilon_{3,t}$$

$$\ln GDP_t = \alpha_4 + \sum_{p=1}^{P}\left[\beta_{4,1,p} \cdot \ln GDP_{t-p} + \beta_{4,2,p} \cdot IR_{t-p} + \beta_{4,3,p} \cdot EFP_{t-p} + \beta_{4,4,p} \cdot RT_{t-p} + \beta_{4,5,p} \cdot \ln QE_{t-p}\right] + \varepsilon_{4,t}$$

Where GDP, IR, EFP, RT and QE denote output, the interest rate, the external finance premium, risk tolerance and quantitative easing respectively.

This implies a fixed number of lags for every variable in every equation. This paper uses 2 methods of estimation that differ slightly. This is elaborated upon in subsections 6.1.1 and 6.2.1 below. It remains true, however, that every independent variable enters the system with multiple lags. To find an overall effect of quantitative easing on the interest rate, the external finance premium and on risk tolerance, and to find an overall effect of the interest rate, the external finance premium and risk tolerance on output, the long-run multipliers are derived from the systems of equations in subsection 6.1.3 and 6.2.3.

Notice that the quantitative easing equation is omitted, since the purpose of this paper is not to explain what drives quantitative easing. Since GDP is included in the system, all simultaneous equations models estimated are of quarterly frequency.

Before proceeding, cointegration among the variables is investigated again, since the assumed relationships between the variables have changed. Table 11 below reports the Trace statistics of a Johansen Cointegration test on 5 variables: the interest rate, the external finance premium, the equity risk premium, quantitative easing and output. The proxies used for the interest rate, the external finance premium and quantitative easing are indicated in the table. The results are satisfactory, as cointegration is found for each tested combination.

IR proxy→	10-year bond rate				13-week Treasury Bill rate			
EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio
QE proxy↓								
Treasury securities	28.35** [4]	23.43* [3]	23.96* [2]	27.53** [3]	24.97* [2]	30.24** [2]	23.92* [2]	24.39* [2]
Mortgage-backed securities	21.38 [2]	23.68* [2]	41.23*** [2]	37.38*** [2]	33.96*** [2]	29.88** [2]	39.85*** [2]	31.64*** [2]
Treasury & mortgage-backed securities	25.20* [4]	25.05* [4]	23.53* [2]	23.87* [2]	34.40*** [2]	27.47** [4]	23.70* [2]	29.21** [4]
Balance sheet Fed	24.05* [2]	30.41** [1]	50.49*** [3]	31.07** [1]	27.99** [2]	25.38* [1]	48.89*** [3]	33.71*** [1]

*Table 11 | Trace statistics of Johansen Cointegration tests on the interest rate (IR), the external finance premium (EFP), the equity risk premium, quantitative easing and output. The null hypothesis of at most 3 cointegrating relationships is tested. When this is rejected, there are assumed to be 4 cointegrating relationships: between the respective interest rate, external finance premium, equity risk premium, quantitative easing and output. The number of lags used is reported in brackets [ ]. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

6.1 Vector autoregressive models – long-run dynamics

In this subsection, various vector autoregressive (VAR) models are estimated using different proxies for all variables involved. This is similar to the isolated case in subsections 5.1.1 and 5.2.1, where entering and exiting the transmission channels was estimated separately using autoregressive

distributed lag regressions in levels. In this case, however, the channels are not estimated in isolation and thus the channels are allowed to affect each other.

First, vector autoregressive models are estimated (subsection 6.1.1) using every combination of proxies (outlined in subsection 4.1). Then, these models are interpreted (subsection 6.1.2). Lastly, the long-run multipliers are computed (subsection 6.1.3) so as to be able to interpret an overall effect of quantitative easing on the interest rate, the external finance premium and risk tolerance, as well as an overall effect of the interest rate, the external finance premium and risk tolerance on output.

6.1.1 Estimation

Normally in a vector autoregressive model, each variable in the model has the same number of lags, and this number of lags does not change across the equations in the model. However, when variables are allowed to influence each other in a longer time-frame, and every variable is restricted to influence every other variable with the same number of lags, the degrees of freedom of the regression will be quickly exhausted[13]. It is common for monetary policy to take two years before its effects are felt. Using quarterly data this means eight lags of all five variables should be included in every equation. Together with the low number of observations, due to the quarterly nature of GDP, there will be practically no degrees of freedom left for proper estimation. Therefore, following Hsiao (1979), every variable is allowed to enter the equations with different lags. The author states that, in order to not exhaust the degrees of freedom, the maximum orders of lags of all variables have to be small, but this contradicts with the notion that variables (especially monetary policy) can take a long time before its effects are felt. Also, if the lag order would be restricted to be equal for all variables in the equation, a lot of insignificant coefficients would be estimated. For these reasons Hsiao (1979) states it is appropriate to allow variables to enter the equations with different lag orders, so that the number of coefficients to be estimate can be reduced and the influence of each variable can be felt at different time lags. This means the system of equations actually estimated is as follows.

[13] Degrees of freedom (dof) of an Ordinary Least Squares regression are computed by subtracting the number of variables (k) from the number of observations (n), i.e. $dof = n - k$.

$$IR_t = \alpha_1 + \sum_{l=1}^{L_{1,1}} \beta_{1,1,l} \cdot \ln GDP_{t-l} + \sum_{l=1}^{L_{1,2}} \beta_{1,2,l} \cdot IR_{t-l} + \sum_{l=1}^{L_{1,3}} \beta_{1,3,l} \cdot EFP_{t-l} + \sum_{l=1}^{L_{1,4}} \beta_{1,4,l} \cdot RT_{t-l} + \sum_{l=1}^{L_{1,5}} \beta_{1,5,l} \cdot QE_{t-l} + \varepsilon_{1,t} \quad 6.1.1$$

$$EFP_t = \alpha_2 + \sum_{l=1}^{L_{2,1}} \beta_{2,1,l} \cdot \ln GDP_{t-l} + \sum_{l=1}^{L_{2,2}} \beta_{2,2,l} \cdot IR_{t-l} + \sum_{l=1}^{L_{2,3}} \beta_{2,3,l} \cdot EFP_{t-l} + \sum_{l=1}^{L_{2,4}} \beta_{2,4,l} \cdot RT_{t-l} + \sum_{l=1}^{L_{2,5}} \beta_{2,5,l} \cdot QE_{t-l} + \varepsilon_{2,t} \quad 6.2.1$$

$$RT_t = \alpha_3 + \sum_{l=1}^{L_{3,1}} \beta_{3,1,l} \cdot \ln GDP_{t-l} + \sum_{l=1}^{L_{3,2}} \beta_{3,2,l} \cdot IR_{t-l} + \sum_{l=1}^{L_{3,3}} \beta_{3,3,l} \cdot EFP_{t-l} + \sum_{l=1}^{L_{3,4}} \beta_{3,4,l} \cdot RT_{t-l} + \sum_{l=1}^{L_{3,5}} \beta_{3,5,l} \cdot QE_{t-l} + \varepsilon_{3,t} \quad 6.3.1$$

$$\ln GDP_t = \alpha_4 + \sum_{l=1}^{L_{4,1}} \beta_{4,1,l} \cdot \ln GDP_{t-l} + \sum_{l=1}^{L_{4,2}} \beta_{4,2,l} \cdot IR_{t-l} + \sum_{l=1}^{L_{4,3}} \beta_{4,3,l} \cdot EFP_{t-l} + \sum_{l=1}^{L_{4,4}} \beta_{4,4,l} \cdot RT_{t-l} + \sum_{l=1}^{L_{4,5}} \beta_{4,5,l} \cdot QE_{t-l} + \varepsilon_{4,t} \quad 6.4.1$$

Where GDP, IR, EFP, RT and QE denote output, the interest rate, the external finance premium, risk tolerance and quantitative easing respectively.

This system of equations is estimated using the same 2 variables for the interest rate, 4 proxies for the external finance premium and 4 proxies quantitative easing as was done in section 5. The proxy for risk tolerance is always the *equity risk premium* and the proxy for output is always *real GDP*. This means there are $2 \times 4 \times 4 \times 1 \times 1 = 32$ combinations of variables and thus 32 final models. The procedure to decide a specification of lag orders for the different variables and different equations in the models is as follows. For a certain equation, every specification is estimated, i.e. every combination of lag orders for each variable in the equation from 1 to 8 is estimated. Then, the lags of each variable are tested for joint significance using a Wald test, for each specification. The chosen specification is the one with the highest overall joint significance of independent variables for which the signs are as expected. If the correct coefficient signs are not found, this restriction is dropped. This is all done by a computer script[14]. To clarify, this is not a standard VAR where a lag order is chosen that is the same for every variable in every equation. Instead, within an equation as well as across equations, the lag orders for each variable are allowed to differ. This is indicated in equations 6.1.1, 6.2.1, 6.3.1 and 6.4.1 by the subscripts of each lag order L, which are different within and across equations. The expected signs are

[14] For the interested reader, this computer script (for the EViews statistical package) is reported in Appendix E.3. It is undocumented, albeit with a few comments in the code.

the same as in section 5, i.e. quantitative easing is expected to have a negative relationship with the interest rate and external finance premium, and the interest rate, external finance premium and equity risk premium are expected to have a negative relationship with GDP. This is done for every equation in the VAR model, for every VAR model estimated. A model is estimated for each of the 32 combination of proxies. Every equation has 5 independent variables. The maximum lag order for the variables in the models incorporating quantitative easing proxies *Treasury securities held by the* Fed and the sum of *Treasury & mortgage-backed securities held by the Fed* is 8, but due to data availability the models incorporating quantitative easing proxies *mortgage-backed securities held by the Fed* and the *size of the Fed's balance sheet* have maximum lag orders of 4 and 5 respectively. There are 4 equations per model: 1 for each of output, the interest rate, the external finance premium and risk tolerance. This procedure involved attempting $32 \times (8^5 + 8^5 + 4^5 + 5^5) = 2{,}229{,}920$ equations. With 4 equations per model, 557,480 models were attempted. From these attempts, 32 models with a total of 128 equations were chosen (based on a Wald test as described above).

6.1.2 Interpretation

The resulting models are reported in Appendix D.1. In most models, the constant in all four equations is significant. The constant is almost always positive for the GDP equation, and often negative for the interest rate, external finance premium and risk tolerance equations. This makes sense for GDP, as it can be interpreted as GDP being positive in the absence of influence from previous periods of the interest rate, external finance premium, risk tolerance, quantitative easing and GDP itself. However, for the other variables it seems odd that their constant is negative. This would imply a negative interest rate, external finance premium and equity risk premium in the absence of influence from previous periods.

Regarding the number of lags of each variable in each equation in each model, it is very often the case that the GDP equation (where GDP is the dependent variable) includes the maximum number of lags of all variables. That means the interest rate, external finance premium, risk tolerance, quantitative easing and GDP itself influence GDP over a time-frame of one year, five quarters or two years, depending on the quantitative easing proxy used. It seems credible that GDP takes time to reflect changes in its underlying variables. Drivers of GDP such as production levels, consumption habits and investment strategies generally do not change overnight, but are all influenced by the interest rate, external finance premium, equity risk premium and/or quantitative easing. Lag orders of the variables in the other equations seem more random. However, the models incorporating quantitative easing proxies *mortgage-backed securities held by the Fed* and the *size of the Fed's balance sheet* usually show a more direct effect of the independent variables on the interest rate, external finance premium and risk tolerance. In quite some cases only one quarter is of influence. It is also notable that in most

models, irrespective of proxies used, a lot of the quantitative easing lags are significant in the interest rate, external finance premium and risk tolerance equations, and less often so in the GDP equations.

The relationship between the interest rate and the equity risk premium is investigated by Van Ewijk, De Groot & Santing (2010) and Damodaran (2015) who find a negative and positive relationship, respectively. While it is not the aim of this paper, the VAR models do show an ambiguous relationship between the interest rate and the equity risk premium, in both the interest rate and risk tolerance equations.

6.1.3 Deriving the long-run effects

The long-run effects of quantitative easing on the interest rate, the external finance premium and risk tolerance and the long-run effects of the interest rate, the external finance premium and risk tolerance on output can be derived from the vector autoregressive models using the same approach as used in section 5 (detailed in Appendix B.1.4). This is done in order to obtain overall effects of the variables, which eases the interpretation. While all of these effects are estimated simultaneously, due to the nature of VAR models, the long-run effects of quantitative easing on the interest rate, the external finance premium and risk tolerance are first interpreted, after which the long run effects of the interest rate, the external finance premium and risk tolerance on output are interpreted. This is done to stay close to the analogy of entering and exiting the transmission channels, used in section 5.
So, the long-run effects of quantitative easing entering the different channels is reported in Table 12 below.

Table 12 should be read as follows. The interest rate, external finance premium, risk tolerance and quantitative easing proxies used in the system are indicated in the 'IR proxy', 'EFP proxy', 'RT proxy' and 'QE proxy' rows and columns respectively. Furthermore, the first four rows indicate the long-run effect of quantitative easing on the interest rate, the second four indicate the long-run effect of quantitative easing on the external finance premium and the last four rows indicate the long-run effect of quantitative easing on risk tolerance, according to the proxies indicated.

All of the long-term coefficients are of the correct sign and all, but one, are significant. This may be due to the computer script used in estimation, that gives the specification with the highest significance and the correct sign. In the interest rate case, quantitative easing generally has a bigger impact (in absolute sense) on the short-term *13-week Treasury Bill rate* than on the long-term *10-year bond rate*. This makes sense as, generally, the short-term rate is a few percentage points above the long-term one. This distinction was also visible in the non-simultaneous case, in subsection 5.1.1.3 (approach 3). Most of the long-run effects of quantitative easing on the interest rate found are quite credible, being slightly negative and above -2. Others are, unfortunately, more extreme and should probably be

disregarded, especially the values obtained from the models combining the *Treasury securities held by the Fed* and the *13-week Treasury Bill rate*.

	RT proxy→	Equity risk premium							
	IR proxy→	10-year bond rate				13-week Treasury Bill rate			
	EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio
	QE proxy↓								
Long-run effect of quantitative easing on the interest rate	Treasury securities	-1.77 (17.8)***	-0.05 (6.40)***	-0.68 (12.84)***	-0.94 (12.78)***	-2.73 (13.51)***	-175.87 (31.80)***	-8.51 (9.75)***	-24.84 (9.48)***
	Mortgage-backed securities	-0.27 (6.76)**	-0.51 (4.50)**	-0.44 (8.36)**	-0.47 (4.69)**	-0.19 (14.88)***	-0.08 (8.94)***	-0.63 (17.86)***	-0.004 (9.96)***
	Treasury & mortgage-backed securities	-1.55 (11.48)***	-1.23 (8.02)***	-0.03 (11.07)***	-9.88 (6.35)***	-3.16 (8.36)***	-9.26 (18.72)***	-2.98 (16.82)***	-0.31 (4.64)***
	Balance sheet Fed	-0.13 (32.45)***	-0.38 (8.46)**	-2.57 (6.50)**	-1.61 (3.69)**	-0.03 (16.53)***	-0.06 (14.50)***	-0.17 (24.99)***	-0.11 (23.70)***
Long-run effect of quantitative easing on the external finance premium	Treasury securities	-2.84 (10.39)***	-14.69 (9.08)***	-6.68 (14.62)***	-1693.79 (15.92)***	-1.81 (22.75)***	-3.35 (8.83)***	-2.09 (14.66)***	-1113.44 (22.42)***
	Mortgage-backed securities	-1.15 (26.95)***	-33.17 (8.39)***	-7.37 (5.14)**	-28.79 (7.58)**	-0.94 (28.53)***	-67.77 (8.71)***	-0.29 (2.76)	-20.85 (8.49)***
	Treasury & mortgage-backed securities	-0.52 (8.12)***	-3.07 (11.79)***	-11.35 (6.65)***	-64.94 (11.22)***	-5.98 (13.66)***	-11.50 (30.12)***	-0.95 (9.11)***	-75.33 (4.37)***
	Balance sheet Fed	-8.63 (15.39)***	-61.14 (15.45)***	-58.31 (5.71)***	-0.53 (3.10)*	-4.41 (17.00)***	-48.01 (15.66)***	-14.19 (14.55)***	-20.08 (5.35)***
Long-run effect of quantitative easing on risk tolerance	Treasury securities	4.25 (8.02)***	-39.00 (8.10)***	-2.18 (7.72)***	-34.74 (8.77)***	15.79 (8.43)***	20.10 (9.77)***	-2.37 (8.31)***	-12.66 (5.62)***
	Mortgage-backed securities	-1.73 (20.18)***	-4.88 (7.18)***	-2.41 (19.16)***	-1.45 (14.33)***	-5.04 (17.75)***	-4.46 (26.26)***	-2.40 (19.31)***	-2.07 (34.41)***
	Treasury & mortgage-backed securities	6.66 (11.69)***	4.81 (9.95)***	-1.89 (9.18)***	-3.78 (11.03)***	1.65 (9.65)***	44.05 (9.93)***	0.51 (10.04)***	6.11 (12.24)***
	Balance sheet Fed	1.66 (8.43)***	1.85 (5.23)***	14.81 (30.21)***	0.11 (10.64)***	-13.08 (19.37)***	-9.07 (20.08)***	14.55 (28.71)***	-18.29 (9.74)***

Table 12 | Long-run effect of quantitative easing (QE) on the interest rate (IR), the external finance premium (EFP) and risk tolerance derived from VAR models reported in Appendix D.1, using various proxies for quantitative easing, the interest rate and the external finance premium. The proxy for risk tolerance is always the equity risk premium. The procedure of deriving the long-run effect is outlined in Appendix B.1.4.
*F-statistics of a Wald test of joint significance are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

It seems that quantitative easing has a greater influence on the external finance premium than on the interest rate, as the values in these rows are overall greater (in absolute sense) than the ones in the

interest rate rows. The four corporate bond spread columns show credible coefficients, also when compared to the non-simultaneous case in subsection 5.1.1.3 (approach 3). The values in the *debt-to-GDP ratio* columns seem too extreme, however. This is probably due to *debt-to-GDP ratio* not being an interest rate-derived variable, which makes the long-run coefficients hard to compare to the other external finance premium proxies.

The long-run effect of quantitative easing on risk tolerance is ambiguous, as no sign restriction was imposed. Risk tolerance is proxied by the equity risk premium. The sum of *Treasury & mortgage-backed securities held by the Fed* seems to produce credible results, with no values too extreme, except when coupled with the *13-week Treasury Bill rate* and the *high yield (≤CCC-AAA) corporate bond spread*.

Now the long-run effect of the interest rate, the external finance premium and risk tolerance on output is derived from the vector autoregressive models, again using the same approach as used in section 5 (detailed in Appendix B.1.4). This shows how much the interest rate, credit and risk-taking channels affect output. This is analogous to the notion of quantitative easing exiting the transmission channels, as in subsection 5.2.1. The long-run coefficients are reported in Table 13, below.

Table 13 should be read as follows. The interest rate, external finance premium and quantitative easing proxies used in the system are indicated in the 'IR proxy', 'EFP proxy' and 'QE proxy' rows and columns respectively. Furthermore, the first four rows indicate the long-run effect of the interest rate on output, the second four indicate the long-run effect of the external finance premium on output and the last four rows indicate the long-run effect of risk tolerance on output, according to the proxies indicated.

Due to the usage of a computer script in the estimation procedure that provides the specification with the highest significance and the correct sign (outlined in subsection 6.1.1), a lot of the long-run coefficients are of the correct sign. It is slightly disappointing that not many are significant. However, most of the effects found are of the expected magnitude, which is small. The low number of significant long-run coefficients in Table 13 as compared to Table 8 may be caused by the inclusion of the quantitative easing variable in equation 6.4.1 which could be capturing the effects of the interest rate, the external finance premium and risk tolerance found in equation 5.4.1 (in which quantitative easing is not included).

Looking at the interest rate, it seems that, when proxying quantitative easing by the sum of *Treasury & mortgage-backed securities held by the Fed*, the *10-year bond rate* has more influence on output than the *13-week Treasury Bill rate*. This seems credible, as output is a slowly evolving time series,

dependent on long-run relationships. It only makes sense that the long-run interest rate affects it more than the short run.

	RT proxy→	Equity risk premium							
	IR proxy→	10-year bond rate				13-week Treasury Bill rate			
	EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio
	QE proxy↓								
Long-run effect of the interest rate on output	Treasury securities	-0.0003 (1.46)	-0.005 (0.60)	-0.124 (4.09)*	-0.134 (0.12)	-0.109 (37.20)**	-0.094 (0.65)	-0.035 (3.71)	-0.010 (2.55)
	Mortgage-backed securities	-0.031 (1.03)	-0.016 (0.61)	-0.308 (2.14)	-0.089 (4.24)**	-0.831 (2.50)	-1.107 (2.95)*	-0.577 (2.23)	-0.688 (3.20)*
	Treasury & mortgage-backed securities	-0.131 (0.94)	-0.096 (0.59)	-0.023 (2.65)	-0.100 (1.95)	-0.001 (0.63)	-0.003 (0.91)	-0.020 (2.70)	-0.019 (12.87)*
	Balance sheet Fed	-0.016 (1.08)	-0.032 (1.42)	-0.012 (1.60)	-0.005 (2.68)	-0.644 (0.91)	-0.008 (3.65)**	-0.013 (1.57)	-0.005 (1.83)
Long-run effect of the external finance premium on output	Treasury securities	-0.017 (1.07)	-0.002 (1.00)	-0.039 (4.73)*	-0.014 (0.17)	-0.016 (22.80)**	-0.001 (0.33)	-0.021 (3.74)	-0.002 (2.43)
	Mortgage-backed securities	-0.107 (0.66)	-0.003 (0.12)	0.300 (2.19)	-0.006 (2.84)*	-0.028 (0.30)	-0.001 (0.72)	-0.014 (0.51)	-0.001 (0.59)
	Treasury & mortgage-backed securities	-0.134 (1.91)	-0.010 (0.44)	-0.011 (4.99)*	-0.008 (2.82)	-0.012 (0.87)	-0.001 (0.71)	-0.030 (3.83)	-0.011 (15.50)*
	Balance sheet Fed	-0.037 (0.86)	-0.009 (1.29)	-0.025 (1.75)	-0.001 (3.60)*	-0.060 (0.20)	-0.006 (4.55)**	-0.038 (0.97)	-0.0001 (1.99)
Long-run effect of risk tolerance on output	Treasury securities	-0.014 (1.16)	-0.042 (1.29)	-0.071 (4.26)*	-0.081 (0.18)	-0.080 (55.18)**	-0.128 (1.23)	-0.027 (4.41)*	-0.017 (4.57)*
	Mortgage-backed securities	-0.034 (1.29)	-0.013 (0.66)	0.007 (0.50)	-0.014 (2.56)	-0.025 (0.52)	-0.012 (0.97)	-0.015 (0.95)	-0.004 (0.07)
	Treasury & mortgage-backed securities	-0.027 (0.67)	-0.076 (0.55)	-0.009 (4.05)*	-0.018 (0.99)	-0.010 (0.73)	-0.020 (1.29)	-0.007 (4.14)*	-0.0002 (14.76)*
	Balance sheet Fed	-0.006 (1.17)	-0.017 (1.28)	-0.022 (2.58)	-0.003 (2.15)	-0.320 (0.27)	-0.0002 (0.14)	-0.022 (2.53)	-0.004 (0.32)

Table 13 | Long-run effect of the interest rate (IR), the external finance premium (EFP) and risk tolerance on output originating from VAR models, reported in Appendix D.1, using various proxies for the interest rate, the external finance premium and for quantitative easing. The risk tolerance proxy is always the equity risk premium. The procedure of deriving the long-run effect is outlined in Appendix B.1.4.
*F-statistics of a Wald test of joint significance are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

In the external finance premium case, the long-run effects on output are quite close to each other, which is good. Most of them are greater than -0.05, but still negative.

Unfortunately, one of the long-run effects of the equity risk premium on output is found to be positive. This is not expected, based on Van Ewijk, De Groot, & Santing (2010), Damodaran (2015) and Bowyer (2013), who all find a negative correlation. Using the sum of *Treasury & mortgage-backed securities held by the Fed* as quantitative easing proxy seems a good choice again, as in this case all long-run coefficients found are negative.

Interpreting Table 12 and Table 13 is difficult at a glance, due to the high number of coefficients reported. Table 12 shows a lot of significant effects, while Table 13 shows far less significant effects. There is at least some evidence of the existence of all 3 transmission channels for quantitative easing. Later, in section 7, information from these tables will be combined in order to gain a complete picture of the transmission channels of quantitative easing according to the VAR models estimated.

6.2 Vector error correction models – short-run dynamics

Vector autoregression models from the previous subsection (6.1) do not include cointegration, just as standard autoregressive distributed lag regressions from subsections 5.1.1 and 5.2.1 did not. However, as Table 11 reported, the variables used are generally cointegrated. This subsection uses that information to estimate simultaneous equations models, which are known as vector error correction models. This is analogous to the error correction models estimated in the non-simultaneous case, in subsections 5.1.2 and 5.2.2.

First, vector error correction models are estimated (subsection 6.2.1) using every combination of proxies (outlined in subsection 4.1). Then, these models are interpreted (subsection 6.2.2). Lastly, the long-run multipliers are computed (subsection 6.2.3) so as to be able to interpret an overall effect of quantitative easing on the interest rate, the external finance premium and risk tolerance, as well as an overall effect of the interest rate, the external finance premium and risk tolerance on output.

6.2.1 Estimation

Vector error correction models are estimated in first differences, using Ordinary Least Squares estimation. As opposed to the estimation approach used for VAR models, the variables in the VEC models will all enter with the same amount of lags. The lag order across equations in a model is equal as well. Specifically, the number of lags is determined by the number for which cointegration was found, as reported in Table 11. This number of lags is also used to estimate cointegrating equations, which are reported in Appendix D.2. These cointegrating equations are then transformed into error correction terms by subtracting the quantitative easing term, the trend and the constant from both sides of the equals sign. The corresponding four error correction terms are added to each equation in the VEC model. This leads to the following system of equations.

$$\Delta IR_t = \alpha_1 + \theta_{1,1}ECT_{GDP,t-1} + \theta_{1,2}ECT_{IR,t-1} + \theta_{1,3}ECT_{EFP,t-1} + \theta_{1,4}ECT_{RT,t-1} + \sum_{p=1}^{P} X(1,p) + \varepsilon_{1,t} \quad 6.1.2$$

$$\Delta EFP_t = \alpha_2 + \theta_{2,1}ECT_{GDP,t-1} + \theta_{2,2}ECT_{IR,t-1} + \theta_{2,3}ECT_{EFP,t-1} + \theta_{2,4}ECT_{RT,t-1} + \sum_{p=1}^{P} X(2,p) + \varepsilon_{2,t} \quad 6.2.2$$

$$\Delta RT_t = \alpha_3 + \theta_{3,1}ECT_{GDP,t-1} + \theta_{3,2}ECT_{IR,t-1} + \theta_{3,3}ECT_{EFP,t-1} + \theta_{3,4}ECT_{RT,t-1} + \sum_{p=1}^{P} X(3,p) + \varepsilon_{3,t} \quad 6.3.2$$

$$\Delta \ln GDP_t = \alpha_4 + \theta_{4,1}ECT_{GDP,t-1} + \theta_{4,2}ECT_{IR,t-1} + \theta_{4,3}ECT_{EFP,t-1} + \theta_{4,4}ECT_{RT,t-1} + \sum_{p=1}^{P} X(4,p) + \varepsilon_{4,t} \quad 6.4.2$$

Where $X(i,p) = \beta_{i,1,p} \cdot \Delta \ln GDP_{t-p} + \beta_{i,2,p} \cdot \Delta IR_{t-p} + \beta_{i,3,p} \cdot \Delta EFP_{t-p} + \beta_{i,4,p} \cdot \Delta RT_{t-p} + \beta_{i,5,p} \cdot \Delta \ln QE_{t-p}$

Where GDP, IR, EFP, RT and QE denote output, the interest rate, the external finance premium, risk tolerance and quantitative easing respectively. Δ denotes the first difference is used. ECT denotes an error correction term, of which the subscript denotes the dependent variable in the respective cointegrating equation. The error correction terms are defined as follows.

$$ECT_{GDP,t-1} = \ln GDP_{t-1} - \lambda_{1,1} \ln QE_{t-1} - \lambda_{1,2}t - \upsilon_1$$
$$ECT_{IR,t-1} = IR_{t-1} - \lambda_{2,1} \ln QE_{t-1} - \lambda_{2,2}t - \upsilon_2$$
$$ECT_{EFP,t-1} = EFP_{t-1} - \lambda_{3,1} \ln QE_{t-1} - \lambda_{3,2}t - \upsilon_3$$
$$ECT_{RT,t-1} = RT_{t-1} - \lambda_{4,1} \ln QE_{t-1} - \lambda_{4,2}t - \upsilon_4$$

Where GDP, IR, EFP, RT and QE denote output, the interest rate, the external finance premium, risk tolerance and quantitative easing respectively. t is a time trend and υ is a constant.

This system of equations is estimated using the same proxies for the interest rate, external finance premium and quantitative easing as was done in section 5 and 6.1. The proxy for risk tolerance is always the *equity risk premium*. The lag order P is the same lag order for which cointegration was found in the Johansen Cointegration tests (Table 11). The expected signs are the same as in section 5 and 6.1, i.e. quantitative easing is expected to have a negative relationship with the interest rate and external finance premium, and the interest rate, external finance premium and equity risk premium are expected to have a negative relationship with GDP. A model is estimated for each combination of proxies. With 4 equations per model and 32 models, 128 equations are estimated.

6.2.2 Interpretation

The resulting models are reported in Appendix D.3. The adjustment coefficients are not reported in a separate table. 32 VEC models, 4 equations per model and 4 error correction terms per equation means there are 512 adjustment coefficients. The resulting table would be impossible to fit and impossible to interpret. Instead, the adjustment coefficients can be observed in the tables that report the VEC models (Appendix D.3). To recap from subsection 5.1.2.2, the adjustment coefficient should ideally lie between -1 and 0. This ensures that a deviation from the long-run equilibrium gets corrected over time. Unfortunately, this is often not the case. Especially the GDP error correction term often has very extremely positive and negative adjustment coefficients. Only in the models that use the sum of

Treasury & mortgage-backed securities held by the Fed as proxy for quantitative easing, the adjustment coefficients seem to be slightly less extreme. However, there are still plenty of positive values and values below -1. The adjustment coefficients for the other error correction terms are usually a bit closer to the -1 – 0 range, however it is difficult to find a model for which all the adjustment coefficients have a satisfactory value.

The constant in the GDP equations is generally positive, while the constant in the other three equations have varying signs depending on the combination of proxies. A positive constant for GDP means that there is a small persistence of shocks in the GDP equation. Looking at the lag order of the models, no model includes more than four lags. This means the independent variables take at most a year to influence the dependent ones. Only for the quantitative easing proxy of the *size of the Fed's balance sheet* some models have a lag order of one, indicating a near-direct effect. When looking at the R^2 values, notice that most of the unadjusted R^2 values are a lot higher than the adjusted ones. This indicates the equation includes variables, or certain lags, that do not add to the explanatory power of the equation. Interpreting the dynamics in 32 VEC models is challenging. It is probably more useful to examine the long-run effects derived from the error correction terms.

6.2.3 Deriving the long-run effects

The cointegrating equations reported in Appendix D.2 contain information about the long-run relationship between the variables. Long-run effects are helpful in interpreting an overall effect of the independent variables on output. Since each equation in a VEC model is a multivariate one, the derivation of the long-run effect from the error correction models is different from the approach taken in subsection 5.1.2, where quantitative easing was the only independent variable. Now there are four independent variables, and one autoregressive one in each equation of the model, resulting in four cointegrating equations. In order to derive the long-run effect of the four independent variables on the dependent one, it is necessary to combine and substitute the cointegrating relationships into one another. This approach is explained in Appendix C.2.1. The resulting long-run coefficients are reported below, in Table 14.

Table 14 should be read as follows. The interest rate, external finance premium and quantitative easing proxies used in the system are indicated in the 'IR proxy', 'EFP proxy' and 'QE proxy' rows and columns respectively. Furthermore, the first four rows indicate the long-run effect of quantitative easing on the interest rate, the second four indicate the long-run effect of quantitative easing on the external finance premium and the last four rows indicate the long-run effect of quantitative easing on risk tolerance, according to the proxies indicated.

	RT proxy→	Equity risk premium							
	IR proxy→	10-year bond rate				13-week Treasury Bill rate			
	EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio
	QE proxy↓								
Long-run effect of quantitative easing on the interest rate	Treasury securities	5.91 (-2.79)***	-0.06 (0.04)	-6.54 (3.58)***	-4.93 (6.24)***	0.22 (-0.16)	-2.93 (1.67)	-5.36 (2.50)**	-1.62 (1.62)
	Mortgage-backed securities	-0.51 (0.58)	3.38 (-3.81)***	5.29 (-8.05)***	3.53 (-8.77)***	0.19 (-5.43)***	0.14 (-8.57)***	0.11 (-5.19)***	0.23 (-6.72)***
	Treasury & mortgage-backed securities	-6.71 (4.32)***	-7.91 (5.19)***	-4.61 (5.83)***	-2.26 (3.62)***	-6.11 (4.35)***	-11.42 (3.88)***	-5.52 (4.92)***	-1.10 (0.71)
	Fed's balance sheet	-21.65 (4.29)***	40.47 (-3.92)***	11.42 (-20.27)***	130.04 (-2.86)**	-1.00 (5.51)***	-0.61 (3.45)***	-0.31 (1.82)**	-0.48 (2.36)**
Long-run effect of quantitative easing on the external finance premium	Treasury securities	-6.52 (4.25)***	-26.33 (3.30)***	-1.16 (1.39)	31.77 (-6.90)***	-0.21 (0.35)	-2.85 (0.66)	-1.08 (1.30)	42.05 (-5.75)***
	Mortgage-backed securities	-2.39 (7.59)***	-25.91 (6.93)***	5.18 (-7.92)***	33.53 (-3.76)***	-1.44 (8.93)***	-0.88 (0.44)	4.80 (-7.98)***	-42.68 (4.62)***
	Treasury & mortgage-backed securities	4.72 (-4.36)***	13.54 (-2.52)**	1.03 (-1.29)	38.03 (-10.78)***	5.71 (-5.68)***	-37.85 (3.48)***	1.03 (-1.29)	73.00 (-5.83)***
	Fed's balance sheet	12.94 (-5.20)***	-18.30 (1.06)	11.74 (-22.33)***	-889.70 (2.69)**	-3.82 (3.71)***	-1.45 (0.08)	11.70 (-20.50)***	-43.15 (5.04)***
Long-run effect of quantitative easing on risk tolerance	Treasury securities	3.33 (-3.63)***	4.36 (-2.80)***	12.79 (-3.56)***	4.95 (-4.48)***	4.92 (-4.29)***	7.75 (-5.08)***	12.83 (-3.57)***	9.73 (-5.28)***
	Mortgage-backed securities	-0.65 (0.87)	-1.92 (2.21)**	-4.26 (10.46)***	-0.58 (0.57)	-3.57 (16.13)***	-4.92 (12.76)***	-4.13 (9.64)***	-9.17 (6.71)***
	Treasury & mortgage-backed securities	8.86 (-4.90)***	11.85 (-4.92)***	10.38 (-7.03)***	8.20 (-5.16)***	18.30 (-7.28)***	21.58 (-4.93)***	10.41 (-7.03)***	1.65 (-1.05)
	Fed's balance sheet	35.45 (-4.15)***	-69.64 (3.45)***	-23.78 (9.20)***	-204.25 (2.78)***	-63.56 (6.12)***	-10.55 (3.35)***	-23.61 (8.58)***	-12.89 (6.94)***

Table 14 | Long-run effect of quantitative easing (QE) on the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) derived from VEC models reported in Appendix D.3, using various proxies for quantitative easing, the interest rate and the external finance premium. The proxy for risk tolerance is always the equity risk premium. The procedure of deriving the long-run effect is outlined in Appendix C.2.1.
*Since these long-run effects have been computed by combining multiple cointegrating relationships each time, the t-statistics reported in parenthesis is the least significant one. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

Table 14 contains only the long-run effects of quantitative easing on the interest rate, external finance premium and risk tolerance, in order to stay close to the analogy used in section 5.1.2 of entering the

transmission channels. Quantitative easing is expected to have a negative relationship with the interest rate and external finance premium.

In the interest rate case, it appears that for the correct sign, one should look at the quantitative easing proxy of the sum of *Treasury & mortgage-backed securities held by the Fed*. However, the magnitude of the long-run effects in that row seems to large. When only looking at the short-term *13-week Treasury Bill rate*, the long-run coefficients resulting from the quantitative easing proxy of the *size of the Fed's balance sheet* look very good in sign and magnitude.

In the external finance premium case, it is difficult to find credible long-run effects. In the case of *Treasury securities held by the Fed* coupled with the *13-week Treasury Bill rate* an effect between -0.21 and -2.85 is found. Also in the column combining the *high yield (≤CCC-AAA) corporate bond spread* with the *13-week Treasury Bill rate* some satisfactory long-run effects are found. 10-year – 3-mont

For the effect of quantitative easing on the equity risk premium (risk tolerance), no sign was expected beforehand. In terms of magnitude, both the *mortgage-backed securities held by the Fed* and *Treasury securities held by the Fed* quantitative easing proxies seem reasonable.

Now the long-run effects of the interest rate, the external finance premium and risk tolerance on output are derived from the vector error correction models, again using the approach explained in Appendix C.2.1. This shows how much the interest rate, credit and risk-taking channels affect output. It is expected that all three variables have a negative relationship with output. This is analogous to the notion of quantitative easing exiting the transmission channels, as in subsection 5.2. The long-run coefficients are reported in Table 15, below.

Table 15 should be read as follows. The interest rate, external finance premium and quantitative easing proxies used in the system are indicated in the 'IR proxy', 'EFP proxy' and 'QE proxy' rows and columns respectively. Furthermore, the first four rows indicate the long-run effect of the interest rate on output, the second four indicate the long-run effect of the external finance premium on output and the last four rows indicate the long-run effect of risk tolerance on output, according to the proxies indicated.

The magnitude of all long-run effects on output is small, which is expected. However, not all signs are correct. This may be due to the fact that, in the VEC models, the lag order is decided by the Johansen Cointegration test and cannot differ within and across equations. Especially in the interest rate case, there are not many negative effects. Only the quantitative easing proxy of *mortgage-backed securities held by the Fed* shows quite some negative values.

	RT proxy→	Equity risk premium							
	IR proxy→	10-year bond rate				13-week Treasury Bill rate			
	EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y-3m yield spread	Debt-to-GDP ratio
	QE proxy↓								
Long-run effect of the interest rate on output	Treasury securities	0.041 (-2.79)***	-0.962 (0.04)	0.017 (2.54)**	0.016 (2.55)**	-0.018 (-0.16)	0.018 (1.67)	0.021 (2.50)**	0.034 (1.62)
	Mortgage-backed securities	-0.003 (-0.23)	-0.009 (3.77)***	-0.005 (3.10)***	-0.015 (4.52)***	0.031 (-1.36)	0.071 (-2.43)**	-0.204 (2.94)***	0.210 (-4.15)***
	Treasury & mortgage-backed securities	0.033 (4.32)***	0.033 (3.83)***	0.029 (5.83)***	0.008 (1.04)	0.023 (4.35)***	0.023 (3.88)***	0.024 (4.92)***	0.137 (0.71)
	Fed's balance sheet	0.013 (4.29)***	0.008 (-3.12)***	-0.0003 (0.56)	0.011 (-2.68)**	-0.135 (-5.20)***	-0.028 (-1.19)	0.010 (0.48)	-0.070 (2.36)**
Long-run effect of the external finance premium on output	Treasury securities	-0.037 (-3.76)***	-0.002 (-1.32)	0.094 (1.39)	-0.003 (2.55)**	0.020 (0.24)	0.019 (0.66)	0.102 (1.30)	-0.001 (5.50)***
	Mortgage-backed securities	-0.001 (-0.23)	0.001 (3.77)***	-0.005 (3.10)***	-0.002 (-3.76)***	-0.004 (-1.36)	-0.012 (0.44)	-0.005 (2.94)***	-0.001 (-4.15)***
	Treasury & mortgage-backed securities	-0.046 (-4.36)***	-0.019 (-2.52)**	-0.129 (-1.29)	-0.0005 (1.04)	-0.025 (-5.68)***	0.007 (3.48)***	-0.130 (-1.29)	-0.002 (-5.83)***
	Fed's balance sheet	-0.021 (-5.20)***	-0.018 (1.06)	-0.0003 (0.56)	-0.002 (-2.68)**	-0.035 (3.71)***	-0.012 (0.08)	-0.0003 (0.48)	-0.001 (-2.44)**
Long-run effect of risk tolerance on output	Treasury securities	0.072 (-3.63)***	0.014 (-1.32)	-0.009 (2.54)**	-0.016 (2.55)**	-0.001 (0.24)	-0.007 (2.27)**	-0.009 (2.56)**	-0.006 (-5.28)***
	Mortgage-backed securities	-0.002 (-0.23)	0.016 (2.21)**	0.006 (3.10)***	0.088 (0.57)	-0.002 (-1.36)	-0.002 (-2.43)**	0.005 (2.94)***	-0.005 (-4.15)***
	Treasury & mortgage-backed securities	-0.025 (-4.90)***	-0.022 (3.83)***	-0.013 (-7.03)***	-0.002 (1.04)	-0.008 (7.15)***	-0.012 (4.92)***	-0.013 (-7.03)***	-0.092 (-1.05)
	Fed's balance sheet	-0.008 (-4.15)***	-0.005 (-3.12)***	0.0001 (0.56)	-0.007 (-2.68)**	-0.002 (-5.20)***	-0.002 (-1.19)	0.0001 (0.48)	-0.003 (-2.44)**

Table 15 | Long-run effect of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) on output, derived from VEC models reported in Appendix D.3, using various proxies for the interest rate, the external finance premium and for quantitative easing. The risk tolerance proxy is always the equity risk premium. The procedure of deriving the long-run effect is outlined in Appendix C.2.1.
*Since these long-run effects have been computed by combining multiple cointegrating relationships each time, the t-statistics reported in parenthesis is the least significant one. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

Fortunately, the external finance premium results are better. Almost all the long-run coefficients are negative there, as expected. In the risk tolerance case, the only quantitative easing proxy showing all negative long-run coefficients is the sum of *Treasury & mortgage-backed securities held by the Fed*. The significance of the effects in Table 14 and Table 15 is not high. It seems that the evidence presented

by the VEC models of the existence of all three transmission channels of quantitative easing is a bit weak. In section 7, information from Table 15 will be combined with information from Table 14 to get a better sense of the transmission channels of quantitative easing according to the VEC models estimated.

7 Results

The aim of this paper is to find the relative importance of the interest rate channel, credit channel and risk-taking channel when a quantitative easing policy is implemented. It is assumed that these channels are analogous to the interest rate, the external finance premium and risk tolerance, respectively. The effect of quantitative easing on these variables has been estimated, as well as the effect these variables have on output. This was described as quantitative easing entering and exiting the transmission channels. In this way, quantitative easing can be traced through its transmission channels.

So, 2 interest rate proxies, 4 external finance premium proxies and 4 quantitative easing proxies combined with risk tolerance and output in 4 estimation methods has resulted in a total of 79 estimated effects of quantitative easing on the interest rate 95 effects of quantitative easing on the external finance premium, 71 effects of quantitative easing on risk tolerance and 125 effects of the interest rate on output, 125 effects of the external finance premium on output and 125 effects of risk tolerance on output[15]. These effects were all reported in Table 3, Table 6, Table 8, Table 10, Table 12, Table 13, Table 14 and Table 15. Overall, the significance of these effects generally showed evidence of the existence of all three transmission channels. However, this scope is too broad to get a good sense of the dynamics of quantitative easing, and the relative importance of its transmission channels, so it is narrowed down here.

A method of narrowing down could be to simply pick one or two combinations of proxies that seem to generate satisfactory results, and draw conclusions based on those. However, such a method would cause information obtained from estimating the other proxy combinations to be foregone. Therefore, a different method of narrowing down is used. First, the long-run coefficients found of quantitative easing on the three transmission channel variables are studied. It was expected that quantitative easing has a negative effect on the interest rate and on the external finance premium. Every coefficient that does not meet this restriction is disregarded. Then, the mean is calculated of the remaining coefficients. The simple average, as well as a truncated and Winsorized[16] mean (both using the middle 90th percentile) of the long-run coefficients is computed per estimation method. This narrows down

[15] Summing the effects found from the ARDL, EC, VAR and VEC models gives, for the number of effects found of quantitative easing on
the interest rate: $8 + (8 - 1) + 32 + 32 = 79$;
the external finance premium: $16 + (16 - 1) + 32 + 32 = 95$ and
risk tolerance: $4 + (4 - 1) + 32 + 32 = 71$
and for the number of effects on output by the interest rate, the external finance premium and risk tolerance:
$32 + (32 - 3) + 32 + 32 = 125$.

[16] Winsorizing is the limiting of extreme values to chosen upper and lower bounds, in this case the 95th and 5th percentile, by changing the extreme values to the nearest bound.

the number of results considerably. These mean effects are reported in Table 16 below, together with an interval of two standard deviations.

The truncated mean seems to give the most modest result, generally. Also, the ARDL and VAR models look credible in their long-run effects. Especially in the interest rate and risk tolerance case, the EC and VEC models seem too extreme. However, this does not show the complete picture of course. The same method of narrowing down results can be done for the effects of the interest rate, the external finance premium and risk tolerance on output.

		ARDL models			**EC models**			**VAR models**			**VEC models**		
Long-run effect of quantitative easing on the interest rate	$5^{th} – 95^{th}$ percentile	-3.49 – -0.07			-51.95 – -6.16			-16.61 – -0.03			-11.93 – -0.30		
		-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.
	Simple	-2.72	**-1.39**	-0.06	-54.49	**-29.06**	-3.62	-38.41	**-7.86**	22.70	-9.54	**-4.58**	0.37
	Truncated	-1.60	**-1.08**	-0.56	-29.06[1]	**-3.62[1]**	21.82[1]	-4.64	**-1.88**	0.89	-6.96	**-3.89**	-0.81
	Winsorized	-2.34	**-1.28**	-0.22	-51.95	**-29.06**	-6.16	-7.07	**-2.62**	1.82	-7.62	**-4.11**	-0.59
Long-run effect of quantitative easing on the external finance premium	$5^{th} – 95^{th}$ percentile	-29.76 – -0.06			-57.27 – -2.57			-542.48 – -0.53			-212.46 – -0.75		
		-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.
	Simple	-19.68	**-8.69**	2.30	-42.47	**-22.54**	-2.61	-449.46	**-105.87**	237.71	-271.77	**-65.04**	141.69
	Truncated	-12.77	**-6.50**	-0.23	-32.86	**-19.41**	-5.96	-44.34	**-20.71**	2.92	-30.28	**-14.39**	1.51
	Winsorized	-16.81	**-7.90**	1.00	-39.80	**-21.75**	-3.69	-180.69	**-52.06**	76.57	-74.47	**-25.24**	24.00
Long-run effect of quantitative easing on risk tolerance	$5^{th} – 95^{th}$ percentile	-2.51 – 2.04			-0.48 – 23.84			-25.69 – 17.73			-66.30 – 19.78		
		-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.
	Simple	-2.14	**-0.13**	1.88	-0.80	**10.49**	21.78	-15.27	**-0.77**	13.74	-48.64	**-7.82**	33.01
	Truncated	-1.45	**0.02**	1.49	-4.21[1]	**7.08[1]**	18.37[1]	-8.26	**-0.54**	7.19	-16.96	**-1.19**	14.58
	Winsorized	-2.03	**-0.11**	1.81	-0.02	**10.15**	20.31	-11.57	**-0.97**	9.64	-26.36	**-3.95**	18.47

Table 16 | Average long-run effects of quantitative easing on the interest rate, the external finance premium and risk tolerance, to be interpreted as how quantitative easing enters the interest rate, credit and risk-taking channels respectively. The average long-run effects are derived from the 4 types of models in this paper, in Table 3, Table 6, Table 12 and Table 14. Averages are calculated by first deleting effects of the wrong sign. Then the simple, truncated and Winsorized mean is calculated. Truncation and Winsorizing uses the middle 90th percentile. An interval of 2 standard deviations is also reported. [1]: Due to the low number of observations, the mean reported here is the most credible observation and the standard deviation is calculated normally, instead of using a truncated sample.

The narrowed down results of the long-run effects of the interest rate, the external finance premium and risk tolerance on output are reported below, in Table 17. The long-run effects of the interest rate, the external finance premium and risk tolerance are expected to be negative, and thus all positive

coefficients were deleted before the simple, truncated and Winsorized means were calculated for each estimation method.

		ARDL models			EC models			VAR models			VEC models		
Long-run effect of the interest rate on output	5^{th} – 95^{th} percentile	-0.41 – 0.00			-0.06 – -0.01			-0.75 – 0.00			-0.58 – 0.00		
		-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.
	Simple	-0.29	**-0.10**	0.09	-0.05	**-0.02**	0.00	-0.44	**-0.17**	0.11	-0.40	**-0.13**	0.14
	Truncated	-0.18	**-0.07**	0.05	-0.02	**-0.01**	-0.01	-0.31	**-0.12**	0.07	-0.12	**-0.05**	0.01
	Winsorized	-0.22	**-0.09**	0.05	-0.04	**-0.02**	0.00	-0.39	**-0.15**	0.09	-0.26	**-0.10**	0.07
Long-run effect of the external finance premium on output	5^{th} – 95^{th} percentile	-0.04 – 0.00			-0.07 – 0.00			-0.08 – 0.00			-0.11 – 0.00		
		-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.
	Simple	-0.04	**-0.02**	0.01	-0.06	**-0.03**	0.00	-0.05	**-0.02**	0.01	-0.05	**-0.02**	0.01
	Truncated	-0.03	**-0.01**	0.00	-0.04	**-0.02**	0.00	-0.03	**-0.02**	0.00	-0.02	**-0.01**	0.00
	Winsorized	-0.03	**-0.01**	0.00	-0.05	**-0.02**	0.00	-0.04	**-0.02**	0.00	-0.05	**-0.02**	0.01
Long-run effect of risk tolerance on output	5^{th} – 95^{th} percentile	-0.05 – 0.00			-0.03 – 0.00			-0.11 – 0.00			-0.03 – 0.00		
		-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.	-1 St. D.	Mean	+1 St. D.
	Simple	-0.03	**-0.01**	0.00	-0.02	**-0.01**	0.00	-0.10	**-0.04**	0.02	-0.03	**-0.01**	0.01
	Truncated	-0.02	**-0.01**	0.00	-0.01	**-0.01**	0.00	-0.05	**-0.03**	0.00	-0.01	**-0.01**	0.00
	Winsorized	-0.03	**-0.01**	0.00	-0.02	**-0.01**	0.00	-0.06	**-0.03**	0.00	-0.02	**-0.01**	0.00

Table 17 | Average long-run effects of the interest rate, the external finance premium and risk tolerance on output, to be interpreted as how quantitative easing exits the interest rate, credit and risk-taking channels respectively. The average long-run effects are derived from the 4 types of models in this paper, in Table 8, Table 10, Table 13 and Table 15. Averages are calculated by first deleting effects of the wrong sign. Then the simple, truncated and Winsorized mean is calculated. Truncation and Winsorizing uses the middle 90th percentile. An interval of 2 standard deviations is also reported.

The effects of the interest rate, the external finance premium and risk tolerance on output can be interpreted as how quantitative easing exits the interest rate, credit and risk-taking channels respectively. As expected, the effects reported in Table 17 are of smaller magnitude than those reported in Table 16. According to the ARDL, VAR and VEC models, the effect of the interest rate on output is greater than the effect of the external finance premium on output. Only the EC models show a somewhat similar impact on output of the two variables. It is also noteworthy how much the four estimation methods and three averaging methods agree on the effect risk-tolerance has on output. Only the VAR models show a slightly different result.

Table 16 and Table 17 have shown that the best and most credible results are obtained by the ARDL and VAR estimation methods, using the truncated mean method to narrow down the results. For visualization purposes, the three transmission channels are displayed in according to these methods in influence diagrams in Figure 3 below. Note that, while estimated by the VAR (and VEC) models, any interplay between the channels is not shown in these diagrams.

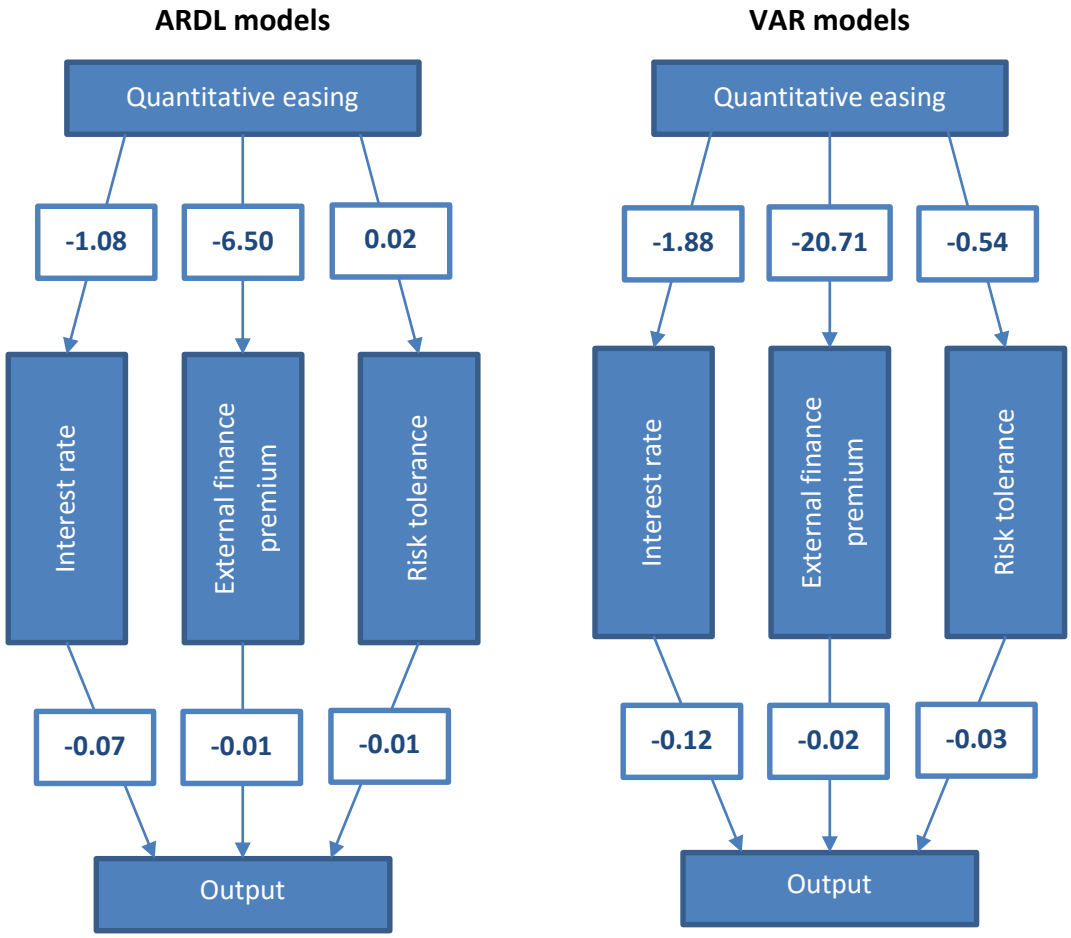


Figure 3 | Influence diagrams showing the complete path of quantitative easing through the interest rate, credit and risk-taking channels, according to the truncated results from the ARDL and VAR models in Table 16 and Table 17.

Quantitative easing enters all models in natural log form and is an independent variable. This means the dynamics of quantitative easing entering the channels can be roughly interpreted as elasticities. The dynamics as reflected by the ARDL models can be interpreted as follows. When quantitative easing is increased by 1%, the interest rate decreases by 1.08%. Note that this is an actual percentage change, not a percentage-point one[17]. That same 1% increase in quantitative easing decreases the external finance premium by 6.50% and increases risk tolerance (the equity risk premium) by 0.02%. Now for the second part, where quantitative easing exits the channels, the natural logarithm of output is the

[17] A percentage change of -1.08% on an interest rate of 2.00% results in an interest rate of $2.00 \cdot \left(\frac{100-1.08}{100}\right) = 1.98\%$. A percentage-point change of -1.08 on an interest rate of 2.00% results in an interest rate of $2.00 - 1.08 = 0.92\%$.

dependent variable and the interest rate, the external finance premium and risk tolerance (the equity risk premium) are independent variables. This means the dynamics as reflected by the ARDL models can be interpreted as follows. A 1-unit (as opposed to %) decrease in the interest rate, increases output by $0.07 \cdot 100 = 7\%$. A 1-unit decrease in the external finance premium, increases output by $0.01 \cdot 100 = 1\%$. A 1-unit decrease in risk tolerance (the equity risk premium), increases output by $0.01 \cdot 100 = 1\%$.

To further clarify, these ARDL dynamics are quantified using the average values of the variables in 2014 (chosen arbitrarily for the sake of example). For the interest rate, external finance premium and quantitative easing the proxies *10-year bond rate*, *BBB-AAA corporate bond spread* and *Treasury & mortgage-backed securities held by the Fed* are used. If quantitative easing increases 1%, from 4,021,505 million dollars to 4,061,720, the interest rate decreases by 1.08%, from 2.541 to 2.513. This is a decrease of 0.027 percentage points, which leads to an increase in output by $-0.027 \times -0.07 = 0.0019 = 0.192\%$. That same 1% increase in quantitative easing would decrease the external finance premium by 6.50% from 0.999 to 0.934, which is an absolute decrease of 0.065. This results in an increase of GDP of $-0.065 \times -0.01 = 0.0006 = 0.06\%$. For the risk-taking channel, the 1% increase in quantitative easing increases the equity risk premium by 0.02%, from 4.057 to 4.058, which is an absolute change of 0.001. This leads to a change in GDP of $0.001 \times -0.01 = -0.00001 = -0.001\%$.

It seems that quantitative easing has its biggest impact on output through the interest rate channel, while also having some influence through the credit channel. The influence through the risk-taking channel seems very small. However, it should be noted that these calculated impacts are dependent on the level of the respective transmission channel variable. A general formula for the calculation of the percentage change on output caused by a 1% increase in quantitative easing through a channel is as follows.

$$d = Var \times C_{entry} \times C_{exit}$$

Where d is the percentage change in output following a 1% change in quantitative easing. Var is the respective transmission channel variable (an interest rate proxy for the interest rate channel, an external finance premium proxy for the credit channel and the equity risk premium for the risk-taking channel). C_{entry} and C_{exit} are the coefficients for quantitative easing entering and exiting the transmission channel (from Table 16 and Table 17), respectively. This formula could be calculated using all results from all estimation methods. However, one should decide which proxies to use for Var, and which values to enter.

Due to d's dependency on the level of Var, the relative importance of the transmission channels changes as Var changes over time. For example, the interest rate channel has more impact on output than the credit channel when:

$$\frac{Var_{IR}}{Var_{EFP}} > \frac{C_{entry,EFP} \times C_{exit,EFP}}{C_{entry,,IR} \times C_{exit,IR}},$$

where IR denotes the interest rate and EFP denotes the external finance premium (the credit channel). Comparing the three transmission channels is also possible. For the interest rate channel to be of higher influence on output than the credit channel, which is in turn of more influence than the risk-taking channel, the following inequality should hold:

$$Var_{IR} \times C_{entry,,IR} \times C_{exit,IR} > Var_{EFP} \times C_{entry,EFP} \times C_{exit,EFP} > Var_{RT} \times C_{entry,RT} \times C_{exit,RT},$$

or

$$Var_{IR} > Var_{EFP} \cdot \frac{C_{entry,EFP} \times C_{exit,EFP}}{C_{entry,,IR} \times C_{exit,IR}} > Var_{RT} \cdot \frac{C_{entry,RT} \times C_{exit,RT}}{C_{entry,,IR} \times C_{exit,IR}}.$$

IR denotes the interest rate, EFP denotes the external finance premium (the credit channel) and RT denotes risk tolerance (the risk-taking channel). An interesting find here is that, as Var changes over time, so does d. So, the formula for d should be altered slightly.

$$d_t = Var_t \times C_{entry,t} \times C_{exit,t}$$

The fact that d_t changes over time implies that the relative importance of the transmission channels also changes over time. The course of d_t over time can be plotted for each of the three transmission channels under all of the 4 estimation methods. This is done for the first one in Figure 4 below, using, again the proxies *10-year bond rate*, *BBB-AAA corporate bond spread* and *Treasury & mortgage-backed securities held by the Fed*.

Figure 4 reports the impact a 1% increase in quantitative easing would have on output (GDP) though each channel over time. Every type of model agrees on the fact that the risk-taking channel is the least important one, except for the EC models. In the EC models, quantitative easing has a negative effect on output through the risk-taking channel. This effect looks to be greater in absolute sense than the interest rate channel effect, especially after 2010. The EC models are also the only models that consistently deem the credit channel more important than the interest rate channel in transmitting the effect of quantitative easing to the economy. In all the other models, especially the ARDL and VEC models, the interest rate channel is generally the transmission channel through which quantitative easing has the most impact. Only in the VAR models the relative importance of the interest rate and

credit channels is less clear, but it seems that the interest rate channel is slightly more often the most influential one. When looking at the ARDL and VAR models, before the start and during the beginning of the first and third rounds of quantitative easing, the credit channel seems to be more influential in transmitting quantitative easing's effect than the interest rate channel. After a while, as quantitative easing continues, the interest rate channel overtakes the credit channel.

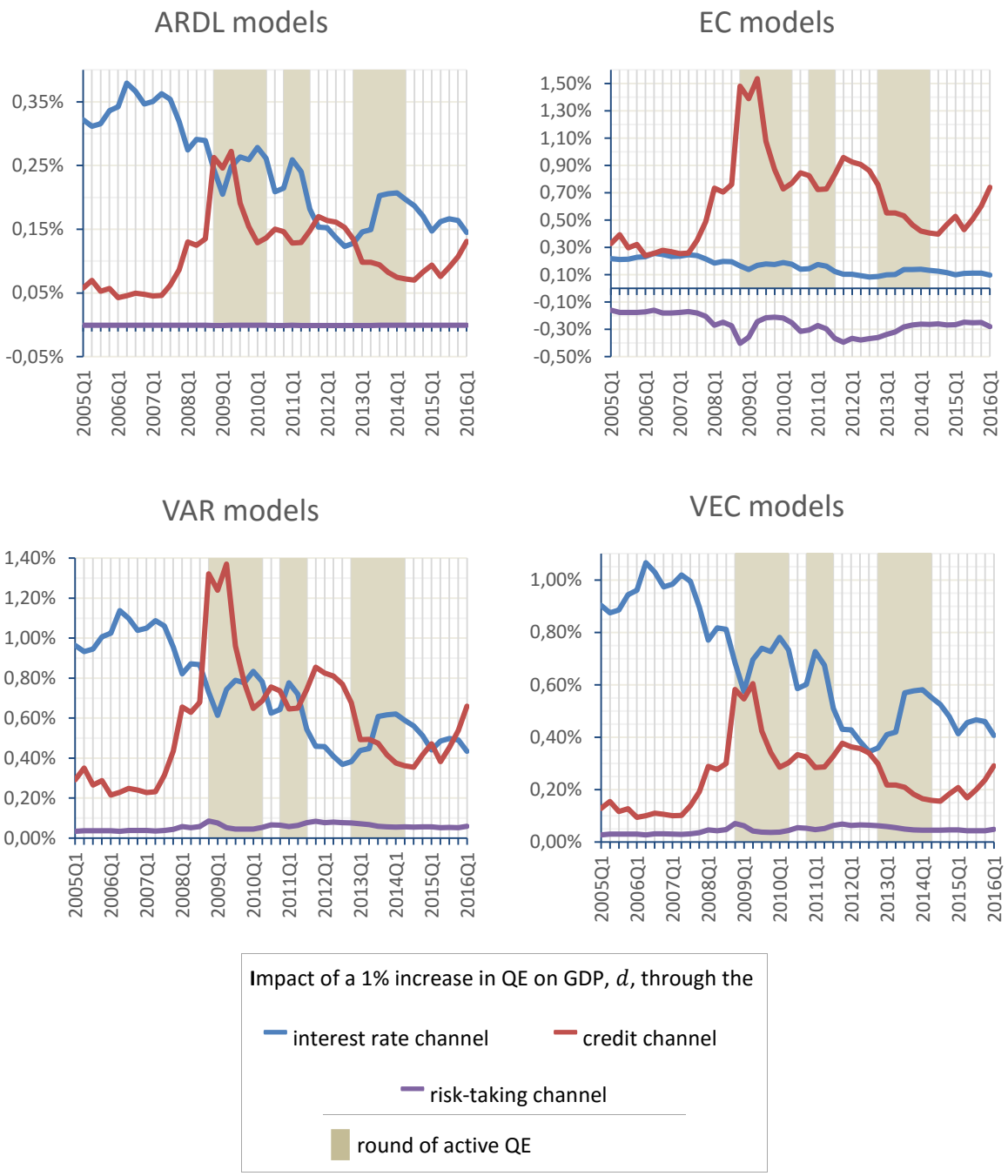


Figure 4 | Impact of a 1% increase in quantitative easing on output (GDP) through the interest rate, credit and risk-taking channels using the 10-year bond rate, the BBB-AAA corporate bond spread, the equity risk premium and the sum of Treasury & mortgage-backed securities held by the Fed as proxies for, respectively, the interest rate, the external finance premium and quantitative easing.

It is striking to see in Figure 4 that the importance of the credit channel shoots up in response to the 2007 crisis, in all four graphs. A similar rise in the importance of the credit channel can be seen during the time of Operation Twist (September 2011). This is likely to be caused by banks being hesitant to provide credit to firms in these uncertain times. This then hinders firms in conducting their regular business activities, essentially bottlenecking the economy. It is found that during (the aftermath of) crises, easier access to credit stimulates the economy more than it does in calmer times. Moreover, easier access to credit often (in the ARDL, EC and VAR models) stimulates the economy even more than a decrease in (long-term) interest rates would. Figure 4 shows that, when the bottleneck of tight credit is gradually lifted by quantitative easing, the interest rate channel effect becomes more prevailing again.

The accelerator effects of the credit and risk-taking channels can also be deduced from Figure 4, as the total effect of quantitative easing on output is the sum of the three channels depicted in the graphs. This is better presented in cumulative graphs, which is done in Figure 5, below. The cumulative graphs clearly show how the total effect of a 1% increase in quantitative easing is built up. These graphs confirm again that the interest rate channel is generally the most important channel of quantitative easing, with the credit and risk-taking channels adding to, or amplifying, its effect. Notice that, according to the EC models, quantitative easing affects the economy negatively through the risk-taking channel. This can be seen by the line depicting the total effect being below the shaded area depicting the risk-taking channel effect.

The rounds of quantitative easing implemented by the Federal Reserve are generally implemented at times when quantitative easing has a relatively large effect on the economy. It seems that the Fed's sense of timing is sound. It is probable that these periods of relative large impact of quantitative easing are caused by crises and/or recessions, when tight credit is a bottleneck of the economy which can be lifted by quantitative easing through (mainly) the credit channel, as discussed above.

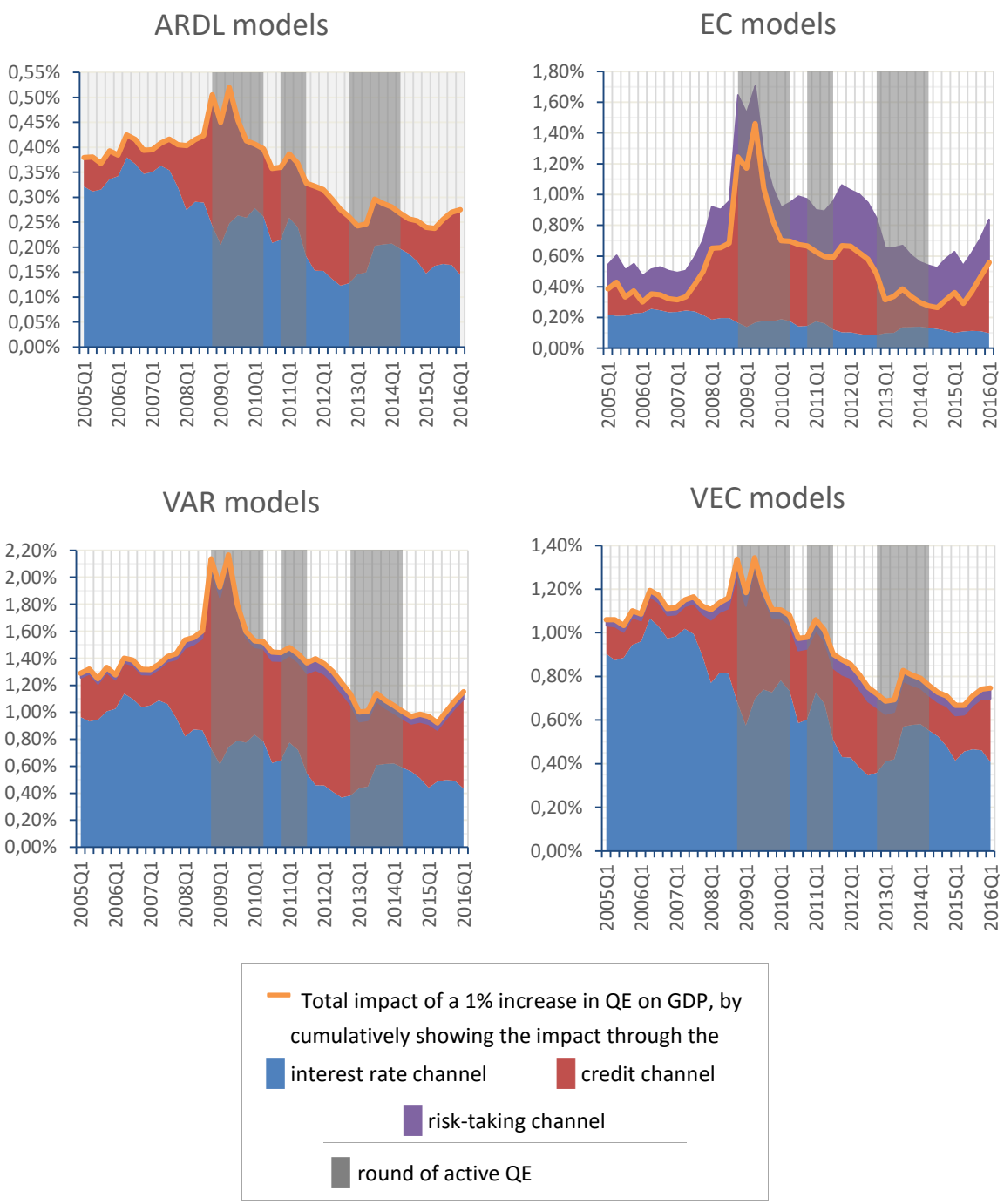


Figure 5 | Total impact of a 1% increase in quantitative easing on output (GDP), by cumulatively showing the impact through the interest rate, credit and risk-taking channels using the 10-year bond rate, the BBB-AAA corporate bond spread, the equity risk premium and the sum of Treasury & mortgage-backed securities held by the Fed as proxies for, respectively, the interest rate, the external finance premium and quantitative easing.

8 Concluding remarks

This paper set out to investigate the transmission channels of monetary policy. In particular, the research goal was to quantify the relative importance of the interest rate, credit and risk-taking channels. It was assumed that these channels are analogous to the interest rate, the external finance premium and risk tolerance, respectively. The effect of quantitative easing on these variables was estimated, as well as the effect these variables have on output. This was described as quantitative easing entering and exiting the transmission channels. In this way, a picture of the path quantitative easing takes before it affects output can be drawn. In other words, quantitative easing can be traced through its transmission channels. The paper has conducted this using four estimation techniques, which can be divided in two categories: separate estimation and simultaneous estimation.

Various proxies were used for the interest rate, the external finance premium and quantitative easing. The proxy for risk tolerance was always the equity risk premium. In each of the four methods, every combination of proxies was estimated. In the separate estimations, the effect quantitative easing has on the three transmission channel variables was estimated separately from the effect the transmission channel variables have on output. Also, the three transmission channels were estimated in isolation. In the simultaneous estimations, both the effect of quantitative easing on the on the transmission channel variables as well as the effect the transmission channel variables have on output were estimated simultaneously. This also means that the three transmission channels were estimated simultaneously.

The first separate estimation method used bivariate autoregressive distributed lag regressions. Initially, three approaches were attempted. A total of 3,856 specifications were estimated before arriving at the 28 final equations, one for each combination of proxies. Later, output was regressed on the fitted values from these equations, in multivariate regressions. 15,408 specifications were estimated before arriving at the final 32 equations, again one for each combination of proxies. The second separate estimation method used error correction models. The lag-order of the equations was decided by Johansen Cointegration tests. For this reason, there were not more specification attempts than final equations. To estimate quantitative easing entering the channels, 28 equations were used, one for each combination of proxies. To estimate quantitative easing exiting the channels, output was regressed on the fitted values of the first separate estimation method, in error correction models. This also resulted in 32 equations, again one for each combination of proxies.

The first simultaneous estimation method used vector autoregressive distributed lag models, with four equations per model. A computer script attempted 2,229,920 specifications per equation, before arriving at the final 32 models (128 equations), one for each combination of proxies. This method

estimated the entry and exit of quantitative easing in and out of the channels simultaneously. The second simultaneous method used vector error correction models, also with 4 equations per model. The specification of these models was decided upon by Johansen Cointegration tests, and therefore not more equations were attempted than the final ones. A total of 32 models (128 equations) was estimated.

8.1 Findings

So, this paper estimated a total of 2,249,372 equations before arriving at 376 final specifications. This has resulted in 79 effects of quantitative easing entering the interest rate channel, 95 effects of quantitative easing entering the credit channel and 71 effects of quantitative easing entering the risk-taking channel. Furthermore, 125 effects of quantitative easing exiting the interest rate channel were found, as well as 125 effects of quantitative easing exiting the credit channel and 125 effects of quantitative easing exiting the risk-taking channel. On the basis of the significance of these effects, the existence of any of the three transmission channels cannot be rejected. This means the null hypotheses of absence of the credit and risk-taking channel, H_0^1 and H_0^2, are rejected while the corresponding alternative hypotheses, H_a^1 and H_a^2, are not. This means the conclusion can be drawn that there is an interest rate channel, a credit channel and a risk-taking channel of quantitative easing.

The effects found of quantitative easing entering and exiting the three transmission channels were then narrowed down by removing coefficients of the wrong sign and then taking the simple, truncated and Winsorized means for each of the four estimation methods. These narrowed down results gave the first impressions of the dynamics of the transmission of quantitative easing, and thus on the relative importance of the 3 channels. For the sake of better visualization, two sample influence diagrams were displayed.

It was not until the formula for the percentage change in output following a 1% change in quantitative easing through a certain transmission channel was derived and calculated with actual data, that a definitive picture of the relative importance of the transmission channels of quantitative easing could be drawn up. Interestingly, the relative importance of the transmission channels was found to be changing over time, so the percentage change in output following a 1% change in quantitative easing was plotted over time. This was done separately for each transmission channel, as well as cumulatively. These plots show that the credit channel becomes very important during (the aftermath of) crises, indicating that quantitative easing stimulates the economy during those times by lifting the bottleneck of tight credit. Moreover, these plots allow the final conclusions to be drawn. When taking into account the plots from all four estimation methods, it can be concluded that the risk-taking channel is the least important transmission channel of quantitative easing. This means the null hypothesis of the risk-

taking channel not being the least important channel, H_0^4, is rejected while its corresponding alternative hypothesis, H_a^4, is not. Furthermore, while the credit channel has at times a larger influence, most often the most important transmission channel of quantitative easing is the interest rate channel. This means the null hypothesis of the interest rate channel not being the most important channel, H_0^3, is rejected while its corresponding alternative hypothesis, H_a^3, is not.

8.2 Shortcomings and recommendations

As any research, this paper has its shortcomings. The number of observations in some of the estimations is low. This is due to availability of the data. Particularly for the quantitative easing proxies (naturally), data on the *Treasury securities held by the Fed* is available since 2003, while data on *mortgage-backed securities held by the Fed* is available only since 2009. The reason for this is that quantitative easing is a relatively new policy measure. If these proxies enter in models of monthly frequency, the number of observations is still reasonable. However, when estimating how quantitative easing exits the transmission channels and when estimating simultaneous equations models, GDP had to be included in the model, which is quarterly. This made it necessary to transform all other variables to quarterly frequency as well, decreasing the number of observations by a factor three.

Furthermore, the paper uses a lot of different proxies and estimation methods resulting in a very high amount of results to be interpreted. While this minimizes the possibility that an effect or relationship is not found, the high number of results can cause some things to be overlooked. In order to effectively interpret this many results, they have to be narrowed down, which can then lead to certain effects or relationships to get lost in the process.

Also, the external finance premium and risk tolerance variables included in the models are unobserved. Therefore, proxies had to be used. This decreases the accuracy of the estimation, as the true variable is not (and cannot be) included. This downside is unfortunately inherent to the theories of the credit and risk-taking channels, that rely on these variables. So, these variables had to be included, even if it means the use of proxies.

Finally, this research started off with the assumption of the existence of three transmission channels of quantitative easing: the interest rate channel, the credit channel and the risk-taking channel. This may make it subject to confirmation bias, which is the bias to interpret information in accordance with preexisting hypotheses. Also, if there are, in reality, additional transmission channels of quantitative easing, this research would not be able to identify those. Related to this is the fact that the computer scripts used in some of the estimation methods searched for (long-run) coefficients of the sign expected ex ante.

Experiences gained from this research can provide some recommendations for future research to the transmission channels of quantitative easing, or to transmission channels of monetary policy in general. The shortcoming of a low number of observations can probably be mitigated by conducting a panel study. Quantitative easing has also been implemented in Japan, the United Kingdom, the European Monetary Union and China (Wei, 2015). Cross-sectional information from these geographies, together with the United States, can provide additional insights, while increasing the number of observations at the very least. Furthermore, it should be interesting to investigate the dynamics of quantitative easing in a more general model of the economy. This way, transmission channels can possibly be identified without first having to assume their existence, which also removes any suspicion of confirmation bias.

As mentioned in the introduction, a better understanding of the dynamics of quantitative easing could help central banks in deciding when and how to implement quantitative easing. Some policy recommendations follow. This study has found considerable variation in the relative importance of the transmission channels of quantitative easing. From this, it can be deduced that the timing of implementation matters. During the periods when the credit channel is the most influential transmission channel of quantitative easing, the external finance premium has a relatively large effect on output. This means that businesses are highly dependent on their way of financing. Certain activities might be forgone if the external finance premium is too high, having a negative effect on output. The fact that the credit channel is the most influential channel in these periods means that most firms do not have sufficient internal funds (retained earnings) available for financing, because if they did, the height of the external finance premium would not matter. So, these are the periods when an economy can benefit the most from quantitative easing, lowering the external finance premium by providing more credit to increase business activity and hereby increasing output. So it is recommended for a central bank to identify these periods when the credit channel is highly influential (by means of this paper, for example) and implement quantitative easing in these periods. It was found in this paper that the Federal Reserve timed their rounds of quantitative easing, at least the first and the third, according to this reasoning.

It is also not recommended to implement quantitative easing at times when the risk-taking channel has a relatively high positive influence. This might fuel bubbles in certain markets. When the risk-taking channel is influential, the risk attitude of economic agents is sensitive to quantitative easing, and output is, in turn, sensitive to the agents' risk attitude. During these times, quantitative easing will cause agents to be less risk averse (decreasing equity risk premium), inducing them into taking relatively risky actions. Examples include taking greater and/or riskier positions in equity and asset markets. This raises prices in these markets, causing them to boom, and eventually bust. Since the risk-

taking channel is highly (positively) influential, output is sensitive to this, causing upwards pressure at first, but downwards pressure after the burst. Such developments are generally considered undesirable business fluctuations and do not aid in a steady growing economy.

However, when the risk-taking channel has a relatively high negative impact on output, it is also not advised to implement quantitative easing. Quantitative easing would, in this case, put downward pressure on output, deeming it counterproductive. This is caused by the fact that, in times of a negative impact of the risk-taking channel on output, quantitative easing increases the risk aversion of economic agents. It may be the case that the agents 'see through the veil' and derive the bad state of the economy from the fact that quantitative easing is implemented. Consumers may, for example, not be willing to start spending due to the uncertainty collateral to such an economic era.

So it is not recommended to implement quantitative easing when the risk-taking channel is influential, either positively or negatively. A central bank's best bet is to implement quantitative easing when the risk-taking channel is inconsequential, in order for the policy to have the desired outcome. Since the European Court of Justice ruled that the European Central Bank is allowed to continue their quantitative easing program (Case C-62/14, 2015), perhaps the central bank can use insights and recommendations from this paper for their quantitative easing program. For example, on the timing of increases to the program, like the expansion recently implemented in April this year, from €60 to €80 billion monthly (European Central Bank, 2016).

In conclusion, this paper has conducted an interesting exploration into the dynamics of the transmission channels of quantitative easing, producing some interesting findings that lead to equally interesting insights and policy recommendations.

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Appendix

A Data

A.1 Descriptive statistics

Series		Unit	Start	End	# obs.	Minimum	Maximum	Mean	Median	Std. Dev	Skewness	Kurtosis
Interest Rates	10-year bond yield	%	Apr-1953	Feb-2016	755	1.53	15.32	5.97	5.56	2.81	0.89	3.53
	13-week Treasury Bill rate	%	Jan-2002	Mar-2016	171	0.01	5.03	1.28	0.26	1.61	1.18	3.04
External Finance Premium	BBB-AAA corp. bond spread	%	Dec-1996	Mar-2016	232	0.44	4.42	1.35	1.17	0.71	1.33	5.76
	≤CCC-AAA corp. bond spread	%	Dec-1996	Mar-2016	232	3.73	33.87	10.71	9.01	5.37	1.38	4.74
	10y – 3m yield curve rate spread	%	Jan-1990	Mar-2016	315	-0.70	3.68	1.85	2.01	1.14	-0.27	2.02
	Debt-to-GDP ratio	%	Q1 1966	Q3 2015	199	30.60	103.63	53.84	53.83	20.54	0.90	3.08
Risk Tolerance	Equity Risk Premium	%	Jan-1988	Mar-2016	339	1.32	6.71	3.09	2.90	1.16	0.80	3.30
Quantitative Easing	Treasury securities	ln(million $)	Dec-2002	Mar-2016	160	13.07	14.72	13.85	13.56	0.54	0.44	1.66
	Mortgage-backed securities	ln(million $)	Jan-2009	Mar-2016	87	7.97	14.38	13.78	13.86	0.88	-4.50	27.57
	Treasury & mortgage-backed securities	ln(million $)	Dec-2002	Mar-2016	160	13.07	15.25	14.15	14.03	0.75	0.19	1.43
	Fed's balance sheet	ln(million $)	Jul-2007	Feb-2016	104	13.67	15.32	14.76	14.87	0.51	-0.95	3.07
Output	Real GDP	ln(billion $)	Q1 1947	Q3 2015	275	7.57	9.71	8.76	8.78	0.64	-0.21	1.82

Table 18 | Descriptive statistics of the variables used in this paper.

A.2 Data sources

Series		Frequency		Adjustment	Source	
		Original	Conversion		Institution	Available at
Interest Rates	10-year bond yield	Monthly			OECD Data	https://data.oecd.org/interest/long-term-interest-rates.htm
	13-week Treasury Bill rate	Daily	Monthly Average		U.S. Department of the Treasury	https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=billratesAll
External Finance Premium	Total Public Debt as Percent of Gross Domestic Product	Quarterly		Seasonal	Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/GFDEGDQ188S#
	BofA Merrill Lynch US Corporate BBB Effective Yield	Daily	Monthly Average		Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/BAMLC0A4CBBBEY#
	BofA Merrill Lynch US Corporate AAA Effective Yield	Daily	Monthly Average		Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/BAMLC0A1CAAAEY#
	BofA Merrill Lynch US High Yield CCC or Below Effective Yield	Daily	Monthly Average		Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/BAMLH0A3HYCEY
	Daily Treasury Yield Curve Rates | 10y-3m	Daily	Monthly average		U.S. Department of the Treasury	https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yieldAll
Risk Tolerance	ASR Composite Equity Risk Premium estimates	Daily	Monthly average		Absolute Strategy Research	Thomson Reuters Datastream: USASERP http://www.absolute-strategy.com/x/erp.html

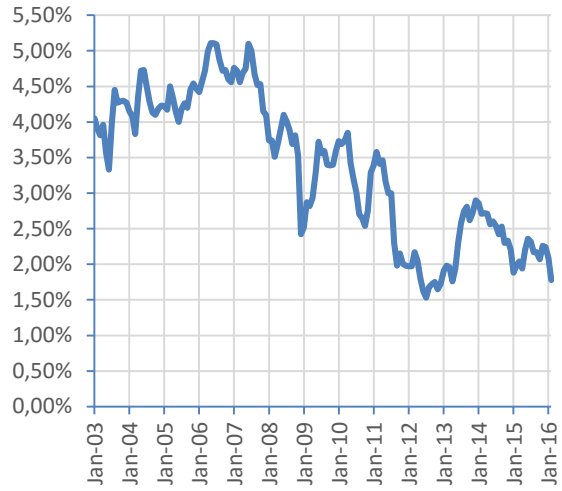
Quantitative Easing	Mortgage-backed securities held by the Fed	Monthly			Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/MBST
	Treasury securities held by the Fed	Monthly			Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/TREAST
	Total Assets of the Federal Reserve	Weekly	Monthly average		Board of Governors of the Federal Reserve System	https://www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm
Output	Real GDP (chained 2009 prices)	Quarterly		Seasonal	Federal Reserve Bank of St. Louis	https://research.stlouisfed.org/fred2/series/GDPC1

Table 19 | 'Total Public Debt as Percentage of Gross Domestic Product' uses nominal GDP. Merrill Lynch US Corporate Bonds Effective Yield are copyrighted by Merrill Lynch. Quarterly data is generally not converted to monthly frequency.

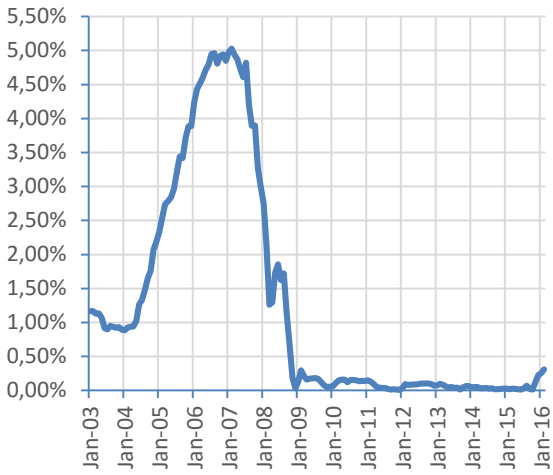
A.3 Plots

A.3.1 Interest rate

10-year bond rate

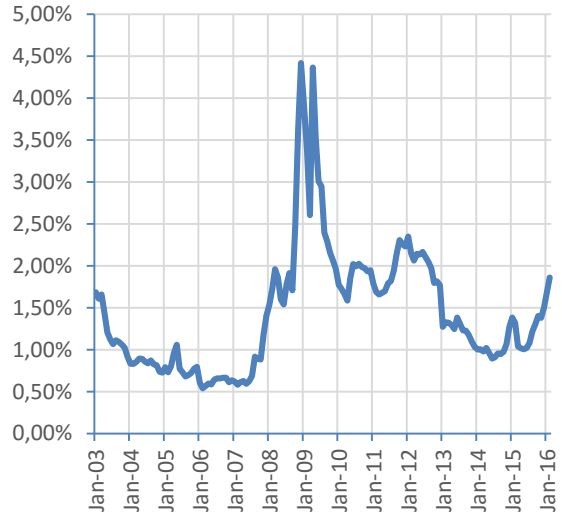


13-week Treasury Bill rate

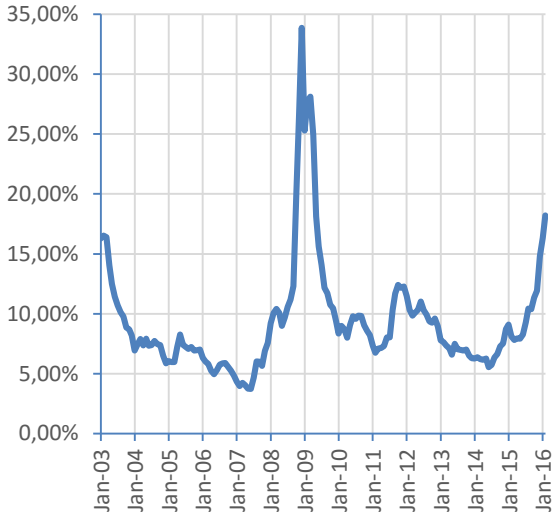


A.3.2 External finance premium

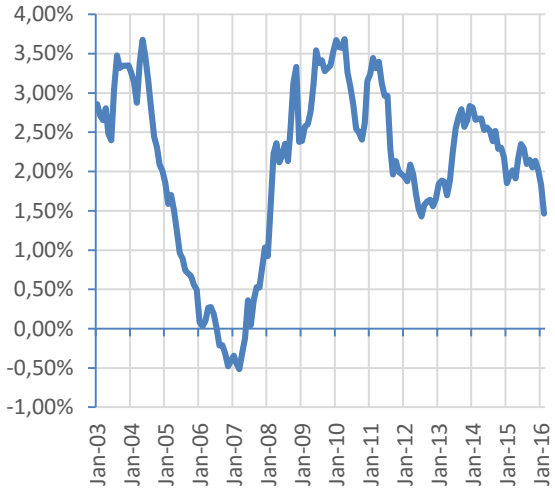
BBB-AAA corporate bond spread



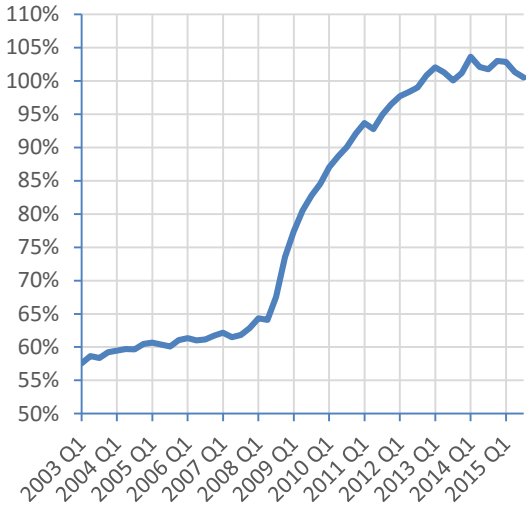
High yield (≤CCC-AAA) corporate bond spread



10-year – 3-month yield curve rate spread

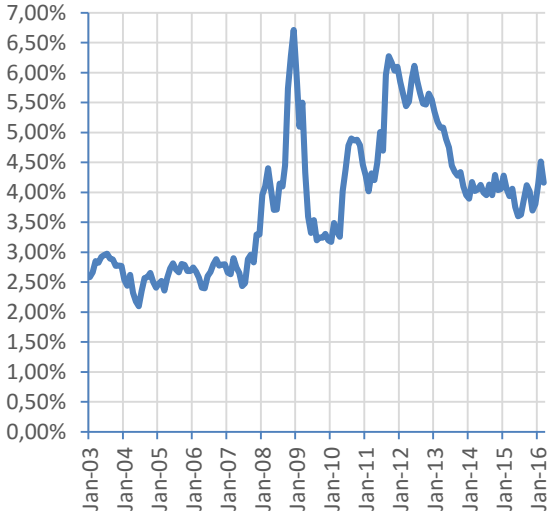


Debt-to-GDP ratio



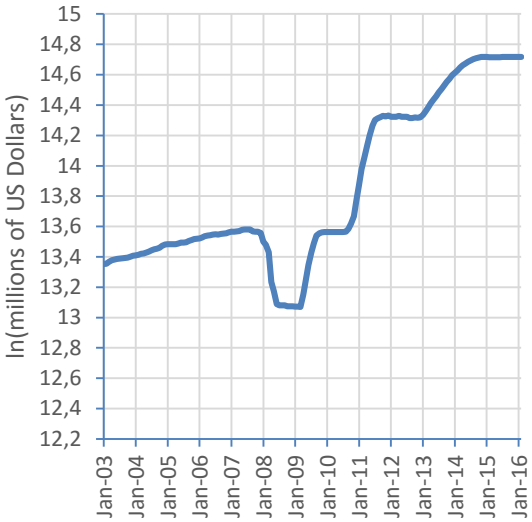
A.3.3 Risk tolerance

Equity risk premium

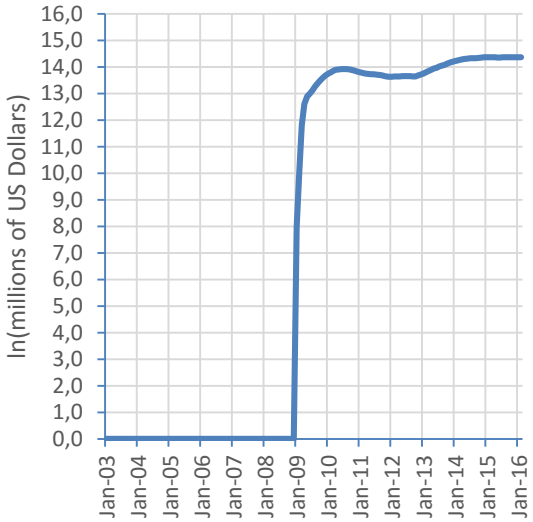


A.3.4 Quantitative easing

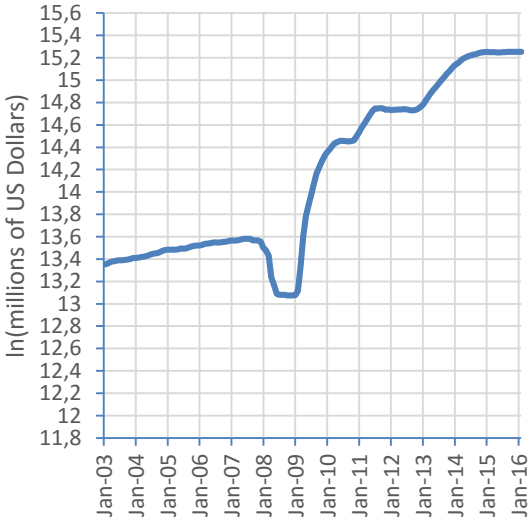
Treasury securities held by the Fed



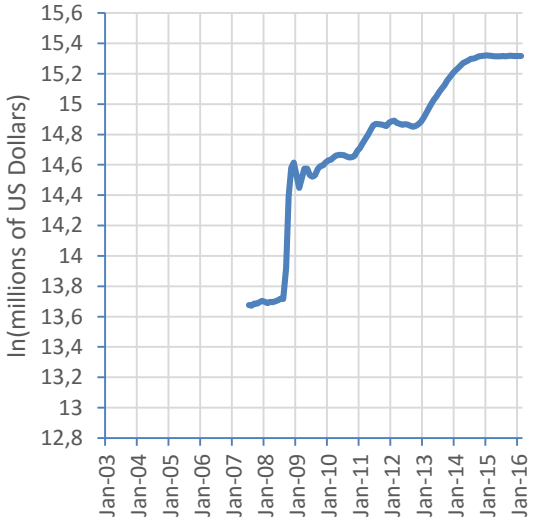
Mortgage-backed securities held by the Fed



Treasury & mortgage-backed securities

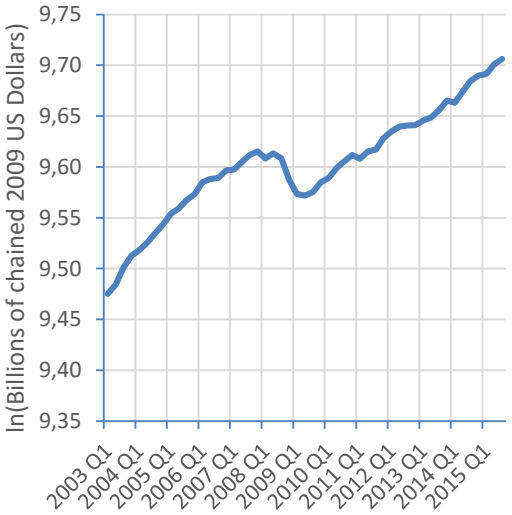


Size of the Fed's balance sheet



A.3.5 Output

Real GDP



B Separate estimation: step 1 – channel entry

B.1 Autoregressive distributed lag models

B.1.1 Approach 1

B.1.1.1 Interest rate

Dep. variable:	10-year bond rate				13-week Treasury Bill rate			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	1.67 (2.19)**	0.17 (0.16)	2.16 (3.03)***	0.57 (0.47)	-0.17 (-0.45)	-0.18 (-1.09)	0.03 (0.09)	1.36 (1.96)*
$trend$	-0.002 (-2.21)**	-0.005 (-1.81)*	-0.002 (-1.51)	-0.003 (-1.02)	-0.002 (-3.20)***	0.0004 (1.18)	-0.002 (-2.86)***	0.002 (1.94)*
$\ln QE_t$				0.58 (2.15)**		-0.01 (-0.42)	-0.11 (-0.68)	-0.23 (-1.02)
$\ln QE_{t-1}$								-0.11 (-0.45)
$\ln QE_{t-2}$	-0.15 (-1.15)			-3.24 (-5.06)***				-0.48 (-1.96)*
$\ln QE_{t-3}$			-0.09 (-0.59)	4.32 (4.07)***			1.35 (2.15)**	1.67 (6.46)***
$\ln QE_{t-4}$				-0.98 (-0.89)	-1.89 (-3.15)***		-3.06 (-2.99)***	-1.22 (-5.17)***
$\ln QE_{t-5}$		0.89 (1.86)*		-1.21 (-1.73)*	4.61 (4.04)***		3.70 (3.66)***	
$\ln QE_{t-6}$					-2.26 (-1.91)*		-1.96 (-3.39)***	-0.05 (-0.30)
$\ln QE_{t-7}$		-0.56 (-1.29)	-0.53 (-0.67)	1.77 (4.35)***	-0.53 (-0.73)			0.57 (3.11)***
$\ln QE_{t-8}$	3.72 (3.93)***		3.18 (2.35)**					-0.34 (-3.56***)
$\ln QE_{t-9}$	-5.44 (-4.14)***		-3.57 (-3.38)***	-2.61 (-3.73)***		-0.03 (-1.04)		
$\ln QE_{t-10}$				2.03 (1.95)*			0.20 (1.74)*	
$\ln QE_{t-11}$	2.47 (1.91)*	-0.06 (-1.47)	1.73 (1.89)*	-0.37 (-0.40)		0.09 (1.92)*		
$\ln QE_{t-12}$	-0.58 (-0.70)		-0.75 (-1.24)	-0.17 (-0.37)	0.21 (1.81)*	-0.05 (-2.19)**		-0.001 (-0.04)
IR_{t-1}	1.17 (14.48)***	1.14 (9.93)***	1.17 (14.37)***	1.20 (11.51)***	1.40 (18.44)***	1.29 (11.16)***	1.41 (18.28)***	0.63 (7.14)***
IR_{t-2}	-0.26	-0.35	-0.28	-0.30	-0.42	-0.29	-0.43	0.20

	(-3.27)***	(-3.00)***	(-3.42)***	(-2.88)***	(-5.70)***	(-2.11)**	(-5.53)***	(2.07)**
IR_{t-3}								
IR_{t-4}								
IR_{t-5}								-0.57 (-6.69)***
IR_{t-6}								0.60 (6.18)***
IR_{t-7}								-0.15 (-2.56)**
R^2	0.97	0.92	0.97	0.94	0.99	0.85	0.99	0.99
Adj. R^2	0.96	0.91	0.96	0.93	0.99	0.83	0.99	0.98
AIC	-0.37	-0.53	-0.33	-0.45	-1.03	-4.46	-0.99	-3.77
DW	1.95	2.06	1.94	1.99	1.98	1.92	1.99	1.56
# obs.	146	74	146	92	146	74	146	92
Start	2004M01	2009M12	2004M01	2008M07	2004M01	2010M01	2003M11	2008M07
End	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 20 | Estimation of the effect of quantitative easing on the interest rate, using various proxies for both variables. This table allows for the 'wrong' sign (positive) for the QE coefficients, as long as they are significant.
The 'IR proxy' row indicates the Interest Rate proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.1.2 External finance premium

B.1.1.2.1 Corporate bond spreads

EFP proxy:	BBB-AAA corporate bond spread				high-yield (≤CCC-AAA) corporate bond spread			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$Const.$	1.80 (2.27)**	0.23 (0.21)	0.70 (1.59)	1.19 (1.23)	3.44 (0.96)	-13.83 (-2.65)**	3.43 (1.39)	-8.28 (-1.27)
$trend$	0.004 (2.76)***	-0.001 (-0.65)	0.004 (2.55)**	0.002 (0.94)	0.01 (2.34)**	-0.01 (-0.98)	0.03 (2.95)***	0.01 (0.55)
$\ln QE_t$			1.58 (1.82)*		-18.58 (-3.93)***		-1.25 (-0.32)	17.03 (6.23)***
$\ln QE_{t-1}$	-1.42 (-3.05)***		-0.58 (-0.33)	1.75 (7.07)***	24.03 (3.73)***		-4.77 (-0.84)	-24.49 (-4.54)***
$\ln QE_{t-2}$			-3.94 (-2.26)**					34.55 (5.88)***
$\ln QE_{t-3}$	2.71 (3.37)***		3.59 (2.11)**	-4.31 (-7.35)***		5.66 (1.93)*	18.90 (2.91)***	-65.00 (-10.53)***
$\ln QE_{t-4}$			-0.79 (-0.65)	4.26 (4.15)***	-4.14 (-0.81)		-23.60 (-2.63)***	64.16 (8.59)***
$\ln QE_{t-5}$				-5.38 (-4.94)***			19.96 (2.17)**	-29.92 (-5.71)***
$\ln QE_{t-6}$	-4.73 (-4.83)***		-0.91 (-1.5)	9.27 (7.96)***	-33.82 (-4.15)***		-31.07 (-3.39)***	
$\ln QE_{t-7}$		-0.99 (-1.8)*		-8.99 (-6.37)***	42.14 (4.19)***	-30.47 (-2.64)**	40.21 (4.33)***	-13.33 (-3.3)***
$\ln QE_{t-8}$	3.22 (1.98)**			2.39 (1.73)*	-26.48 (-2.67)***	32.50 (2.33)**	-48.69 (-5.18)***	29.67 (5.64)***
$\ln QE_{t-9}$	4.41 (2.33)**	3.84 (2.02)**	3.56 (3.47)***	2.39 (2.35)**	62.65 (6.51)***		64.94 (6.81)***	-14.17 (-2.36)**
$\ln QE_{t-10}$	-7.10 (-3.72)***	-4.25 (-1.99)*	-5.47 (-3.28)***	-2.06 (-2.06)**	-78.41 (-7.55)***	-12.61 (-1.37)	-61.75 (-6.22)***	-6.40 (-1.17)
$\ln QE_{t-11}$	3.89 (2.05)**	1.75 (2.02)**	5.17 (3.2)***	-0.48 (-0.54)	33.01 (3.2)***	9.03 (1.7)*	34.63 (3.9)***	10.86 (2.25)**
$\ln QE_{t-12}$	-1.31 (-1.34)	-0.32 (-1.78)*	-2.46 (-3.13)***	0.98 (2.29)**	-1.27 (-0.25)	-2.57 (-1.86)*	-8.94 (-2.14)**	-2.78 (-1.1)
EFP_{t-1}	0.91 (11.11)***	1.25 (10.31)***	0.98 (10.71)***	0.95 (8.72)***	1.34 (17.2)***	1.35 (11.17)***	1.32 (16.56)***	1.33 (12.18)***
EFP_{t-2}	-0.04 (-0.47)	-0.32 (-2.47)**	-0.10 (-1.02)	0.001 (0.01)	-0.44 (-5.61)***	-0.29 (-2.05)**	-0.43 (-5.19)***	-0.32 (-2.79)***
R^2	0.92	0.94	0.92	0.96	0.95	0.93	0.94	0.98
Adj. R^2	0.91	0.94	0.91	0.96	0.94	0.92	0.94	0.97
AIC	-0.07	-1.47	-0.02	-0.74	3.20	2.14	3.33	2.81

DW	1.90	2.01	1.83	1.92	1.99	2.07	1.87	2.16
# obs.	146	74	146	92	146	74	146	92
Start:	2004M01	2010M01	2004M01	2008M07	2004M01	2010M01	2004M01	2008M07
End:	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 21 | Estimation of the effect of quantitative easing on the external finance premium, using various proxies for both variables. This table allows for the 'wrong' sign (positive) for the QE coefficients, as long as they are significant.
The 'EFP proxy' row indicates the External Finance Premium proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.1.2.2 Yield curve rate spread & debt-to-GDP ratio

EFP proxy:	10-year – 3-month yield curve rate				Debt-to-GDP ratio			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.89 (1.55)	-0.02 (-0.02)	0.62 (1.68)*	0.44 (0.38)	43.61 (4.18)***	12.33 (2.00)*	61.71 (4.14)***	31.81 (1.13)
$trend$	0.003 (2.83)***	-0.01 (-1.86)*	0.004 (3.23)***	-0.003 (-0.91)	0.10 (2.23)**	-0.06 (-0.76)	0.06 (1.25)	0.01 (0.07)
$\ln QE_t$				1.30 (2.42)**			-2.73 (-1.35)	
$\ln QE_{t-1}$				-0.63 (-0.64)	-3.30 (-3.93)***	-0.26 (-0.54)	-1.24 (-0.64)	-0.34 (-0.17)
$\ln QE_{t-2}$		0.38 (1.92)*		-3.02 (-2.9)***				-0.36 (-0.17)
$\ln QE_{t-3}$	-1.45 (-1.65)		-0.11 (-0.36)	3.47 (4.82)***				-0.42 (-0.19)
$\ln QE_{t-4}$	3.59 (2.08)**						-1.31 (-1.69)*	-0.57 (-0.31)
$\ln QE_{t-5}$	-3.57 (-2.72)***		-0.52 (-1.05)	-2.35 (-3.3)***				
$\ln QE_{t-6}$				1.67 (2.38)**				
$\ln QE_{t-7}$								
$\ln QE_{t-8}$	5.37 (4.03)***		2.35 (3.01)***	1.21 (1.69)*				
$\ln QE_{t-9}$	-4.86 (-3.93)***		-1.93 (-3.23)***	-3.09 (-2.98)***				
$\ln QE_{t-10}$				2.22 (1.95)*				
$\ln QE_{t-11}$		-0.06 (-2.09)**		-0.62 (-0.64)				
$\ln QE_{t-12}$	0.74 (2.45)**			-0.04 (-0.08)				
EFP_{t-1}	1.15 (14.47)***	1.15 (9.95)***	1.13 (13.92)***	1.14 (10.56)***	1.10 (7.23)***	0.85 (3.84)***	1.11 (7.31)***	0.94 (12.34)***
EFP_{t-2}	-0.20 (-2.58)**	-0.35 (-2.98)***	-0.17 (-2.08)**	-0.25 (-2.27)**	-0.10 (-0.62)	0.10 (0.46)	0.04 (0.21)	
R^2	0.97	0.91	0.96	0.92	0.997	0.98	0.997	0.99
Adj. R^2	0.96	0.91	0.96	0.91	0.996	0.98	0.996	0.99
AIC	-0.21	-0.51	-0.18	-0.40	3.11	3.13	3.16	3.29
DW	1.89	2.06	1.88	2.05	1.82	2.10	2.06	2.19
# obs.	146	75	149	92	47	26	47	29

Start:	2004M01	2009M12	2003M10	2008M07	2004Q1	2009Q2	2004Q1	2008Q3
End:	2016M02	2016M02	2016M02	2016M02	2015Q3	2015Q3	2015Q3	2015Q3

Table 22 | Estimation of the effect of quantitative easing on the external finance premium, using various proxies for both variables. Notice that the 'debt-to-GDP ratio' models are quarterly and therefore include a maximum of 4 lags. This table allows for the 'wrong' sign (positive) for the QE coefficients, as long as they are significant.
The 'EFP proxy' row indicates the External Finance Premium proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.1.3 Risk tolerance

Dep. variable:	Equity risk premium			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.64 (0.88)	8.31 (2.74)***	-0.13 (-0.25)	0.55 (0.36)
$trend$	0.003 (1.96)*	0.004 (1.07)	0.003 (1.48)	-0.002 (-0.63)
$\ln QE_t$	-3.13 (-2.74)***	-0.83 (-2.28)**	-0.83 (-2.64)***	2.11 (3.43)***
$\ln QE_{t-1}$	4.13 (2.63)***			-1.93 (-2.88)***
$\ln QE_{t-2}$				
$\ln QE_{t-3}$			2.14 (1.82)*	
$\ln QE_{t-4}$	-0.67 (-0.38)		-1.33 (-0.96)	-2.34 (-2.67)***
$\ln QE_{t-5}$	-0.35 (-0.15)			5.50 (3.53)***
$\ln QE_{t-6}$	-4.79 (-2.08)**		-2.31 (-1.53)	-7.06 (-4.46)***
$\ln QE_{t-7}$	5.73 (3.79)***		3.67 (1.77)*	3.88 (4.27)***
$\ln QE_{t-8}$			-1.66 (-0.78)	
$\ln QE_{t-9}$		0.13 (2.5)**	-0.94 (-0.44)	
$\ln QE_{t-10}$			4.90 (2.32)**	-1.20 (-1.76)*
$\ln QE_{t-11}$	-1.07 (-3.69)***		-5.75 (-2.94)***	1.15 (2.04)**
$\ln QE_{t-12}$			2.00 (2.08)**	

RT_{t-1}	1.08 (13.53)***	0.96 (8.14)***	1.12 (13.11)***	1.10 (10.81)***
RT_{t-2}	-0.15 (-1.87)*	-0.20 (-1.72)*	-0.18 (-2.12)**	-0.18 (-1.78)*
R^2	0.94	0.91	0.94	0.91
Adj. R^2	0.94	0.91	0.94	0.90
AIC	0.35	0.17	0.40	0.40
DW	2.03	2.06	1.89	2.11
# obs.	147	77	146	93
Start:	2003M12	2009M10	2004M01	2008M06
End:	2016M02	2016M02	2016M02	2016M02

Table 23 | Estimation of the effect of quantitative easing on the equity risk premium, using various proxies for quantitative easing. This table allows for the 'wrong' sign (positive) for the QE coefficients, as long as they are significant.
The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.2 Approach 2

B.1.2.1 Interest rate

Dep. variable:	10-year bond rate	Treasury Bill rate	10-year bond rate	Treasury Bill rate	10-year bond rate	Treasury Bill rate	10-year bond rate	Treasury Bill rate
QE proxy:	Treasury securities	Treasury securities	Mortgage-backed securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	2.00 (2.64)***	0.30 (1.34)	1.15 (1.29)	-0.10 (-0.66)	2.12 (3.16)***	0.30 (1.34)	2.43 (2.15)**	4.23 (5.30)***
$trend$	-0.002 (-2.32)**	-0.0004 (-1.32)	-0.0002 (-0.18)	0.0004 (1.17)	-0.002 (-1.59)	-0.0004 (-1.32)	-0.001 (-0.31)	0.01 (5.09)***
$\ln QE_t$				0.00 (-0.26)				-0.57 (-5.89)***
$\ln QE_{t-1}$								
$\ln QE_{t-2}$							-0.05 (-0.31)	
$\ln QE_{t-3}$								
$\ln QE_{t-4}$								
$\ln QE_{t-5}$								
$\ln QE_{t-6}$								
$\ln QE_{t-7}$								
$\ln QE_{t-8}$								
$\ln QE_{t-9}$	-0.01 (-0.23)				-0.04 (-0.81)		-0.06 (-0.44)	
$\ln QE_{t-10}$								
$\ln QE_{t-11}$			-0.05 (-1.81)					
$\ln QE_{t-12}$				-0.01 (-1.52)				-0.03 (-0.86)
IR_{t-1}	1.16 (14.39)***	1.45 (20.34)***	1.18 (10.29)***	1.31 (11.36)***	1.16 (14.37)***	1.45 (20.34)***	1.15 (11.18)***	0.56 (5.71)***
IR_{t-2}	-0.26 (-3.28)***	-0.46 (-6.53)***	-0.29 (-2.54)**	-0.34 (-2.49)**	-0.26 (-3.28)***	-0.46 (-6.53)***	-0.28 (-2.75)***	0.02 (0.25)
IR_{t-3}								

IR_{t-4}								
IR_{t-5}								-0.28 (-4.89)***
IR_{t-6}								0.28 (3.78)***
IR_{t-7}								-0.03 (-0.53)
R^2	0.96	0.99	0.91	0.84	0.96	0.99	0.91	0.97
Adj. R^2	0.96	0.99	0.91	0.83	0.96	0.99	0.90	0.97
AIC	-0.32	-0.97	-0.51	-4.46	-0.33	-0.97	-0.16	-3.05
DW	1.96	2.04	2.00	1.91	1.96	2.04	1.91	1.70
# obs.	149	158	75	74	149	158	95	92
Start	2003M10	2003M01	2009M12	2010M01	2003M10	2003M01	2008M04	2008M07
End	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 24 | Estimation of the effect of quantitative easing on the interest rate, using various proxies for both variables. This table does not allow for the 'wrong' sign (positive) for the QE coefficients. All positive coefficients are deleted from the estimation.
The 'IR proxy' row indicates the Interest Rate proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.2.2 External finance premium

B.1.2.2.1 Corporate bond spreads

EFP proxy:	BBB-AAA corporate bond spread				high-yield (≤CCC-AAA) corporate bond spread			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	1.95 (2.82)***	-0.20 (-0.69)	0.84 (2.09)**	3.60 (3.1)***	6.59 (1.66)*	-1.31 (-0.74)	5.24 (2.13)**	19.03 (2.92)***
$trend$	0.004 (3.5)***	0.0004 (0.99)	0.005 (3.81)***	0.005 (1.16)	0.01 (2.5)**	0.003 (1.12)	0.03 (3.89)***	0.07 (3.38)***
$\ln QE_t$					-1.09 (-2.22)**		-1.59 (-3.71)***	
$\ln QE_{t-1}$	-0.32 (-3.4)***							
$\ln QE_{t-2}$			-0.28 (-3.72)***					
$\ln QE_{t-3}$				-0.13 (-0.46)				-2.34 (-1.45)
$\ln QE_{t-4}$								
$\ln QE_{t-5}$								
$\ln QE_{t-6}$								
$\ln QE_{t-7}$				-0.31 (-1.36)				-2.02 (-1.26)
$\ln QE_{t-8}$								
$\ln QE_{t-9}$								
$\ln QE_{t-10}$								
$\ln QE_{t-11}$								
$\ln QE_{t-12}$								
EFP_{t-1}	0.91 (11.25)***	0.99 (12.27)***	0.90 (11.07)***	0.87 (8.45)***	1.20 (15.47)***	1.24 (16.15)***	1.14 (14.42)***	1.07 (10.23)***
EFP_{t-2}	-0.06 (-0.79)	-0.05 (-0.67)	-0.02 (-0.3)	-0.01 (-0.13)	-0.31 (-4.05)***	-0.31 (-4.07)***	-0.25 (-3.27)***	-0.16 (-1.51)
R^2	0.90	0.89	0.90	0.84	0.91	0.91	0.91	0.90
Adj. R^2	0.89	0.89	0.90	0.83	0.91	0.90	0.91	0.89
AIC	0.03	0.09	0.02	0.46	3.62	3.64	3.57	3.98

DW	1.98	1.99	1.98	2.00	2.05	2.06	2.00	1.95
# obs.	157	158	156	97	158	158	158	97
Start:	2003M02	2003M01	2003M03	2008M02	2003M01	2003M01	2003M01	2008M02
End:	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 25 | Estimation of the effect of quantitative easing on the external finance premium, using various proxies for both variables. This table does not allow for the 'wrong' sign (positive) for the QE coefficients. All positive coefficients are deleted from the estimation.
The 'EFP proxy' row indicates the External Finance Premium proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.2.2.2 Yield curve rate spread & debt-to-GDP ratio

EFP proxy:	10-year – 3-month yield curve rate				Debt-to-GDP ratio			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.90 (1.6)	1.18 (1.34)	0.44 (1.18)	1.57 (2.11)**	43.61 (4.18)***	12.33 (2.00)*	61.71 (4.14)***	31.81 (1.13)
$trend$	0.001 (1.67)*	-0.0004 (-0.3)	0.003 (2.65)***	-0.001 (-0.38)	0.10 (2.23)**	-0.06 (-0.76)	0.06 (1.25)	0.01 (0.07)
$\ln QE_t$							-2.73 (-1.35)	
$\ln QE_{t-1}$					-3.30 (-3.93)***	-0.26 (-0.54)	-1.24 (-0.64)	-0.34 (-0.17)
$\ln QE_{t-2}$								-0.36 (-0.17)
$\ln QE_{t-3}$			-0.09 (-0.88)					-0.42 (-0.19)
$\ln QE_{t-4}$							-1.31 (-1.69)*	-0.57 (-0.31)
$\ln QE_{t-5}$	-0.13 (-1.84)*							
$\ln QE_{t-6}$								
$\ln QE_{t-7}$								
$\ln QE_{t-8}$								
$\ln QE_{t-9}$			-0.08 (-0.79)	-0.04 (-0.33)				
$\ln QE_{t-10}$								
$\ln QE_{t-11}$		-0.05 (-1.64)						
$\ln QE_{t-12}$								
EFP_{t-1}	1.20 (14.98)***	1.18 (10.15)***	1.17 (14.14)***	1.10 (10.8)***	1.10 (7.23)***	0.85 (3.84)***	1.11 (7.31)***	0.94 (12.34)***
EFP_{t-2}	-0.24 (-3.04)***	-0.29 (-2.49)**	-0.20 (-2.44)**	-0.20 (-2.04)**	-0.10 (-0.62)	0.10 (0.46)	0.04 (0.21)	
R^2	0.96	0.91	0.96	0.87	0.997	0.98	0.997	0.99
Adj. R^2	0.96	0.91	0.96	0.87	0.996	0.98	0.996	0.99
AIC	-0.07	-0.49	-0.14	-0.14	3.11	3.13	3.16	3.29
DW	1.92	2.00	1.93	1.89	1.82	2.10	2.06	2.19
# obs.	153	75	149	95	47	26	47	29

Start:	2003M06	2009M12	2003M10	2008M04	2004Q1	2009Q2	2004Q1	2008Q3
End:	2016M02	2016M02	2016M02	2016M02	2015Q3	2015Q3	2015Q3	2015Q3

Table 26 | Estimation of the effect of quantitative easing on the external finance premium, using various proxies for both variables. Notice that the 'debt-to-GDP ratio' models are quarterly and therefore include a maximum of 4 lags. This table does not allow for the 'wrong' sign (positive) for the QE coefficients. All positive coefficients are deleted from the estimation.
The 'EFP proxy' row indicates the External Finance Premium proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.2.3 Risk tolerance

Dep. variable:	Equity risk premium			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.15 (0.21)	-0.34 (-0.89)	-0.17 (-0.37)	2.23 (1.84)*
$trend$	0.002 (1.45)	0.001 (1.37)	0.002 (1.65)	0.003 (1.02)
$\ln QE_t$			-0.08 (-1.04)	
$\ln QE_{t-1}$				-0.10 (-0.4)
$\ln QE_{t-2}$				
$\ln QE_{t-3}$				
$\ln QE_{t-4}$				
$\ln QE_{t-5}$				
$\ln QE_{t-6}$				-0.18 (-0.73)
$\ln QE_{t-7}$				
$\ln QE_{t-8}$				
$\ln QE_{t-9}$				
$\ln QE_{t-10}$				
$\ln QE_{t-11}$	-0.08 (-0.88)			
$\ln QE_{t-12}$				
RT_{t-1}	1.14 (13.95)***	1.15 (14.51)***	1.15 (14.47)***	1.11 (10.76)***
RT_{t-2}	-0.22 (-2.65)***	-0.21 (-2.69)***	-0.23 (-2.87)***	-0.22 (-2.18)**
R^2	0.93	0.94	0.94	0.85
Adj. R^2	0.93	0.94	0.94	0.85
AIC	0.44	0.37	0.36	0.75
DW	2.02	2.01	2.03	1.97
# obs.	148	159	158	99
Start:	2003M12	2003M01	2003M01	2008M01
End:	2016M03	2016M03	2016M02	2016M03

Table 27 | Estimation of the effect of quantitative easing on the equity risk premium, using various proxies for quantitative easing. This table does not allow for the 'wrong' sign (positive) for the QE coefficients. All positive coefficients are deleted from the estimation.
The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.3 Approach 3

B.1.3.1 Interest rate

Dep. variable:	10-year bond rate				13-week Treasury Bill rate			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.98 (1.24)	1.45 (1.52)	2.00 (2.75)***	1.63 (1.58)	0.57 (1.44)	0.12 (0.79)	2.24 (4.57)***	1.53 (2.01)**
$trend$	-0.002 (-2.27)**	-0.001 (-0.31)	-0.002 (-1.68)*	0.0003 (0.13)	-0.001 (-0.95)	0.001 (3.61)***	0.003 (2.45)**	0.003 (1.99)**
$\ln QE_t$	1.57 (1.79)*	-0.04 (-0.15)	-0.50 (-0.72)	-0.10 (-0.2)	-0.42 (-0.59)	-0.10 (-2.49)**	-0.82 (-1.28)	-1.25 (-5.59)***
$\ln QE_{t-1}$	-1.32 (-0.79)	-0.01 (-0.08)	1.10 (0.79)	0.90 (0.87)	-0.74 (-0.59)	0.05 (1.81)*	-1.22 (-0.98)	1.02 (4.65)***
$\ln QE_{t-2}$	-0.82 (-0.49)		-0.05 (-0.03)	-3.67 (-3.07)***	1.20 (1.03)		3.23 (2.47)**	
$\ln QE_{t-3}$	-0.38 (-0.23)		-0.93 (-0.61)	3.72 (3.08)***	1.13 (0.95)		-0.14 (-0.12)	
$\ln QE_{t-4}$	1.05 (0.62)		-0.11 (-0.07)	-0.30 (-0.25)	-3.93 (-3.31)***		-4.05 (-3.5)***	
$\ln QE_{t-5}$	-0.45 (-0.26)		0.57 (0.38)	-1.14 (-0.95)	4.81 (3.9)***		4.90 (4.43)***	
$\ln QE_{t-6}$	0.02 (0.01)		-0.09 (-0.06)	-0.20 (-0.17)	-1.23 (-0.94)		-2.22 (-4.06)***	
$\ln QE_{t-7}$	0.54 (0.32)		-0.71 (-0.47)	2.37 (2.34)**	0.11 (0.09)			
$\ln QE_{t-8}$	3.47 (2.04)**		3.48 (2.31)**	-1.69 (-3.43)***	-2.81 (-2.34)**			
$\ln QE_{t-9}$	-4.96 (-2.95)***		-4.32 (-3.1)***		1.88 (3.05)***			
$\ln QE_{t-10}$	-0.66 (-0.4)		1.54 (2.26)**					
$\ln QE_{t-11}$	2.00 (2.29)**							
IR_{t-1}	0.92 (28.93)***	0.93 (17.41)***	1.17 (13.83)***	0.92 (22.28)***	1.41 (15.02)***	0.96 (14.45)***	1.37 (16.27)***	0.85 (34.69)***
IR_{t-2}			-0.28 (-3.27)***		-0.52 (-3.28)***		-0.41 (-3.00)***	
IR_{t-3}					0.43 (2.65)***		0.27 (1.93)*	
IR_{t-4}					-0.47 (-2.92)***		-0.36 (-2.5)**	
IR_{t-5}					0.23 (1.49)		0.01 (0.06)	
IR_{t-6}					0.09 (0.59)		0.31 (1.95)*	

IR_{t-7}					-0.21 (-2.18)**		-0.15 (-0.90)	
IR_{t-8}							0.04 (0.24)	
IR_{t-9}							0.09 (0.54)	
IR_{t-10}							-0.37 (-2.13)**	
IR_{t-11}							0.66 (3.75)***	
IR_{t-12}							-0.51 (-4.79)***	
R^2	0.97	0.91	0.97	0.93	0.995	0.80	0.996	0.98
Adj. R2	0.96	0.90	0.96	0.92	0.99	0.79	0.99	0.98
AIC	-0.27	-0.37	-0.27	-0.33	-1.12	-4.06	-1.20	-1.35
DW	1.58	1.43	1.98	1.47	2.09	1.22	2.09	1.71
# obs.	146	85	146	96	146	85	146	103
Start	2004M01	2009M02	2004M01	2008M03	2004M01	2009M02	2004M01	2007M08
End	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 28 | Estimation of the effect of quantitative easing on the interest rate, using various proxies for both variables. These models are selected on the Wald statistic of joint significance of the QE coefficients, while restricting the long-run effect of QE on the interest rate to be negative. If a negative long-run effect is not found, this restriction is dropped. The only case for which no negative long-run effect is found is in the '10-year bond rate' coupled with 'Treasury securities held by the Fed' case.

The 'IR proxy' row indicates the Interest Rate proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).

AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.3.2 External finance premium

B.1.3.2.1 Corporate bond spreads

Dep. variable:	BBB-AAA corporate bond spread				high-yield (≤CCC-AAA) corporate bond spread			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	1.76 (2.27)**	6.18 (3.18)***	0.69 (1.55)	1.38 (1.45)	1.68 (0.39)	-14.10 (-3.14)***	4.32 (1.6)	2.06 (0.42)
$trend$	0.004 (2.68)***	-0.001 (-0.49)	0.004 (2.47)**	-0.001 (-0.43)	0.01 (2.01)**	0.002 (0.37)	0.04 (3.58)***	0.03 (1.58)
$\ln QE_t$	1.17 (1.19)	-2.62 (-6.88)***	1.15 (1.47)	0.002 (0.00)	-15.29 (-2.5)**	-6.43 (-1.58)	-9.06 (-2.7)***	16.79 (5.82)***
$\ln QE_{t-1}$	-3.42 (-1.83)*	3.92 (8.7)***	0.27 (0.17)	2.88 (2.3)**	9.35 (0.8)	14.70 (2.41)**	7.13 (2.01)**	-18.13 (-6.26)***
$\ln QE_{t-2}$	0.99 (0.52)	-1.66 (-8.75)***	-4.40 (-2.54)**	-2.31 (-1.57)	8.10 (0.69)	-13.13 (-4.49)***		
$\ln QE_{t-3}$	1.91 (1)		3.74 (2.16)**	-1.88 (-1.29)	9.80 (0.82)	5.71 (6.63)***		
$\ln QE_{t-4}$	0.26 (0.14)		-1.82 (-1.05)	2.08 (1.67)*	-7.95 (-0.67)			
$\ln QE_{t-5}$	1.67 (0.86)		1.97 (1.14)	-0.80 (-1.31)	-2.40 (-0.2)			
$\ln QE_{t-6}$	-6.09 (-3.17)***		-2.74 (-1.58)		-29.68 (-2.55)**			
$\ln QE_{t-7}$	-0.22 (-0.11)		1.24 (0.72)		27.32 (4.47)***			
$\ln QE_{t-8}$	2.79 (1.47)		-0.84 (-0.49)					
$\ln QE_{t-9}$	4.51 (2.42)**		4.00 (2.31)**					
$\ln QE_{t-10}$	-3.88 (-3.97)***		-5.39 (-3.12)***					
$\ln QE_{t-11}$			4.91 (3.1)***					
$\ln QE_{t-12}$			-2.34 (-3.02)***					
EFP_{t-1}	0.87 (21.46)***	0.58 (7.93)***	0.89 (24.67)***	0.85 (15.07)***	0.91 (26.9)***	1.08 (26.19)***	0.91 (23.38)***	0.97 (27.19)***
R^2	0.92	0.92	0.92	0.89	0.92	0.95	0.91	0.91
Adj. R^2	0.91	0.91	0.91	0.88	0.91	0.95	0.91	0.91
AIC	-0.03	-0.52	0.00	0.13	3.61	2.25	3.65	3.82
DW	1.92	1.39	1.69	2.37	1.54	1.60	1.60	1.83
# obs.	146	84	146	99	146	83	146	103
Start	2004M01	2009M03	2004M01	2007M12	2004M01	2009M04	2004M01	2007M08
End	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 29 | Estimation of the effect of quantitative easing on the external finance premium, using various proxies for both variables. These models are selected on the Wald statistic of joint significance of the QE coefficients, while restricting the long-run effect of QE on the external finance premium to be negative.
The 'EFP proxy' row indicates the External Finance Premium proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.3.2.2 Yield curve rate spread & debt-to-GDP ratio

Dep. variable:	10-year – 3-month yield curve rate spread				Debt-to-GDP ratio			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.73 (1.26)	0.49 (0.44)	0.59 (1.51)	1.42 (1.71)*	49.25 (6.54)***	34.84 (1.75)*	51.24 (5.83)***	-45.59 (-2.42)**
$trend$	0.002 (2.04)**	-0.01 (-3.03)***	0.004 (3.57)***	-0.002 (-0.55)	0.09 (1.84)*	-0.09 (-0.79)	0.04 (0.84)	-0.19 (-2.99)***
$\ln QE_t$	1.15 (1.18)	-3.12 (-1.54)	-0.50 (-0.68)	1.07 (2.03)**	-1.48 (-0.65)	-0.13 (-0.07)	-1.14 (-0.64)	6.50 (3.87)***
$\ln QE_{t-1}$	-0.44 (-0.24)	8.91 (2.03)**	1.45 (0.97)	-0.07 (-0.07)	-2.33 (-1.08)	-1.07 (-1.19)	-3.28 (-2.17)**	-2.44 (-1.30)
$\ln QE_{t-2}$	-1.80 (-0.97)	-7.17 (-2)**	-0.42 (-0.26)	-3.49 (-2.85)***				
$\ln QE_{t-3}$	-0.43 (-0.24)	2.61 (2.04)**	-1.75 (-1.06)	3.28 (2.65)***				
$\ln QE_{t-4}$	4.36 (2.4)**	-0.63 (-2.19)**	1.97 (1.19)	-0.13 (-0.1)				
$\ln QE_{t-5}$	-5.69 (-3.07)***		-2.22 (-1.35)	-1.33 (-1.08)				
$\ln QE_{t-6}$	1.92 (1.03)		1.14 (0.69)	0.14 (0.11)				
$\ln QE_{t-7}$	0.72 (0.38)		-0.48 (-0.29)	1.99 (1.92)*				
$\ln QE_{t-8}$	4.39 (2.39)**		2.68 (1.79)*	-1.47 (-2.9)***				
$\ln QE_{t-9}$	-6.92 (-3.83)***		-2.11 (-2.92)***					
$\ln QE_{t-10}$	2.61 (2.76)***							
$\ln QE_{t-11}$								
$\ln QE_{t-12}$								
EFP_{t-1}	1.25 (14.32)***	1.07 (8.71)***	0.96 (51.76)***	0.90 (18.64)***	1.03 (25.86)***	0.62 (2.83)**	1.14 (22.84)***	0.93 (16.36)***
EFP_{t-2}	-0.40 (-3.02)***	-0.21 (-1.2)				-0.45 (-1.94)*		
EFP_{t-3}	0.23 (1.67)*	0.07 (0.42)				0.52 (2.16)**		
EFP_{t-4}	-0.19 (-1.34)	-0.29 (-1.66)				0.18 (0.97)		
EFP_{t-5}	0.17 (1.24)	0.21 (1.13)						
EFP_{t-6}	-0.11 (-1.27)	-0.11 (-0.64)						

EFP_{t-7}		-0.07 (-0.44)						
EFP_{t-8}		-0.03 (-0.16)						
EFP_{t-9}		0.01 (0.07)						
EFP_{t-10}		0.21 (1.41)						
EFP_{t-11}		-0.18 (-1.75)*						
EFP_{t-12}								
R^2	0.97	0.94	0.96	0.90	0.997	0.99	0.996	0.99
Adj. R^2	0.96	0.92	0.96	0.89	0.996	0.99	0.996	0.99
AIC	-0.16	-0.47	-0.11	-0.28	3.11	2.68	3.14	3.20
DW	2.02	1.90	1.58	1.57	1.80	2.15	1.91	2.12
# obs.	146	82	146	96	47	26	47	32
Start	2004M01	2009M05	2004M01	2008M03	2004Q1	2009Q2	2004Q1	2007Q4
End	2016M02	2016M02	2016M02	2016M02	2015Q3	2015Q3	2015Q3	2015Q3

Table 30 | Estimation of the effect of quantitative easing on the external finance premium, using various proxies for both variables. Notice that the 'debt-to-GDP ratio' models are quarterly and therefore include a maximum of 4 lags. These models are selected on the Wald statistic of joint significance of the QE coefficients, while restricting the long-run effect of QE on the external finance premium to be negative. If a negative long-run effect is not found, this restriction is dropped. The only case for which no negative long-run effect is found is in the '10-year – 3-month yield curve rate spread' coupled with 'mortgage-backed securities held by the Fed' case.
The 'EFP proxy' row indicates the External Finance Premium proxies used in that respective column. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.3.3 Risk tolerance

Dep. variable:	Equity risk premium			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.
$const.$	0.83 (1.11)	0.36 (0.21)	-0.13 (-0.27)	-0.12 (-0.1)
$trend$	0.003 (1.91)*	-0.002 (-0.72)	0.002 (1.34)	-0.001 (-0.42)
$\ln QE_t$	-3.14 (-2.54)**	1.89 (3.6)***	-1.77 (-3.04)***	2.63 (3.48)***
$\ln QE_{t-1}$	3.25 (1.39)	-3.20 (-4.93)***	1.68 (2.89)***	-2.82 (-1.85)*
$\ln QE_{t-2}$	1.36 (0.57)	1.41 (5.06)***		1.05 (0.6)
$\ln QE_{t-3}$	-0.22 (-0.09)			-0.62 (-0.35)
$\ln QE_{t-4}$	-0.75 (-0.31)			-2.35 (-1.34)
$\ln QE_{t-5}$	-0.59 (-0.24)			4.84 (2.77)***
$\ln QE_{t-6}$	-4.34 (-1.8)*			-5.87 (-3.89)***
$\ln QE_{t-7}$	4.36 (1.82)*			3.23 (4.38)***
$\ln QE_{t-8}$	1.18 (0.49)			
$\ln QE_{t-9}$	-1.43 (-0.6)			
$\ln QE_{t-10}$	2.88 (1.23)			
$\ln QE_{t-11}$	-2.75 (-2.23)**			
RT_{t-1}	0.93 (32.7)***	0.96 (21.63)***	0.94 (32.06)***	0.94 (25.76)***
R^2	0.94	0.91	0.94	0.90
Adj. R^2	0.94	0.90	0.93	0.89
AIC	0.42	0.26	0.43	0.46
DW	1.68	1.76	1.70	1.70
# obs.	146	84	146	97
Start	2004M01	2009M03	2004M01	2008M02
End	2016M02	2016M02	2016M02	2016M02

Table 31 | Estimation of the effect of quantitative easing on the equity risk premium, using various proxies for quantitative easing. These models are selected on their Wald statistic of joint significance of the QE coefficient.
The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.1.4 Derivation of the long-run effect

For an estimated autoregressive distributed lag equation, the long-run multiplier (or effect) can be calculated from its coefficients. Take the following sample equation.

$$y_t = c + \alpha_0 y_{t-1} + \alpha_1 y_{t-2} + \beta_0 x_{t-1} + \beta_1 x_{t-2} + \varepsilon_t$$

Using lag operator L to denote a 1-period lag, assuming $\varepsilon_t = 0$ and then subtracting all y_t terms from both sides of the equation, this becomes:

$$y_t \cdot L^0 = c + \alpha_0 y_t \cdot L^1 + \alpha_1 y_t \cdot L^2 + \beta_0 x_t \cdot L^1 + \beta_1 x_t \cdot L^2$$

$$y_t \cdot L^0 - \alpha_0 y_t \cdot L^1 - \alpha_1 y_t \cdot L^2 = c + \beta_0 x_t \cdot L^1 + \beta_1 x_t \cdot L^2$$

Then, using factorization to separate the coefficients from the variables:

$$y_t(L^0 - \alpha_0 L^1 - \alpha_1 L^2) = c + x_t(\beta_0 L^1 + \beta_1 L^2)$$

The coefficients in brackets can be written as functions of L:

$$C(L) = 1 - \alpha_0 L^1 - \alpha_1 L^2$$

$$B(L) = \beta_0 L^1 + \beta_1 L^2$$

Finally, in order to obtain the long-run effect of x on y, or long-run multiplier $A(1)$, compute:

$$A(1) = \frac{B(1)}{C(1)} = \frac{\beta_0 + \beta_1}{1 - \alpha_0 - \alpha_1}$$

In essence, this boils down to dividing the sum of x coefficients by 1 minus the sum of y coefficients, or:

$$A(1) = \frac{\sum_{m=0}^{1} \beta_m}{1 - \sum_{n=0}^{1} \alpha_n}$$

This is explained in, for example, Yoder (2007).

B.2 Error correction models

B.2.1 Interest rate

Dep. variable:	$\Delta 10y\ bond\ rate_t$				$\Delta Treasury\ Bill\ rate_t$			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$		-0.04 (-1.85)*	-0.02 (-0.93)	-0.02 (-0.64)	-0.002 (-0.19)	0.001 (0.31)	-0.002 (-0.20)	-0.02 (-1.48)
ECT_{t-1}		-0.08 (-2.54)**	-0.05 (-1.58)	-0.001 (-0.20)	0.001 (1.50)	0.03 (1.41)	0.01 (2.09)**	-0.13 (-5.15)***
ΔIR_{t-1}		0.34 (3.09)***	0.26 (3.06)***	0.30 (2.57)**	0.42 (5.20)***	0.20 (2.27)**	0.41 (5.40)***	0.17 (1.77)*
ΔIR_{t-2}			-0.17 (-1.90)*	-0.04 (-0.34)	0.04 (0.49)			
ΔIR_{t-3}			0.08 (0.90)	0.07 (0.61)				
ΔIR_{t-4}			-0.04 (-0.47)	-0.12 (-1.06)				
ΔIR_{t-5}			-0.08 (-0.93)	0.02 (0.23)				
ΔIR_{t-6}				-0.05 (-0.50)				
ΔIR_{t-7}				-0.14 (-1.35)				
ΔIR_{t-8}				0.04 (0.37)				
ΔIR_{t-9}				-0.10 (-1.03)				
ΔIR_{t-10}				0.18 (1.84)*				
$\Delta \ln QE_{t-1}$		0.42 (2.61)**	0.19 (0.26)	0.92 (1.90)*	-0.91 (-1.39)	-0.01 (-0.77)	-0.05 (-0.17)	-0.67 (-2.61)**
$\Delta \ln QE_{t-2}$			0.44 (0.48)	-3.12 (-4.91)***	0.89 (1.40)			
$\Delta \ln QE_{t-3}$			0.13 (0.14)	1.85 (2.49)**				
$\Delta \ln QE_{t-4}$			-0.48 (-0.52)	0.62 (0.82)				
$\Delta \ln QE_{t-5}$			0.31 (0.44)	-0.94 (-1.24)				
$\Delta \ln QE_{t-6}$				-0.54 (-0.73)				
$\Delta \ln QE_{t-7}$				1.28 (1.72)*				

$\Delta \ln QE_{t-8}$				0.89 (1.18)				
$\Delta \ln QE_{t-9}$				-1.93 (-2.66)***				
$\Delta \ln QE_{t-10}$				0.79 (1.37)				
R^2	-	0.14	0.13	0.48	0.24	0.20	0.24	0.42
Adj. R^2	-	0.11	0.06	0.33	0.22	0.17	0.22	0.40
AIC	-	-0.49	-0.17	-0.32	-0.94	-4.40	-0.97	-1.21
DW	-	2.11	1.93	1.99	2.05	1.54	1.99	1.77
# obs.	-	84	152	93	155	84	156	102
Start:	-	2009M03	2003M07	2008M06	2003M04	2009M03	2003M03	2007M09
End:	-	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 32 | Estimation error correction models of the effect of quantitative easing on the interest rate, using various proxies for both variables. The number of lags is the number reported in Table 2, regardless of their significance. The ECT term is the respective error correction term, derived from Table 4.
The 'Dep. variable' row indicates the Interest Rate proxies used in that respective column, as dependent variable.
The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column, as independent variable. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.2.2 External finance premium

B.2.2.1 Corporate bond spreads

Dep. variable:	$\Delta(BBB - AAA)\ spread_t$				$\Delta(CCC - AAA)\ spread_t$			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$		-0.08 (-2.42)**	-0.001 (-0.06)	-0.02 (-0.55)	0.05 (0.38)	0.13 (1.28)	0.11 (0.92)	-0.34 (-2.3)**
ECT_{t-1}		0.22 (3.23)***	-0.09 (-4.1)***	-0.002 (-0.22)	-0.15 (-4.38)***	-0.04 (-2.15)**	-0.09 (-2.96)***	-0.15 (-6.37)***
ΔEFP_{t-1}		-0.41 (-3.62)***	0.003 (0.04)	-0.33 (-3.13)***	0.30 (3.81)***	0.57 (7.35)***	0.24 (3.09)***	0.18 (2.12)**
ΔEFP_{t-2}				-0.03 (-0.25)	0.12 (1.54)			-0.09 (-1.12)
ΔEFP_{t-3}				0.16 (1.44)	0.01 (0.15)			0.09 (1.07)
ΔEFP_{t-4}				0.27 (2.5)**	0.27 (3.24)***			0.28 (3.51)***
ΔEFP_{t-5}				0.28 (2.82)***				
$\Delta \ln QE_{t-1}$		0.62 (3.18)***	0.23 (0.47)	3.08 (5.26)***	-3.41 (-0.56)	-2.37 (-4.71)***	-8.13 (-2.57)**	8.11 (2.44)**
$\Delta \ln QE_{t-2}$				1.08 (1.28)	3.57 (0.5)			23.83 (5.65)***
$\Delta \ln QE_{t-3}$				-1.31 (-1.51)	8.34 (1.18)			-25.11 (-5.96)***
$\Delta \ln QE_{t-4}$				-0.14 (-0.16)	-8.89 (-1.5)			18.58 (4.97)***
$\Delta \ln QE_{t-5}$				-1.55 (-2.04)**				
R^2	-	0.18	0.10	0.48	0.24	0.50	0.22	0.63
Adj. R^2	-	0.15	0.09	0.41	0.19	0.48	0.20	0.59
AIC	-	0.08	0.02	0.09	3.59	2.55	3.55	3.34
DW	-	1.73	1.99	1.81	1.96	2.33	2.03	1.58
# obs.	-	84	156	98	153	84	156	99
Start:	-	2009M03	2003M03	2008M01	2003M06	2009M03	2003M03	2007M12
End:	-	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02	2016M02

Table 33 | Estimation error correction models of the effect of quantitative easing on the external finance premium, using various proxies for both variables. The number of lags is the number reported in Table 2, regardless of their significance. The ECT term is the respective error correction term, derived from Table 4. The 'Dep. variable' row indicates the External Finance Premium proxy used in that respective column, as dependent variable. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column, as independent variable. The quantitative easing proxy is always logarithmically transformed (naturally).

AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.2.2.2 Yield curve rate spread & debt-to-GDP ratio

Dep. variable:	$\Delta(10year - 3month)\ yield\ curve\ rate_t$				$\Delta\, debt/_{GDP}\, ratio_t$			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	-0.01 (-0.35)	-0.04 (-1.77)*	-0.02 (-1.02)	0.01 (0.34)	0.88 (4.17)***	1.06 (2.82)**	0.85 (3.86)***	1.87 (4.37)***
ECT_{t-1}	-0.03 (-1.86)*	-0.07 (-2.2)**	0.01 (1.4)	-0.02 (-0.45)	0.07 (3.97)***	-0.08 (-2.74)**	0.15 (3.8)***	-0.07 (-4.2)***
ΔEFP_{t-1}	0.27 (2.99)***	0.32 (2.94)***	0.22 (2.49)**	0.26 (2.43)**	0.09 (0.57)	0.09 (0.45)	0.04 (0.24)	0.06 (0.28)
ΔEFP_{t-2}	-0.06 (-0.64)		-0.13 (-1.45)			-0.43 (-1.98)*		-0.65 (-3.08)***
ΔEFP_{t-3}	0.14 (1.52)		0.13 (1.47)					
ΔEFP_{t-4}	-0.07 (-0.73)		0.005 (0.06)					
ΔEFP_{t-5}	0.10 (1.04)		0.01 (0.06)					
ΔEFP_{t-6}	0.09 (0.99)		-0.002 (-0.03)					
ΔEFP_{t-7}	0.01 (0.1)		0.01 (0.11)					
ΔEFP_{t-8}	0.11 (1.25)		0.00 (0.04)					
ΔEFP_{t-9}	0.07 (0.79)							
ΔEFP_{t-10}	0.05 (0.6)							
ΔEFP_{t-11}	0.05 (0.57)							
$\Delta \ln QE_{t-1}$	2.24 (2.11)**	0.40 (2.52)**	0.77 (0.97)	-0.13 (-0.3)	-4.01 (-2.22)**	-0.06 (-0.02)	-0.91 (-0.62)	0.29 (0.15)
$\Delta \ln QE_{t-2}$	-0.78 (-0.64)		0.54 (0.53)			0.41 (0.40)		2.42 (1.23)
$\Delta \ln QE_{t-3}$	-1.89 (-1.52)		-1.13 (-1.14)					
$\Delta \ln QE_{t-4}$	2.89 (2.3)**		1.05 (1.07)					
$\Delta \ln QE_{t-5}$	-2.55 (-1.99)**		-1.83 (-1.9)*					
$\Delta \ln QE_{t-6}$	-1.28 (-0.98)		0.40 (0.41)					

$\Delta \ln QE_{t-7}$	-0.05 (-0.04)		-0.82 (-0.84)					
$\Delta \ln QE_{t-8}$	4.42 (3.59)***		1.79 (2.36)**					
$\Delta \ln QE_{t-9}$	-2.13 (-1.67)*							
$\Delta \ln QE_{t-10}$	-1.59 (-1.26)							
$\Delta \ln QE_{t-11}$	0.64 (0.60)							
R^2	0.28	0.14	0.19	0.06	0.50	0.40	0.46	0.58
Adj. R^2	0.14	0.11	0.08	0.03	0.46	0.23	0.42	0.49
AIC	-0.06	-0.49	-0.05	0.00	3.04	3.30	3.11	3.42
DW	1.97	2.12	1.91	1.94	1.87	1.75	1.92	1.93
# obs.	146	84	149	102	49	24	49	30
Start:	2004M01	2009M03	2003M10	2007M09	2003Q3	2009Q4	2003Q3	2008Q2
End:	2016M02	2016M02	2016M02	2016M02	2015Q3	2015Q3	2015Q3	2015Q3

Table 34| Estimation error correction models of the effect of quantitative easing on the external finance premium, using various proxies for both variables. The number of lags is the number reported in Table 2, regardless of their significance. The ECT term is the respective error correction term, derived from Table 4. The 'Dep. variable' row indicates the External Finance Premium proxy used in that respective column, as dependent variable. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column, as independent variable. The quantitative easing proxy is always logarithmically transformed (naturally).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

B.2.3 Risk tolerance

Dep. variable:	$\Delta Equity\ risk\ premium_t$			
QE proxy:	Treasury securities	Mortgage-backed securities	Treasury & mortgage-backed securities	Fed balance sheet
	Coeff.	Coeff.	Coeff.	Coeff.
$constant$		0.06 (1.69)*	0.02 (0.84)	-0.01 (-0.15)
ECT_{t-1}		-0.08 (-3.01)***	-0.04 (-1.67)*	-0.02 (-2.07)**
ΔRT_{t-1}		0.14 (1.26)	0.15 (1.85)*	0.10 (0.87)
ΔRT_{t-2}			0.02 (0.2)	0.04 (0.38)
ΔRT_{t-3}			0.01 (0.07)	0.10 (0.9)
ΔRT_{t-4}				0.00 (-0.01)
ΔRT_{t-5}				-0.12 (-1.03)
$\Delta \ln QE_{t-1}$		-0.94 (-3.71)***	-2.49 (-2.52)**	0.90 (0.97)
$\Delta \ln QE_{t-2}$			1.13 (0.92)	0.44 (0.36)
$\Delta \ln QE_{t-3}$			0.18 (0.19)	-0.48 (-0.37)
$\Delta \ln QE_{t-4}$				-0.86 (-0.71)
$\Delta \ln QE_{t-5}$				0.82 (0.86)
R^2		0.16	0.11	0.15
Adj. R^2		0.12	0.07	0.04
AIC		0.39	0.39	0.85
DW		1.82	1.98	1.91
# obs.		85	155	99
Start:		2009M03	2003M05	2008M01
End:		2016M03	2016M03	2016M03

*Table 35 | Estimation error correction models of the effect of quantitative easing on the equity risk premium, using various proxies for quantitative easing. The number of lags is the number reported in Table 2, regardless of their significance. The ECT term is the respective error correction term, derived from Table 4. The 'Dep. variable' row indicates the Equity Risk Premium proxy used in that respective column, as dependent variable. The 'QE proxy' row indicates the Quantitative Easing proxy used in that respective column, as independent variable. The quantitative easing proxy is always logarithmically transformed (naturally). AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C Separate estimation: step 2 – channel exit

C.1 Autoregressive distributed lag models

C.1.1 QE proxy: Treasury securities held by the Fed

Dep. variable:	$\ln real\ GDP_t$							
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	9.455 (312.8)***	9.608 (143.37)***	9.665 (248.6)***	9.629 (240.64)***	9.569 (638.16)***	9.636 (531.23)***	9.691 (258.33)***	9.695 (139.34)***
$trend$	0.004 (20.43)***	0.005 (8.47)***	0.003 (14.02)***	0.005 (17.07)***	0.004 (15.81)***	0.003 (15.06)***	0.003 (12.9)***	0.006 (5.47)***
$\widehat{IR}_t$	-0.002 (-0.35)	0.005 (0.37)	-0.014 (-2.06)*	-0.007 (-1.68)	-0.007 (-1.54)	-0.007 (-1.42)	-0.005 (-0.66)	-0.005 (-1.30)
$\widehat{IR}_{t-1}$	0.005 (0.96)	0.009 (0.57)	0.006 (0.56)	0.003 (0.67)	0.004 (0.58)	0.002 (0.33)	-0.006 (-0.53)	-0.001 (-0.15)
$\widehat{IR}_{t-2}$	-0.009 (-1.58)	-0.010 (-0.71)	-0.017 (-1.32)	-0.007 (-1.23)	-0.001 (-0.14)	0.003 (0.43)	-0.003 (-0.23)	0.006 (0.77)
$\widehat{IR}_{t-3}$	0.009 (1.57)	0.001 (0.06)	-0.006 (-0.45)	0.007 (1.2)	0.005 (0.63)	0.004 (0.42)	-0.015 (-1.05)	0.004 (0.45)
$\widehat{IR}_{t-4}$	0.004 (0.61)	-0.008 (-0.49)	0.035 (2.37)**	0.002 (0.38)	-0.002 (-0.21)	-0.022 (-2)*	0.024 (1.62)	-0.004 (-0.42)
$\widehat{IR}_{t-5}$	0.003 (0.46)	0.001 (0.06)	-0.009 (-0.72)	0.0001 (0.01)	0.010 (1.26)	0.022 (2.45)**	0.004 (0.32)	0.017 (2.23)**
$\widehat{IR}_{t-6}$	0.005 (0.83)	0.012 (0.81)	-0.004 (-0.3)	-0.001 (-0.17)	-0.013 (-1.61)	-0.005 (-0.5)	-0.021 (-1.26)	-0.018 (-2.4)**
$\widehat{IR}_{t-7}$	0.003 (0.58)	-0.001 (-0.05)	0.014 (0.94)	-0.003 (-0.69)	0.007 (0.73)	0.002 (0.21)	0.019 (1.39)	-0.004 (-0.53)
$\widehat{IR}_{t-8}$	0.001 (0.12)	-0.011 (-1.02)	-0.020 (-2.29)**	0.005 (1.43)	-0.004 (-0.51)	-0.003 (-0.41)	-0.018 (-2.42)**	-0.0002 (-0.03)
$\widehat{EFP}_t$	-0.020 (-3.19)***	-0.002 (-3.02)***	-0.002 (-0.5)	-0.004 (-3.99)***	-0.020 (-2.1)*	-0.002 (-1.71)	-0.008 (-1.06)	-0.002 (-2.00)*
$\widehat{EFP}_{t-1}$	-0.003 (-0.48)		-0.003 (-0.45)	0.0004 (0.24)	-0.0001 (-0.01)	-0.003 (-1.73)	-0.005 (-0.7)	0.000004 (0.00)
$\widehat{EFP}_{t-2}$	-0.0001 (-0.02)		0.009 (1.04)	-0.001 (-0.41)	-0.002 (-0.28)	0.00005 (0.03)	-0.007 (-1)	-0.001 (-0.75)
$\widehat{EFP}_{t-3}$	-0.006 (-0.68)		0.002 (0.26)	0.001 (0.52)	0.002 (0.25)	0.001 (0.59)	-0.009 (-1.14)	-0.001 (-0.76)
$\widehat{EFP}_{t-4}$	-0.003 (-0.33)		-0.021 (-2.22)**	0.002 (2.15)**	0.002 (0.23)	-0.004 (-2.04)*	0.012 (1.61)	0.001 (0.56)
$\widehat{EFP}_{t-5}$	0.0003 (0.04)		0.001 (0.12)		0.001 (0.06)	0.004 (2.02)*	-0.003 (-0.48)	0.0001 (0.08)

$\widehat{EFP}_{t-6}$	0.003 (0.31)		0.002 (0.23)		-0.003 (-0.37)	-0.002 (-1.18)	-0.002 (-0.46)	0.001 (0.45)
$\widehat{EFP}_{t-7}$	0.001 (0.12)		-0.009 (-0.94)		0.002 (0.23)	0.001 (0.92)	0.00001 (0.00)	0.001 (0.48)
$\widehat{EFP}_{t-8}$	-0.009 (-1.90)*		0.015 (1.84)*		-0.012 (-1.63)	-0.003 (-3.65)***	-0.007 (-1.33)	-0.001 (-0.71)
$\widehat{RT}_t$	0.002 (0.58)	-0.003 (-0.46)	-0.010 (-1.8)*	-0.005 (-2.3)**	0.003 (0.69)	-0.011 (-2.66)**	-0.001 (-0.14)	-0.003 (-0.93)
$\widehat{RT}_{t-1}$	0.004 (0.77)	0.010 (1.05)	-0.001 (-0.08)		0.004 (0.5)	0.014 (2.32)**	-0.007 (-0.92)	0.0002 (0.04)
$\widehat{RT}_{t-2}$	-0.004 (-0.64)	-0.008 (-0.74)	-0.002 (-0.22)		-0.001 (-0.2)	-0.007 (-1.09)	0.0002 (0.03)	-0.001 (-0.16)
$\widehat{RT}_{t-3}$	0.002 (0.31)	-0.003 (-0.26)	-0.013 (-1.70)		0.002 (0.31)	0.003 (0.54)	-0.013 (-1.56)	0.005 (0.73)
$\widehat{RT}_{t-4}$	0.001 (0.13)	-0.009 (-0.79)	0.011 (1.25)		-0.013 (-1.99)*	-0.005 (-0.93)	0.002 (0.15)	-0.009 (-1.59)
$\widehat{RT}_{t-5}$	0.002 (0.23)	-0.004 (-0.33)	-0.001 (-0.12)		0.008 (1.29)	-0.001 (-0.25)	0.009 (0.95)	0.013 (2.38)**
$\widehat{RT}_{t-6}$	-0.003 (-0.39)	0.0002 (0.02)	-0.010 (-1.12)		-0.010 (-1.83)*	-0.010 (-1.94)*	-0.016 (-1.67)	-0.007 (-1.42)
$\widehat{RT}_{t-7}$	0.003 (0.48)	0.007 (0.73)	0.012 (1.63)		0.006 (1.05)	0.001 (0.20)	0.013 (1.74)	0.004 (1.01)
$\widehat{RT}_{t-8}$	0.002 (0.43)	-0.017 (-2.13)**	-0.008 (-2.26)**		-0.001 (-0.18)	0.004 (1.33)	-0.009 (-2.03)*	-0.004 (-1.5)
R^2	0.997	0.951	0.997	0.989	0.996	0.998	0.996	0.996
Adj. R^2	0.991	0.906	0.991	0.983	0.989	0.993	0.989	0.989
AIC	-8.05	-5.65	-8.11	-7.36	-7.91	-8.36	-7.87	-7.87
DW	1.88	0.52	1.41	1.12	1.29	2.11	1.31	1.48
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	43	43	43	43	43	43	43	43

Table 36 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate autoregressive distributed lag models in levels. The fitted values are generated using the quantitative easing proxy indicated in the 'QE proxy' row. The number of lags is chosen based on the number that gives the best overall Wald F-statistic of joint significance of the interest rate, external finance premium and risk tolerance coefficients.
The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.1.2 QE proxy: mortgage-backed securities held by the Fed

Dep. variable:	$\ln real\ GDP_t$							
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	9.461 (223.4)***	9.493 (72.79)***	9.520 (268.28)***	9.718 (97.19)***	9.444 (234.1)***	9.484 (234.59)***	9.900 (92.07)***	9.621 (59.13)***
$trend$	0.005 (10.94)***	0.005 (3.15)**	0.005 (17.44)***	0.004 (2.79)**	0.005 (7.63)***	0.005 (6.09)***	-0.00005 (-0.04)	0.006 (5.77)***
$\widehat{IR}_t$	-0.006 (-1.27)	-0.0003 (-0.03)	-0.002 (-0.1)	-0.007 (-1.23)	-0.091 (-0.76)	-0.131 (-1.21)	-0.342 (-4.18)***	-0.074 (-0.6)
$\widehat{IR}_{t-1}$	0.005 (1.69)	-0.005 (-0.37)	0.005 (0.25)	0.002 (0.34)	-0.002 (-0.03)	-0.004 (-0.05)	-0.039 (-1.36)	0.012 (0.18)
$\widehat{IR}_{t-2}$		-0.011 (-1.19)	-0.010 (-0.84)	-0.011 (-2.09)*	0.024 (0.35)	-0.005 (-0.07)	-0.114 (-2.52)*	-0.039 (-0.52)
$\widehat{IR}_{t-3}$		0.014 (1.39)		0.009 (2.34)*	-0.087 (-1.52)	-0.103 (-1.54)	-0.160 (-4.74)***	-0.050 (-0.69)
$\widehat{IR}_{t-4}$				-0.010 (-1.84)	-0.014 (-0.3)	-0.016 (-0.34)	-0.215 (-3.22)**	0.003 (0.06)
$\widehat{EFP}_t$	-0.0001 (-0.04)	-0.0004 (-0.27)	-0.009 (-0.68)	-0.005 (-3.76)**	0.001 (0.1)	0.0005 (0.33)	0.007 (1.15)	-0.001 (-0.42)
$\widehat{EFP}_{t-1}$	-0.001 (-0.41)	0.002 (0.87)	0.001 (0.06)	-0.001 (-1.5)	0.010 (0.72)	-0.001 (-0.28)	0.004 (0.62)	-0.001 (-0.7)
$\widehat{EFP}_{t-2}$		0.0002 (0.13)	0.006 (0.57)	0.0004 (0.49)	-0.006 (-0.37)	0.001 (0.33)	-0.031 (-4.87)***	0.001 (0.61)
$\widehat{EFP}_{t-3}$		-0.001 (-0.46)		0.001 (1.35)	0.002 (0.29)	0.0002 (0.09)	-0.014 (-2.07)*	-0.0003 (-0.26)
$\widehat{EFP}_{t-4}$		-0.0004 (-0.6)		0.003 (2.15)*	0.008 (1.46)	0.001 (0.93)	0.001 (0.2)	-0.001 (-0.27)
$\widehat{RT}_t$	-0.001 (-0.44)	0.004 (0.43)	-0.003 (-0.78)	0.005 (1.01)	0.002 (0.3)	-0.002 (-0.25)	-0.00003 (-0.01)	-0.001 (-0.2)
$\widehat{RT}_{t-1}$		-0.009 (-0.72)	0.001 (0.21)	-0.005 (-0.79)	-0.004 (-0.56)	0.002 (0.25)	0.003 (0.72)	0.004 (0.63)
$\widehat{RT}_{t-2}$		-0.010 (-0.93)	0.001 (0.25)	0.0005 (0.07)	0.005 (0.73)	0.003 (0.32)	-0.017 (-3.2)**	0.0001 (0.02)
$\widehat{RT}_{t-3}$		0.010 (0.76)	-0.007 (-2.96)**	-0.0004 (-0.1)	-0.005 (-1.12)	-0.004 (-0.51)	-0.012 (-2.03)*	-0.001 (-0.14)
$\widehat{RT}_{t-4}$				-0.008 (-1.68)	-0.003 (-0.85)	-0.002 (-0.47)	0.005 (1.66)	0.0002 (0.05)
R^2	0.991	0.996	0.995	0.999	0.998	0.997	0.999	0.998
Adj. R^2	0.988	0.989	0.991	0.997	0.992	0.989	0.998	0.991
AIC	-7.85	-8.32	-8.23	-9.84	-8.65	-8.49	-10.10	-8.63

DW	1.16	1.78	1.92	2.93	2.31	2.66	1.67	2.88
Start	2009Q2	2010Q2	2009Q4	2010Q2	2010Q1	2010Q2	2010Q2	2010Q2
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	26	22	24	22	23	22	22	22

Table 37 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate autoregressive distributed lag models in levels. The fitted values are generated using the quantitative easing proxy indicated in the 'QE proxy' row. The number of lags is chosen based on the number that gives the best overall Wald F-statistic of joint significance of the interest rate, external finance premium and risk tolerance coefficients.
The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.1.3 QE proxy: Treasury & mortgage-backed securities held by the Fed

Dep. variable:	$\ln real\ GDP_t$							
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	9.447 (375.04)***	9.589 (134.43)***	9.744 (213)***	9.624 (231.11)***	9.570 (685.74)***	9.635 (548.74)***	9.760 (313.95)***	9.627 (156.81)***
$trend$	0.004 (25.98)***	0.005 (8.24)***	0.003 (12.22)***	0.005 (17.08)***	0.004 (14.6)***	0.003 (12.74)***	0.003 (13.62)***	0.005 (5.32)***
$\widehat{IR}_t$	0.003 (0.56)	0.012 (0.83)	-0.007 (-0.9)	-0.003 (-0.66)	-0.007 (-1.75)	-0.011 (-2.73)**	-0.006 (-0.95)	-0.006 (-1.5)
$\widehat{IR}_{t-1}$	0.007 (1.34)	0.007 (0.38)	0.001 (0.1)	-0.001 (-0.17)	0.005 (0.77)	0.008 (1.51)	-0.001 (-0.08)	0.005 (0.8)
$\widehat{IR}_{t-2}$	-0.008 (-1.44)	-0.010 (-0.54)	-0.014 (-1.44)	-0.006 (-1.26)	0.001 (0.16)	0.001 (0.22)	-0.005 (-0.49)	0.002 (0.28)
$\widehat{IR}_{t-3}$	0.001 (0.2)	-0.003 (-0.15)	-0.004 (-0.34)	0.003 (0.68)	0.001 (0.14)	-0.003 (-0.45)	-0.014 (-1.39)	0.004 (0.62)
$\widehat{IR}_{t-4}$	0.007 (1.1)	0.002 (0.12)	0.018 (1.48)	0.005 (1.11)	-0.001 (-0.19)	-0.011 (-1.55)	0.021 (2)*	-0.003 (-0.43)
$\widehat{IR}_{t-5}$	-0.001 (-0.1)	-0.008 (-0.4)	0.006 (0.42)	-0.001 (-0.22)	0.011 (1.55)	0.017 (2.29)**	0.010 (0.93)	0.014 (2.26)**
$\widehat{IR}_{t-6}$	0.011 (2.02)*	0.014 (0.77)	-0.025 (-1.62)	0.002 (0.38)	-0.005 (-0.63)	0.002 (0.29)	-0.028 (-2.32)**	-0.017 (-2.84)**
$\widehat{IR}_{t-7}$	0.001 (0.29)	0.004 (0.27)	0.009 (0.86)	-0.004 (-1.09)	-0.002 (-0.39)	-0.006 (-0.89)	0.006 (0.86)	-0.004 (-0.64)
$\widehat{IR}_{t-8}$	-0.003 (-0.57)	-0.019 (-1.54)	-0.012 (-1.75)	0.003 (1.08)	-0.002 (-0.32)	-0.003 (-0.44)	-0.015 (-2.82)**	0.004 (0.8)
$\widehat{EFP}_t$	-0.025 (-4.54)***	-0.002 (-2.51)**	0.001 (0.21)	-0.005 (-5.08)***	-0.023 (-3)***	-0.002 (-2.72)**	-0.004 (-0.51)	-0.002 (-2.69)**
$\widehat{EFP}_{t-1}$	0.005 (0.69)		-0.002 (-0.36)	0.0003 (0.2)	0.006 (0.69)	-0.001 (-0.96)	-0.002 (-0.31)	-0.0004 (-0.31)
$\widehat{EFP}_{t-2}$	0.0005 (0.06)		0.002 (0.23)	-0.001 (-0.38)	0.002 (0.17)	-0.0005 (-0.33)	-0.009 (-1.17)	-0.001 (-0.66)
$\widehat{EFP}_{t-3}$	-0.009 (-1.3)		-0.010 (-1.35)	0.0004 (0.27)	-0.009 (-0.96)	0.001 (0.74)	-0.018 (-2.15)**	-0.001 (-0.63)
$\widehat{EFP}_{t-4}$	0.00002 (0.00)		-0.005 (-0.72)	0.003 (3.26)***	0.010 (1.13)	-0.003 (-1.92)*	0.015 (2.33)**	0.002 (1.42)
$\widehat{EFP}_{t-5}$	-0.001 (-0.07)		-0.004 (-0.53)		-0.001 (-0.08)	0.002 (1.56)	-0.002 (-0.25)	0.0000003 (0.00)
$\widehat{EFP}_{t-6}$	-0.003 (-0.39)		0.015 (1.41)		-0.004 (-0.51)	-0.0003 (-0.23)	-0.008 (-1.25)	0.001 (0.95)
$\widehat{EFP}_{t-7}$	0.003 (0.5)		-0.010 (-1.42)		-0.003 (-0.36)	-0.001 (-0.7)	0.001 (0.19)	0.00002 (0.02)

$\widehat{EFP}_{t-8}$	-0.009 (-2.61)**		0.003 (0.39)		-0.008 (-1.76)	-0.003 (-3.56)***	-0.016 (-2.64)**	-0.0003 (-0.31)
$\widehat{RT}_t$	0.004 (1.34)	-0.001 (-0.16)	-0.001 (-0.24)	-0.001 (-0.41)	0.001 (0.4)	-0.010 (-2.72)**	0.001 (0.17)	-0.006 (-1.72)
$\widehat{RT}_{t-1}$	0.006 (1.26)	0.014 (0.99)	0.0005 (0.07)		0.006 (1.09)	0.016 (2.38)**	-0.0004 (-0.06)	0.006 (1.27)
$\widehat{RT}_{t-2}$	-0.003 (-0.56)	-0.011 (-0.7)	-0.008 (-1)		-0.004 (-0.73)	-0.007 (-1)	-0.004 (-0.63)	-0.005 (-0.87)
$\widehat{RT}_{t-3}$	-0.004 (-0.65)	-0.002 (-0.12)	-0.008 (-0.72)		0.005 (0.72)	0.002 (0.32)	-0.012 (-1.27)	0.009 (1.44)
$\widehat{RT}_{t-4}$	0.002 (0.27)	-0.007 (-0.33)	-0.004 (-0.3)		-0.015 (-2.4)**	-0.011 (-1.81)*	-0.005 (-0.41)	-0.013 (-2.14)*
$\widehat{RT}_{t-5}$	0.0004 (0.06)	-0.002 (-0.1)	0.015 (1.04)		0.009 (1.59)	0.006 (1.13)	0.018 (1.26)	0.016 (2.88)**
$\widehat{RT}_{t-6}$	0.0002 (0.03)	-0.005 (-0.25)	-0.021 (-1.78)*		-0.013 (-2.38)**	-0.017 (-3.48)***	-0.024 (-1.96)*	-0.015 (-2.92)**
$\widehat{RT}_{t-7}$	0.006 (1.1)	0.017 (1.03)	0.014 (1.74)		0.010 (1.94)*	0.010 (2)*	0.020 (2.24)**	0.010 (2.44)**
$\widehat{RT}_{t-8}$	-0.003 (-0.72)	-0.025 (-2.45)**	-0.012 (-2.33)**		-0.002 (-0.62)	0.002 (0.58)	-0.019 (-3.08)***	-0.007 (-2.82)**
R^2	0.998	0.949	0.997	0.990	0.997	0.998	0.997	0.997
Adj. R^2	0.994	0.902	0.990	0.983	0.992	0.994	0.992	0.991
AIC	-8.51	-5.60	-7.99	-7.39	-8.17	-8.42	-8.21	-8.05
DW	1.64	0.55	1.36	1.41	1.32	2.03	1.30	1.52
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	43	43	43	43	43	43	43	43

Table 38 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate autoregressive distributed lag models in levels. The fitted values are generated using the quantitative easing proxy indicated in the 'QE proxy' row. The number of lags is chosen based on the number that gives the best overall Wald F-statistic of joint significance of the interest rate, external finance premium and risk tolerance coefficients.
The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.1.4 QE proxy: size of the Fed's balance sheet

Dep. variable:	$\ln real\ GDP_t$							
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	9.501 (116.55)***	9.467 (256.47)***	10.389 (56.53)***	9.520 (131.1)***	9.534 (462.57)***	9.305 (189.16)***	10.422 (68.88)***	9.444 (169.46)***
$trend$	0.005 (5.47)***	0.005 (16.02)***	-0.003 (-1.85)	0.005 (4.71)***	0.005 (15.22)***	0.009 (6.52)**	-0.003 (-2.7)	0.006 (16.81)***
$\widehat{IR}_t$	-0.009 (-1.15)	-0.006 (-1.11)	-0.005 (-0.19)	-0.010 (-1.58)	0.050 (2)	-0.062 (-1.44)	0.002 (0.1)	-0.028 (-1.48)
$\widehat{IR}_{t-1}$	0.002 (0.21)	0.0003 (0.05)	-0.183 (-4.96)**	0.010 (1.83)	-0.050 (-2.26)	-0.094 (-2.21)	-0.201 (-6.11)**	0.028 (1.72)
$\widehat{IR}_{t-2}$	-0.003 (-0.7)	-0.003 (-0.6)	-0.100 (-4.17)*	-0.011 (-2.39)*	-0.124 (-7.98)**	-0.142 (-2.68)	-0.085 (-4.28)*	-0.057 (-3.54)*
$\widehat{IR}_{t-3}$	0.008 (1.59)	0.008 (1.83)*	-0.050 (-2.79)	0.013 (3.28)**	-0.131 (-9.2)**	-0.236 (-2.71)	-0.037 (-1.99)	-0.080 (-3.55)*
$\widehat{IR}_{t-4}$	-0.001 (-0.26)	-0.001 (-0.2)	0.004 (0.93)	-0.003 (-0.87)	0.044 (7.4)**	0.126 (2.98)*	0.012 (2.37)	0.013 (2.02)
$\widehat{IR}_{t-5}$	0.002 (0.55)	0.002 (0.66)	-0.020 (-2.56)	0.002 (0.74)	0.051 (5.24)**	0.049 (2.32)	-0.021 (-2.88)	0.004 (1.1)
$\widehat{IR}_{t-6}$	-0.002 (-0.53)	-0.002 (-0.77)	-0.058 (-4.99)**	-0.003 (-1.45)	-0.015 (-2.84)	-0.014 (-1.51)	-0.064 (-6.47)**	-0.014 (-3.17)*
$\widehat{EFP}_t$	-0.0003 (-0.03)	-0.0002 (-0.33)	-0.025 (-0.75)	-0.003 (-2.53)**	-0.047 (-8.88)**	-0.010 (-2.67)	-0.027 (-3.6)*	0.001 (1.23)
$\widehat{EFP}_{t-1}$	-0.002 (-0.25)		0.137 (4.18)*	0.002 (1.69)	-0.026 (-7.02)**	-0.011 (-2.27)	-0.055 (-8.62)**	0.001 (2.72)
$\widehat{EFP}_{t-2}$	-0.0002 (-0.03)		0.096 (3.79)*	0.0001 (0.13)	-0.011 (-2.53)	0.007 (2.28)	-0.005 (-1.95)	0.002 (3.51)*
$\widehat{EFP}_{t-3}$	-0.002 (-0.26)		0.069 (3.69)*	-0.001 (-0.58)	0.028 (4.06)*	0.001 (0.71)	0.019 (7.29)**	-0.002 (-4.75)**
$\widehat{EFP}_{t-4}$			0.004 (1.16)	0.001 (1.96)*	0.012 (2.7)	0.001 (0.58)	0.006 (2.61)	-0.001 (-1.31)
$\widehat{EFP}_{t-5}$			0.0004 (0.11)	-0.0003 (-0.54)	0.015 (4.66)**	0.007 (1.88)	-0.018 (-3.87)*	-0.001 (-1.84)
$\widehat{EFP}_{t-6}$			0.025 (5.03)**	-0.0003 (-0.46)	0.00001 (0.00)	0.001 (2.44)	-0.035 (-5.95)**	-0.001 (-2.73)
$\widehat{RT}_t$	-0.002 (-0.32)	0.0004 (0.09)	-0.013 (-2.57)	-0.003 (-0.56)	0.003 (2.96)*	0.004 (0.94)	-0.012 (-2.72)	-0.0005 (-0.37)
$\widehat{RT}_{t-1}$	-0.002 (-0.37)	-0.003 (-0.73)	-0.042 (-6.35)**	0.004 (0.75)	0.012 (5.84)**	0.046 (2.09)	-0.043 (-7.65)**	0.003 (1.95)
$\widehat{RT}_{t-2}$			-0.005 (-1.57)	-0.003 (-0.77)	0.011 (5.08)**	-0.004 (-0.49)	-0.006 (-2.08)	-0.001 (-0.71)

$\widehat{RT}_{t-3}$			0.017 (6.59)**		-0.003 (-1.73)	0.001 (0.19)	0.022 (8.05)**	0.001 (0.64)
$\widehat{RT}_{t-4}$			-0.001 (-0.5)		-0.011 (-10.83)***	-0.009 (-2.94)*	-0.006 (-2.67)	-0.006 (-3.98)*
$\widehat{RT}_{t-5}$			0.002 (0.85)		0.002 (1.6)	0.001 (0.35)	0.006 (2.36)	0.006 (5.67)**
$\widehat{RT}_{t-6}$			-0.030 (-4.51)**		-0.018 (-9.44)**	-0.035 (-2.89)	-0.030 (-5.76)**	-0.005 (-4.63)**
R^2	0.996	0.996	0.99996	0.999	0.99997	0.9998	0.99997	0.99996
Adj. R^2	0.991	0.992	0.9996	0.997	0.9997	0.998	0.9996	0.9995
AIC	-8.11	-8.30	-12.15	-9.46	-12.51	-10.51	-12.35	-12.09
DW	1.90	1.93	3.56	2.83	2.84	3.34	3.10	3.90
Start	2009Q3	2009Q3	2009Q3	2009Q3	2009Q3	2009Q3	2009Q3	2009Q3
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	25	25	25	25	25	25	25	25

Table 39 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate autoregressive distributed lag models in levels. The fitted values are generated using the quantitative easing proxy indicated in the 'QE proxy' row. The number of lags is chosen based on the number that gives the best overall Wald F-statistic of joint significance of the interest rate, external finance premium and risk tolerance coefficients.
The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.2 Cointegrating relationships

IR proxy→	10-year bond rate											
EFP proxy→	BBB-AAA corporate bond spread											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	0.005 (-0.40)	-0.419 (2.57)**	-0.042 (0.21)	-0.004 (8.89)***	-0.520 (7.62)***	-0.144 (1.97)**	-0.012 (1.34)	-0.612 (5.07)***	0.269 (-1.73)**			
$trend$	0.003 (-4.03)***	-0.041 (3.94)***	0.008 (-0.66)	0.004 (-52.29)***	-0.045 (3.48)***	-0.179 (12.86)***	0.004 (-6.40)***	-0.032 (4.00)***	-0.004 (0.41)			
$const.$	9.511	6.149	1.417	9.491	6.707	9.254	9.555	6.649	0.540			

IR proxy→	10-year bond rate											
EFP proxy→	High yield (≤CCC-AAA) corporate bond spread											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	-0.001 (0.05)	-0.440 (3.24)***	-1.044 (0.76)				-0.004 (0.43)	-0.455 (4.25)***	-0.743 (0.67)	0.003 (-0.18)	-0.808 (0.97)	0.600 (-0.16)
$trend$	0.003 (-4.52)***	-0.032 (3.52)***	0.015 (-0.16)				0.004 (-6.54)***	-0.027 (3.59)***	-0.033 (0.42)	-0.00002 (-0.02)	0.153 (-2.91)***	-1.056 (4.52)***
$const.$	9.523	5.986	12.758				9.519	5.890	12.937	9.606	1.255	43.622

IR proxy→	10-year bond rate											
EFP proxy→	10-year – 3-month yield rate spread											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	-0.022 (4.55)***	-0.346 (5.15)***	0.380 (-1.96)**	-0.008 (4.96)***	-0.248 (4.49)***	-0.153 (2.02)**	-0.018 (3.65)***	-0.477 (6.86)***	0.274 (-1.25)	-0.010 (3.16)***	0.670 (-1.52)	0.985 (-1.79)**
$trend$	0.004 (-11.25)***	-0.038 (7.65)***	0.015 (-1.06)	0.004 (-26.92)***	-0.028 (5.25)***	-0.002 (0.22)	0.004 (-9.97)***	-0.030 (5.81)***	0.023 (-1.42)	0.005 (-14.35)***	-0.005 (0.11)	0.011 (-0.20)
$const.$	9.586	5.766	-0.015	9.517	4.800	3.253	9.580	6.047	0.232	9.502	-0.290	-2.431

IR proxy→	10-year bond rate											
EFP proxy→	Debt-to-GDP ratio											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	-0.003 (0.24)	-0.315 (1.39)	3.008 (-1.49)	-0.007 (5.30)***	-0.238 (2.05)**	4.692 (-7.86)***	0.004 (-0.16)	-0.260 (0.47)	2.231 (-0.47)	-0.008 (2.72)**	-0.373 (3.59)***	4.613 (-4.76)***
$trend$	0.002 (-2.49)**	-0.069 (3.89)***	1.315 (-8.41)***	0.004 (-25.85)***	-0.018 (1.37)	0.960 (-13.86)***	-0.0001 (-0.03)	-0.104 (2.54)**	1.652 (-4.77)***	0.004 (-14.81)***	-0.011 (1.13)	0.936 (-9.91)***
$const.$	9.564	6.499	32.684	9.517	4.383	38.237	9.594	7.278	26.305	9.518	4.835	38.057

*Table 40a | Cointegrating equations between real GDP, the fitted values of the interest rate (IR), the fitted values of the external finance premium (EFP) and the fitted values of risk tolerance (RT). Different proxies are used for the interest rate, the external finance premium, and for quantitative easing used to estimate the fitted values. Each combination results in 3 cointegrating equations. Each column in a section is an equation. The numbers represent coefficients. The empty cells originate from models for which the number of lags necessary for cointegration resulted in an insufficient number of observations. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

IR proxy→	13-week Treasury Bill rate											
EFP proxy→	BBB-AAA corporate bond spread											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	0.001 (-0.21)	0.168 (-0.34)	-0.187 (0.95)	-0.004 (5.53)***	-0.009 (2.85)***	0.093 (-2.74)**	0.0002 (-0.04)	0.107 (-0.25)	-0.109 (0.60)	-0.007 (2.07)**	-0.098 (1.52)	0.291 (-1.57)
$trend$	0.003 (-8.04)***	-0.088 (2.56)**	0.018 (-1.32)	0.005 (-46.51)***	-0.004 (8.97)***	-0.034 (6.56)***	0.003 (-9.21)***	-0.085 (2.89)***	0.014 (-1.09)	0.004 (-13.46)***	-0.030 (6.17)***	0.014 (-1.01)
$const.$	9.514	3.058	1.693	9.455	0.268	2.486	9.517	3.207	1.504	9.531	1.691	-0.011
IR proxy→	13-week Treasury Bill rate											
EFP proxy→	High yield (≤CCC-AAA) corporate bond spread											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	-0.007 (1.60)	-0.321 (0.77)	-1.198 (1.30)	-0.009 (2.94)***	-0.079 (1.76)**	-0.952 (1.06)	-0.006 (1.35)	-0.244 (0.61)	-1.180 (1.38)	-0.003 (1.08)	0.041 (-0.73)	-1.225 (1.26)
$trend$	0.003 (-10.31)***	-0.077 (2.53)**	0.107 (-1.58)	0.004 (-11.46)***	-0.030 (6.64)***	-0.007 (0.08)	0.003 (-10.08)***	-0.081 (2.83)***	0.101 (-1.65)	0.004 (-22.99)***	-0.016 (4.15)***	-0.026 (0.39)
$const.$	9.544	4.669	10.709	9.540	1.574	13.360	9.542	4.468	10.793	9.492	0.599	16.954
IR proxy→	13-week Treasury Bill rate											
EFP proxy→	10-year – 3-month yield rate spread											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	-0.026 (2.69)**	-1.064 (2.95)***	0.695 (-1.56)	-0.009 (2.78)**	-0.118 (2.18)**	-0.049 (0.23)	-0.026 (2.19)**	-1.052 (2.30)**	0.607 (-1.15)			
$trend$	0.004 (-5.18)***	-0.051 (1.89)**	0.021 (-0.63)	0.003 (-9.08)***	-0.032 (5.43)***	0.051 (-2.22)**	0.003 (-4.05)***	-0.068 (2.05)**	0.040 (-1.04)			
$const.$	9.608	6.974	-1.370	9.551	1.841	0.789	9.615	7.396	-1.556			
IR proxy→	13-week Treasury Bill rate											
EFP proxy→	Debt-to-GDP ratio											
QE proxy→	Treasury securities held by the Fed			Mortgage-backed securities held by the Fed			Treasury & mortgage-backed securities held			Size of the Fed's balance sheet		
Dep. var.→	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$	GDP_{t-1}	$\widehat{IR}_{t-1}$	$\widehat{EFP}_{t-1}$
$\widehat{RT}_{t-1}$	-0.012 (6.18)***	-0.579 (3.44)***	5.351 (-8.35)***	-0.008 (3.54)***	-0.081 (2.86)***	4.149 (-6.08)***	-0.010 (3.31)***	-0.444 (2.48)**	5.472 (-6.08)***	-0.009 (2.48)***	-0.081 (2.19)***	5.628 (-3.35)***
$trend$	0.004 (-25.84)***	-0.045 (3.47)***	0.914 (-18.50)***	0.004 (-19.81)***	-0.025 (10.45)***	0.922 (-15.87)***	0.004 (-17.77)***	-0.054 (4.11)***	0.908 (-13.69)***	0.004 (-13.36)***	-0.024 (7.69)***	1.050 (-7.57)***
$const.$	9.549	4.894	34.702	9.527	1.411	42.240	9.543	4.616	34.418	9.530	1.373	29.411

*Table 40b | Cointegrating equations between real GDP, the fitted values of the interest rate (IR), the fitted values of the external finance premium (EFP) and the fitted values of risk tolerance (RT). Different proxies are used for the interest rate, the external finance premium, and for quantitative easing used to estimate the fitted values. Each combination results in 3 cointegrating equations. Each column in a section is an equation. The numbers represent coefficients. The empty cells originate from models for which the number of lags necessary for cointegration resulted in an insufficient number of observations. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.2.1 Derivation of the long-run effect

In order to derive the long-run effect on GDP as indicated by the cointegrating relationships presented in Appendix C.2 (and D.2), the following approach is used.

The first three equations in Appendix C.2 are the following.

$$\ln GDP_{t-1} = 0.005 \cdot \widehat{RT}_{t-1} - 0.003 \cdot trend - 9.511$$

$$\widehat{IR}_{t-1} = -0.419 \cdot \widehat{RT}_{t-1} + 0.041 \cdot trend - 6.149$$

$$\widehat{EFP}_{t-1} = -0.042 \cdot \widehat{RT}_{t-1} - 0.008 \cdot trend - 1.417$$

From the first equation, it is obvious that the long-run effect of the fitted values of risk tolerance on GDP is 0.005. The other two equations can be rewritten in terms of fitted risk tolerance, as follows.

$$\widehat{RT}_{t-1} = \frac{\widehat{IR}_{t-1} - 0.041 \cdot trend + 6.149}{-0.419}$$

$$\widehat{RT}_{t-1} = \frac{\widehat{EFP}_{t-1} + 0.008 \cdot trend + 1.417}{-0.042}$$

In this way they can be substituted into the first equation.

$$\ln GDP_{t-1} = 0.005 \cdot \left(\frac{\widehat{IR}_{t-1} - 0.041 \cdot trend + 6.149}{-0.419}\right) - 0.003 \cdot trend - 9.511$$

$$\ln GDP_{t-1} = 0.005 \cdot \left(\frac{\widehat{EFP}_{t-1} + 0.008 \cdot trend + 1.417}{-0.042}\right) - 0.003 \cdot trend - 9.511$$

This makes it clear that the long-run effect of the interest rate on GDP is $\frac{0.005}{-0.419} = -0.011$ and the long-run effect of the external finance premium on GDP is $\frac{0.005}{-0.042} = -0.109$.

C.3 Error correction models

C.3.1 QE proxy: Treasury securities held by the Fed

Dep. variable:	$\ln real\ GDP_t$							
QE proxy→	Treasury securities held by the Fed							
IR proxy→	10-year bond rate				13-week Treasury Bill rate			
EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$Constant$	0.007 (1.06)	0.015 (2.09)*	0.015 (2.88)**	0.022 (3.5)***	0.003 (1.47)	0.002 (0.99)	0.009 (3.32)***	0.009 (2.32)**
$ECT\ GDP_{t-1}$	-0.468 (-1.57)	-0.102 (-0.5)	0.124 (0.28)	0.581 (2.56)**	-0.612 (-3.45)***	-0.502 (-2.68)**	-0.020 (-0.07)	-1.021 (-3.41)***
$ECT\ IR_{t-1}$	-0.002 (-0.2)	-0.027 (-1.85)*	-0.011 (-0.86)	0.003 (0.44)	0.003 (1.58)	0.002 (1.08)	-0.009 (-1.38)	-0.002 (-1.1)
$ECT\ EFP_{t-1}$	-0.018 (-1.61)	-0.002 (-1.76)*	0.006 (0.78)	0.004 (3.5)***	-0.009 (-3.33)***	-0.001 (-1.94)*	-0.007 (-0.68)	-0.002 (-2.03)*
$\Delta\ln \widehat{GDP}_{t-1}$	-0.064 (-0.17)	-0.379 (-1.03)	-0.679 (-1.53)	-1.010 (-2.63)**	0.432 (2.34)**	0.313 (1.31)	-0.153 (-0.48)	0.321 (1.25)
$\Delta\ln \widehat{GDP}_{t-2}$	-0.257 (-0.76)	-0.452 (-1.35)	-0.620 (-1.57)	-0.781 (-2.52)**	0.065 (0.35)	0.141 (0.62)	-0.375 (-1.63)	0.186 (0.95)
$\Delta\ln \widehat{GDP}_{t-3}$	0.024 (0.06)	-0.347 (-0.88)	-0.395 (-1.36)	-0.606 (-1.62)	-0.094 (-0.49)	0.092 (0.41)	0.021 (0.11)	0.290 (1.11)
$\Delta\ln \widehat{GDP}_{t-4}$	0.110 (0.36)	-0.165 (-0.48)	-0.110 (-0.49)	-0.257 (-1.09)			-0.194 (-1.06)	-0.422 (-2.54)**
$\Delta\ln \widehat{GDP}_{t-5}$	-0.349 (-1.09)	-0.735 (-1.99)*	-0.343 (-1.6)	-0.497 (-1.85)*			-0.282 (-1.58)	-0.174 (-0.95)
$\Delta\ln \widehat{GDP}_{t-6}$	-0.153 (-0.48)	-0.311 (-0.94)	-0.197 (-0.73)					
$\Delta\widehat{IR}_{t-1}$	-0.003 (-0.3)	0.013 (1.19)	-0.001 (-0.05)	-0.010 (-1.6)	-0.003 (-1.04)	-0.005 (-1.41)	0.005 (0.56)	-0.005 (-1.97)*
$\Delta\widehat{IR}_{t-2}$	-0.015 (-1.82)*	0.009 (0.79)	-0.005 (-0.41)	-0.017 (-2.68)**	-0.004 (-0.93)	-0.001 (-0.16)	-0.007 (-0.97)	0.001 (0.32)
$\Delta\widehat{IR}_{t-3}$	-0.001 (-0.07)	0.017 (1.83)*	0.010 (0.82)	-0.007 (-0.95)	0.009 (2.01)*	0.007 (1.45)	0.011 (1.37)	0.004 (1.17)
$\Delta\widehat{IR}_{t-4}$	0.015 (1.56)	0.021 (2.22)**	0.013 (1.35)	-0.0002 (-0.03)			0.007 (1.05)	0.009 (2.59)**
$\Delta\widehat{IR}_{t-5}$	0.007 (0.94)	0.018 (2.26)**	0.024 (1.85)*	0.003 (0.53)			0.017 (2.01)*	0.022 (5.96)***
$\Delta\widehat{IR}_{t-6}$	0.001 (0.14)	0.013 (2.08)*	0.010 (0.75)					
$\Delta\widehat{EFP}_{t-1}$	0.006 (0.68)	0.001 (0.84)	-0.001 (-0.18)	-0.002 (-1.29)	0.011 (1.96)*	0.001 (0.72)	0.004 (0.4)	0.0004 (0.41)
$\Delta\widehat{EFP}_{t-2}$	0.003 (0.28)	-0.0002 (-0.15)	-0.002 (-0.32)	-0.002 (-1.43)	0.002 (0.31)	0.001 (0.72)	-0.006 (-0.77)	0.001 (1.24)
$\Delta\widehat{EFP}_{t-3}$	-0.002 (-0.17)	-0.0004 (-0.32)	-0.009 (-1.21)	-0.001 (-0.42)	0.011 (2.13)**	0.002 (2.41)**	0.004 (0.6)	-0.003 (-3.67)***
$\Delta\widehat{EFP}_{t-4}$	-0.008 (-0.88)	0.001 (0.41)	-0.008 (-1.03)	-0.002 (-1.45)			0.003 (0.56)	-0.001 (-1.5)

$\Delta\widehat{EFP}_{t-5}$	0.001 (0.1)	-0.004 (-2.62)**	-0.016 (-1.66)	0.001 (0.58)			0.008 (2.2)**	-0.002 (-2.87)***
$\Delta\widehat{EFP}_{t-6}$	0.011 (1.38)	0.002 (2.53)**	-0.005 (-0.51)					
$\Delta\widehat{RT}_{t-1}$	-0.00004 (-0.01)	0.007 (0.78)	0.002 (0.16)	0.003 (0.8)	0.001 (0.18)	0.001 (0.24)	0.006 (0.73)	0.0004 (0.15)
$\Delta\widehat{RT}_{t-2}$	-0.008 (-1.18)	0.008 (0.83)	-0.007 (-0.64)	-0.005 (-1.48)	0.0001 (0.03)	0.001 (0.41)	-0.005 (-0.88)	0.001 (0.37)
$\Delta\widehat{RT}_{t-3}$	-0.002 (-0.28)	0.012 (1.32)	-0.002 (-0.19)	-0.006 (-1.44)	-0.002 (-0.69)	-0.005 (-1.68)	0.001 (0.16)	0.001 (0.38)
$\Delta\widehat{RT}_{t-4}$	0.014 (1.76)*	0.009 (1.06)	-0.004 (-0.48)	-0.001 (-0.17)			-0.002 (-0.34)	-0.004 (-1.67)
$\Delta\widehat{RT}_{t-5}$	0.007 (1.03)	0.024 (2.73)**	0.003 (0.41)	-0.001 (-0.15)			0.004 (1.16)	0.006 (3.68)***
$\Delta\widehat{RT}_{t-6}$	-0.003 (-0.57)	0.005 (0.83)	0.0003 (0.06)					
R^2	0.76	0.80	0.80	0.75	0.65	0.63	0.77	0.89
Adj. R^2	0.35	0.45	0.47	0.48	0.48	0.44	0.53	0.77
AIC	-7.39	-7.56	-7.60	-7.58	-7.65	-7.59	-7.67	-8.41
DW	2.37	2.30	1.84	2.21	2.34	2.34	2.21	2.38
Start	2004Q4	2004Q4	2004Q4	2004Q3	2004Q1	2004Q1	2004Q3	2004Q3
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	44	44	44	45	47	47	45	45

Table 41 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate error correction models. The fitted values are generated using the quantitative easing proxy indicated in the 'QE proxy' row. A hat (^) indicates a fitted series. The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium. The number of lags is chosen based on the number for which cointegration is found in a Johansen Cointegration test (Table 7).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.3.2 QE proxy: mortgage-backed securities held by the Fed

Dep. variable:	$\ln real\ GDP_t$							
QE proxy→	Mortgage-backed securities held by the Fed							
IR proxy→	10-year bond rate				13-week Treasury Bill rate			
EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$Constant$	0.009 (2)*		0.002 (1.15)	0.008 (2.06)*	0.004 (0.41)	0.006 (4.85)***	0.004 (1.75)	0.007 (4.38)***
$ECT\ GDP_{t-1}$	0.007 (0.01)		-0.821 (-3.13)***	-0.074 (-0.25)	-0.967 (-0.9)	-0.620 (-3.65)***	-0.619 (-2)*	-0.525 (-3.16)***
$ECT\ IR_{t-1}$	-0.002 (-0.18)		0.035 (2.79)**	-0.003 (-0.41)	0.074 (0.75)	0.031 (3.14)***	0.045 (2.04)*	0.023 (2.2)**
$ECT\ EFP_{t-1}$	-0.001 (-0.53)		-0.035 (-2.93)**	0.001 (0.81)	0.010 (0.47)	0.0005 (1.07)	0.003 (0.54)	-0.0002 (-0.38)
$\Delta\ln \widehat{GDP}_{t-1}$	0.075 (0.13)		0.274 (1.23)	-0.151 (-0.59)	0.188 (0.21)	0.106 (0.56)	0.151 (0.57)	-0.014 (-0.07)
$\Delta\ln \widehat{GDP}_{t-2}$	-0.353 (-0.76)		0.269 (1.4)	-0.021 (-0.09)	0.080 (0.13)		-0.037 (-0.15)	
$\Delta\ln \widehat{GDP}_{t-3}$	-0.198 (-0.72)				-0.160 (-0.44)			
$\Delta\widehat{IR}_{t-1}$	0.001 (0.1)		-0.023 (-1.26)	0.002 (0.28)	-0.034 (-0.52)	0.008 (0.36)	0.026 (0.89)	0.010 (0.43)
$\Delta\widehat{IR}_{t-2}$	-0.006 (-0.51)		-0.018 (-1.65)	-0.006 (-0.92)	-0.034 (-0.57)		-0.044 (-1.59)	
$\Delta\widehat{IR}_{t-3}$	0.011 (1.15)				-0.057 (-1.54)			
$\Delta\widehat{EFP}_{t-1}$	0.027 (1.9)*		0.025 (1.57)	-0.002 (-1.48)	0.009 (0.62)	0.001 (1.37)	-0.004 (-0.59)	-0.001 (-1.55)
$\Delta\widehat{EFP}_{t-2}$	-0.010 (-0.53)		0.016 (1.77)	0.0001 (0.04)	-0.001 (-0.14)		-0.008 (-1.34)	
$\Delta\widehat{EFP}_{t-3}$	-0.0004 (-0.06)				-0.002 (-0.55)			
$\Delta\widehat{RT}_{t-1}$	-0.006 (-0.64)		0.004 (0.82)	0.006 (1.06)	0.004 (0.47)	0.0003 (0.08)	0.002 (0.43)	0.004 (1.96)*
$\Delta\widehat{RT}_{t-2}$	-0.005 (-0.39)		-0.0003 (-0.06)	-0.003 (-0.52)	0.003 (0.99)		-0.005 (-0.98)	
$\Delta\widehat{RT}_{t-3}$	0.006 (0.66)				0.003 (0.57)			
R^2	0.60		0.59	0.42	0.68	0.54	0.52	0.55
Adj. R^2	-0.15		0.24	-0.07	0.09	0.37	0.12	0.38
AIC	-7.80		-8.09	-7.75	-8.04	-8.14	-7.94	-8.16
DW	1.98		2.60	1.96	2.15	2.36	2.48	2.19
Start	2004Q1		2003Q4	2003Q4	2004Q1	2003Q3	2003Q4	2003Q3
End	2015Q3		2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	24		25	25	24	27	25	27

Table 42 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate error correction models. The fitted values are generated

using the quantitative easing proxy indicated in the 'QE proxy' row. A hat (^) indicates a fitted series. The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium. The number of lags is chosen based on the number for which cointegration is found in a Johansen Cointegration test (Table 7).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.3.3 QE proxy: Treasury & mortgage-backed securities held by the Fed

Dep. variable:	$\ln real\ GDP_t$							
QE proxy→	Treasury & mortgage-backed securities held by the Fed							
IR proxy→	10-year bond rate				13-week Treasury Bill rate			
EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$Constant$	0.011 (2.04)*	0.024 (3.72)***	0.010 (4.22)***	0.021 (4.02)***	0.003 (1.35)	0.003 (1.19)	0.009 (3.94)***	0.014 (3.14)***
$ECT\ GDP_{t-1}$	-0.375 (-1.54)	0.140 (0.8)	-0.076 (-0.29)	0.534 (2.91)***	-0.611 (-3.58)***	-0.449 (-2.5)**	0.074 (0.25)	-0.964 (-2.46)**
$ECT\ IR_{t-1}$	-0.010 (-1.08)	-0.043 (-3.35)***	-0.013 (-1.6)	0.008 (1.37)	0.003 (1.74)*	0.002 (0.95)	-0.009 (-1.13)	-0.003 (-1.31)
$ECT\ EFP_{t-1}$	-0.018 (-1.84)*	-0.003 (-2.61)**	0.002 (0.35)	0.004 (4.39)***	-0.009 (-3.16)***	-0.001 (-2.04)*	-0.006 (-0.47)	-0.002 (-1.53)
$\Delta\ln \widehat{GDP}_{t-1}$	-0.224 (-0.76)	-0.684 (-2.42)**	-0.231 (-0.92)	-1.026 (-3.29)***	0.415 (1.96)*	0.211 (0.92)	-0.197 (-0.68)	0.443 (1.29)
$\Delta\ln \widehat{GDP}_{t-2}$	-0.410 (-1.42)	-0.730 (-2.49)**	-0.310 (-1.6)	-0.903 (-3.36)***	-0.027 (-0.14)	0.092 (0.41)	-0.470 (-2.19)**	0.008 (0.03)
$\Delta\ln \widehat{GDP}_{t-3}$	-0.036 (-0.12)	-0.639 (-2.04)*	-0.079 (-0.4)	-0.520 (-1.58)	0.010 (0.05)	0.147 (0.65)	-0.050 (-0.25)	0.110 (0.35)
$\Delta\ln \widehat{GDP}_{t-4}$	-0.074 (-0.28)	-0.360 (-1.32)	-0.117 (-0.68)	-0.231 (-1.05)			-0.079 (-0.44)	-0.570 (-2.63)**
$\Delta\ln \widehat{GDP}_{t-5}$	-0.598 (-2.04)*	-1.273 (-3.72)***	-0.452 (-2.32)**	-0.397 (-1.56)			-0.356 (-1.79)*	-0.149 (-0.64)
$\Delta\ln \widehat{GDP}_{t-6}$	-0.357 (-1.2)	-0.708 (-2.16)**						
$\Delta\widehat{IR}_{t-1}$	0.004 (0.51)	0.028 (2.78)**	0.003 (0.43)	-0.012 (-2.06)*	-0.005 (-1.37)	-0.005 (-1.33)	0.002 (0.28)	-0.004 (-1.36)
$\Delta\widehat{IR}_{t-2}$	-0.013 (-2.11)*	0.020 (1.91)*	-0.007 (-0.99)	-0.023 (-3.59)***	0.0004 (0.14)	0.001 (0.19)	-0.011 (-1.34)	-0.001 (-0.35)
$\Delta\widehat{IR}_{t-3}$	0.002 (0.19)	0.023 (2.37)**	0.015 (1.82)*	-0.012 (-1.76)*	0.005 (1.19)	0.005 (1.26)	0.012 (1.41)	0.008 (2.02)*
$\Delta\widehat{IR}_{t-4}$	0.016 (2.27)**	0.033 (4.14)***	0.012 (1.51)	-0.0001 (-0.02)			0.004 (0.6)	0.012 (2.7)**
$\Delta\widehat{IR}_{t-5}$	0.011 (1.51)	0.029 (3.62)***	0.020 (2.49)**	-0.001 (-0.2)			0.020 (2.66)**	0.016 (3.98)***
$\Delta\widehat{IR}_{t-6}$	0.004 (0.69)	0.019 (3.07)***						
$\Delta\widehat{EFP}_{t-1}$	0.006 (0.73)	0.001 (0.74)	0.002 (0.38)	-0.004 (-2.8)**	0.011 (1.84)*	0.0003 (0.28)	-0.001 (-0.07)	-0.001 (-0.51)
$\Delta\widehat{EFP}_{t-2}$	-0.005 (-0.51)	-0.001 (-0.8)	0.002 (0.46)	-0.002 (-1.23)	0.001 (0.14)	0.001 (1.35)	-0.009 (-0.94)	0.001 (0.54)
$\Delta\widehat{EFP}_{t-3}$	0.003 (0.3)	0.001 (0.48)	-0.008 (-1.48)	-0.001 (-0.98)	0.011 (2.21)**	0.001 (2.08)**	0.006 (0.69)	-0.005 (-3.52)***
$\Delta\widehat{EFP}_{t-4}$	-0.016 (-2.24)**	-0.002 (-1.39)	-0.005 (-0.94)	-0.001 (-0.67)			-0.001 (-0.16)	-0.001 (-1.34)
$\Delta\widehat{EFP}_{t-5}$	-0.005 (-0.67)	-0.003 (-2.81)**	-0.012 (-2.24)**	0.001 (0.76)			0.008 (1.58)	-0.002 (-2.61)**

$\Delta\widehat{EFP}_{t-6}$	0.006 (1.01)	0.001 (1.7)						
$\Delta\widehat{RT}_{t-1}$	0.005 (0.69)	0.019 (2.46)**	0.008 (1.03)	0.005 (1.15)	-0.002 (-0.68)	0.0001 (0.02)	0.006 (0.64)	-0.001 (-0.25)
$\Delta\widehat{RT}_{t-2}$	-0.002 (-0.44)	0.018 (2.1)*	-0.007 (-1.14)	-0.006 (-1.6)	0.002 (0.67)	0.001 (0.4)	-0.012 (-1.74)*	-0.003 (-0.9)
$\Delta\widehat{RT}_{t-3}$	0.002 (0.22)	0.016 (1.71)	0.008 (0.84)	-0.005 (-1.09)	-0.003 (-0.86)	-0.007 (-2.03)*	0.006 (0.62)	0.002 (0.67)
$\Delta\widehat{RT}_{t-4}$	0.019 (2.77)**	0.023 (2.95)***	-0.001 (-0.3)	0.001 (0.21)			-0.008 (-1.88)*	-0.002 (-0.78)
$\Delta\widehat{RT}_{t-5}$	0.010 (1.83)*	0.031 (3.53)***	0.007 (1.21)	-0.003 (-0.67)			0.006 (1.05)	0.006 (2.67)**
$\Delta\widehat{RT}_{t-6}$	0.006 (1.03)	0.012 (1.73)						
R^2	0.84	0.85	0.81	0.81	0.64	0.63	0.77	0.83
Adj. R^2	0.58	0.61	0.60	0.61	0.47	0.45	0.52	0.65
AIC	-7.83	-7.89	-7.83	-7.86	-7.63	-7.60	-7.67	-7.97
DW	2.65	1.99	2.33	2.19	2.13	2.38	2.26	2.20
Start	2004Q4	2004Q4	2004Q3	2004Q3	2004Q1	2004Q1	2004Q3	2004Q3
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	44	44	45	45	47	47	45	45

Table 43 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate error correction models. The fitted values are generated using the quantitative easing proxy indicated in the 'QE proxy' row. A hat (^) indicates a fitted series. The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium. The number of lags is chosen based on the number for which cointegration is found in a Johansen Cointegration test (Table 7).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

C.3.4 QE proxy: size of the Fed's balance sheet

Dep. variable:	$\ln real\ GDP_t$							
QE proxy→	Size of the Fed's balance sheet							
IR proxy→	10-year bond rate				13-week Treasury Bill rate			
EFP proxy→	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio	BBB-AAA spread	≤CCC-AAA spread	10y – 3m yield rate	Debt-to-GDP ratio
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$Constant$		0.003 (3.12)***	0.004 (0.92)	0.005 (1.83)*	0.006 (3.89)***	0.002 (1.54)		0.009 (2.75)**
$ECT\ GDP_{t-1}$		-0.334 (-4.61)***	-0.368 (-0.85)	-0.315 (-1.43)	-0.441 (-1.38)	-0.426 (-2.11)**		-0.039 (-0.13)
$ECT\ IR_{t-1}$		-0.009 (-4.49)***	0.040 (1.23)	-0.006 (-1.83)*	-0.007 (-0.48)	0.001 (0.16)		-0.009 (-0.68)
$ECT\ EFP_{t-1}$		-0.0003 (-1.04)	-0.033 (-1.19)	0.001 (1.02)	-0.009 (-3.65)***	-0.0004 (-1.24)		0.0005 (0.72)
$\Delta\ln \widehat{GDP}_{t-1}$		0.151 (0.77)	0.115 (0.32)	-0.023 (-0.1)	-0.055 (-0.24)	0.418 (1.91)*		-0.197 (-0.67)
$\Delta\ln \widehat{GDP}_{t-2}$			0.083 (0.26)	-0.056 (-0.25)	-0.162 (-0.93)			-0.279 (-1.04)
$\Delta\ln \widehat{GDP}_{t-3}$			0.005 (0.02)					
$\Delta\widehat{IR}_{t-1}$		0.001 (0.35)	0.014 (0.71)	0.003 (0.54)	0.013 (1.4)	-0.005 (-1.09)		0.010 (1.13)
$\Delta\widehat{IR}_{t-2}$			-0.010 (-0.63)	-0.002 (-0.58)	0.008 (1.22)			0.012 (1.36)
$\Delta\widehat{IR}_{t-3}$			-0.000003 (0.00)					
$\Delta\widehat{EFP}_{t-1}$		0.0002 (0.43)	-0.014 (-0.94)	-0.0004 (-0.5)	0.006 (1.09)	0.0002 (0.22)		-0.001 (-1.36)
$\Delta\widehat{EFP}_{t-2}$			0.003 (0.2)	-0.0001 (-0.15)	0.005 (0.83)			-0.0001 (-0.13)
$\Delta\widehat{EFP}_{t-3}$			0.001 (0.12)					
$\Delta\widehat{RT}_{t-1}$		0.002 (0.61)	0.002 (0.55)	0.004 (1.4)	0.00004 (0.02)	-0.001 (-0.34)		0.001 (0.26)
$\Delta\widehat{RT}_{t-2}$			-0.004 (-0.87)	0.001 (0.45)	-0.0003 (-0.12)			0.002 (0.77)
$\Delta\widehat{RT}_{t-3}$			-0.002 (-0.38)					
R^2		0.70	0.72	0.75	0.78	0.63		0.68
Adj. R^2		0.61	0.36	0.59	0.64	0.52		0.48
AIC		-7.69	-7.75	-7.63	-7.77	-7.48		-7.40
DW		2.45	2.10	1.81	1.95	2.12		2.10
Start		2003Q3	2004Q1	2003Q4	2003Q4	2003Q3		2003Q4
End		2015Q3	2015Q3	2015Q3	2015Q3	2015Q3		2015Q3
# obs.		32	28	30	30	32		30

Table 44 | Estimation of the effect of fitted values of the interest rate (IR), the external finance premium (EFP) and risk tolerance (RT) (from Appendix B.1.3) on output, using multivariate error correction models. The fitted values are generated

using the quantitative easing proxy indicated in the 'QE proxy' row. A hat (^) indicates a fitted series. The 'EFP proxy' row indicates the external finance premium proxy used in that respective column. The 'IR proxy' row indicates the interest rate proxy used in that respective column. The proxy for risk tolerance is always the equity risk premium. The number of lags is chosen based on the number for which cointegration is found in a Johansen Cointegration test (Table 7).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
*t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D Simultaneous estimation

D.1 Vector autoregressive models

D.1.1 QE proxy: Treasury securities held by the Fed

D.1.1.1 BBB-AAA corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	2.74 (3.16)***	-60.80 (-2.61)**	-74.51 (-3.1)***	-72.91 (-1.9)*	4.67 (5.52)**	-19.77 (-0.87)	-55.60 (-2.73)***	-103.44 (-3.22)***
$\ln GDP_{t-1}$	0.33 (1.27)	-16.09 (-1.54)	10.08 (3.2)***	8.15 (1.72)*	-1.14 (-8.68)**	-20.50 (-3.21)***	7.42 (3.19)***	14.56 (3.73)***
$\ln GDP_{t-2}$	-0.34 (-1.06)	-6.63 (-0.84)			-1.67 (-9.74)**	0.82 (0.09)		
$\ln GDP_{t-3}$	0.41 (1.37)	-1.91 (-0.22)			1.05 (5.23)**	12.11 (1.55)		
$\ln GDP_{t-4}$	0.31 (0.94)	-10.87 (-1.23)			0.94 (6.42)**	0.76 (0.09)		
$\ln GDP_{t-5}$	-0.31 (-1.08)	11.38 (1.25)			1.38 (6.74)**	-0.92 (-0.12)		
$\ln GDP_{t-6}$	0.01 (0.04)	42.59 (4.35)***			0.09 (0.74)	11.63 (1.7)		
$\ln GDP_{t-7}$	0.02 (0.07)				1.27 (5.08)**			
$\ln GDP_{t-8}$	0.24 (0.89)				-1.32 (-4.71)**			
IR_{t-1}	0.005 (0.69)	-0.68 (-3.16)***	-0.34 (-1.59)	0.19 (0.58)	-0.04 (-6.52)**	0.91 (4.73)***	-0.11 (-1.97)*	-0.24 (-3.46)***
IR_{t-2}	-0.02 (-2.35)**	-0.72 (-3.08)**	0.53 (2.48)**	0.62 (1.82)*	-0.04 (-7.67)**	0.33 (0.78)		
IR_{t-3}	0.004 (0.47)	0.24 (0.95)	-0.49 (-2.55)**	-0.64 (-1.89)*	0.08 (8.95)**	0.24 (0.5)		
IR_{t-4}	0.004 (0.55)	-0.44 (-2.45)**		-0.47 (-1.46)	-0.03 (-3.15)*	-0.97 (-2.89)***		
IR_{t-5}	0.01 (1.43)	-0.18 (-1.07)		0.64 (2.92)***	0.02 (1.59)	0.93 (3.66)***		
IR_{t-6}	-0.01 (-1.39)	-1.09 (-6.96)***			0.06 (8.72)**	-0.86 (-5.06)***		
IR_{t-7}	-0.001 (-0.25)				-0.05 (-5.77)**			
IR_{t-8}	0.001 (0.16)				-0.05 (-7.95)**			
EFP_{t-1}	-0.002 (-0.26)	-1.13 (-4.04)***	0.79 (3.64)***	-0.10 (-0.43)	0.06 (9.16)**	-0.15 (-0.74)	0.38 (2.55)**	0.36 (1.09)
EFP_{t-2}	-0.003 (-0.42)	-0.22 (-0.92)	0.12 (0.64)		-0.02 (-4.18)*	-0.31 (-1.39)		-1.20 (-3.57)***

EFP_{t-3}	-0.01 (-0.89)	-1.17 (-5.56)***	-0.61 (-2.78)***		0.001 (0.14)	0.45 (2.31)**		
EFP_{t-4}	0.004 (0.51)	-0.19 (-0.95)	0.27 (1.37)		-0.01 (-1.69)	-0.60 (-4.23)***		
EFP_{t-5}	-0.01 (-0.91)	-0.47 (-2.26)**	0.23 (1.28)		-0.01 (-3.67)*			
EFP_{t-6}	0.01 (1.62)		-0.47 (-2.49)**		0.02 (6.68)**			
EFP_{t-7}	0.005 (0.85)		-0.14 (-0.86)		-0.02 (-4.92)**			
EFP_{t-8}	-0.01 (-1.15)		0.27 (2)*		-0.02 (-5.79)**			
RT_{t-1}	0.002 (0.46)	-0.60 (-3.42)***	0.11 (1.05)	1.12 (8.23)***	-0.05 (-8.72)**	-0.08 (-0.78)	0.23 (2.92)***	0.85 (4.82)***
RT_{t-2}	-0.01 (-1.14)	-0.30 (-1.7)			-0.01 (-1.98)	0.19 (1.9)*		-0.56 (-2.86)***
RT_{t-3}	0.001 (0.12)	0.60 (2.45)**			-0.02 (-5.18)**			0.87 (5.4)***
RT_{t-4}	-0.002 (-0.22)	-0.25 (-1.18)			0.03 (4.73)**			
RT_{t-5}	0.01 (1.19)	0.67 (3.03)**			-0.003 (-1.51)			
RT_{t-6}	-0.01 (-1.87)*	-0.87 (-5.19)***			0.01 (4.38)**			
RT_{t-7}		0.24 (1.45)			0.01 (4.68)**			
RT_{t-8}		-0.48 (-4.53)***			0.001 (0.77)			
$\ln QE_{t-1}$	0.03 (3.74)***	-2.99 (-3.83)***	1.22 (1.52)	1.38 (1.24)	0.22 (8.9)**	-4.81 (-5.81)***	-1.12 (-4.77)***	-1.53 (-1.38)
$\ln QE_{t-2}$		4.58 (2.59)**	-6.72 (-4.32)***	-6.47 (-2.87)***	-0.57 (-7.16)**	6.77 (4.87)***		-3.20 (-1.49)
$\ln QE_{t-3}$		-9.15 (-4.06)***	8.51 (5.22)***	10.80 (4.74)***	0.57 (6.41)**	-3.13 (-3.54)***		11.47 (3.92)***
$\ln QE_{t-4}$		9.08 (3.56)***	-4.53 (-4.52)***	-6.21 (-5.63)***	-0.20 (-2.82)			-13.37 (-3.72)***
$\ln QE_{t-5}$		-9.56 (-4.16)***			0.12 (2.39)			10.66 (2.94)***
$\ln QE_{t-6}$		10.00 (5.19)***			-0.05 (-1.56)			-11.19 (-3.4)***
$\ln QE_{t-7}$		-8.82 (-6.9)***			0.03 (1.23)			9.13 (3.66)***
$\ln QE_{t-8}$					-0.16 (-7.1)**			-4.55 (-3.83)***
R^2	0.997	0.997	0.94	0.91	0.99998	0.997	0.87	0.94
Adj. R^2	0.99	0.99	0.90	0.87	0.9996	0.99	0.85	0.91
AIC	-7.88	-1.36	0.26	1.20	-12.62	-0.78	0.54	0.84
DW	2.54	2.69	2.30	1.89	3.00	2.28	2.06	2.39
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4

# obs.	43	44	44	44	43	44	44	44

Table 45 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.1.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	3.10 (2.1)*	217.73 (3.84)***	-357.52 (-2.16)**	-72.99 (-2.21)**	2.63 (0.23)	100.05 (4.99)***	-273.31 (-1.77)*	-55.92 (-1.71)*
$\ln GDP_{t-1}$	-0.43 (-0.81)	-42.98 (-2.41)**	49.42 (2.49)**	9.28 (2.38)**	-0.81 (-0.38)	-12.25 (-5.4)***	32.77 (1.81)*	8.34 (2.2)**
$\ln GDP_{t-2}$	0.01 (0.02)	-34.57 (-2.39)**			-0.64 (-0.9)			
$\ln GDP_{t-3}$	0.01 (0.02)	-52.63 (-3.24)***			-0.33 (-0.25)			
$\ln GDP_{t-4}$	0.35 (0.93)	-30.98 (-2.29)**			0.73 (0.34)			
$\ln GDP_{t-5}$	0.16 (0.31)	31.01 (2)*			1.29 (0.27)			
$\ln GDP_{t-6}$	0.34 (0.77)	72.32 (4.03)***			1.07 (0.37)			
$\ln GDP_{t-7}$	0.28 (0.56)	38.53 (2.36)**			-0.26 (-0.1)			
$\ln GDP_{t-8}$	-0.10 (-0.34)				-0.30 (-0.15)			
IR_{t-1}	0.01 (0.59)	0.42 (0.98)	-2.01 (-1.5)	-0.01 (-0.04)	-0.03 (-0.32)	1.01 (18.84)***	-1.30 (-3.96)***	-0.18 (-2.69)**
IR_{t-2}	-0.01 (-0.68)	-0.54 (-1.26)		0.41 (1.24)	-0.005 (-0.11)			
IR_{t-3}	-0.01 (-0.8)	0.16 (0.34)		-0.65 (-2.07)**	0.04 (0.5)			
IR_{t-4}	0.002 (0.37)	-0.92 (-2.55)**		-0.35 (-1.14)	0.0004 (0.01)			
IR_{t-5}	-0.001 (-0.11)	-0.55 (-1.7)		0.56 (2.76)***	-0.02 (-0.23)			
IR_{t-6}	-0.001 (-0.26)	-1.41 (-4.62)***			0.01 (0.28)			
IR_{t-7}	0.002 (0.34)				0.01 (0.21)			
IR_{t-8}	0.01 (1.07)				-0.03 (-0.65)			

EFP_{t-1}	-0.001 (-0.64)	-0.44 (-4.71)***	1.56 (5.7)***	0.01 (0.26)	0.002 (0.56)	0.07 (2.45)**	0.37 (2.83)***	-0.02 (-0.49)
EFP_{t-2}	0.0003 (0.08)	0.31 (2.95)**	-1.07 (-3.11)***	-0.07 (-1.92)*	0.0005 (0.04)	-0.10 (-1.99)*		-0.01 (-0.13)
EFP_{t-3}	0.001 (0.17)	-0.27 (-2.58)**			-0.003 (-0.14)	0.08 (2.25)**		-0.10 (-2.11)**
EFP_{t-4}	0.0002 (0.15)	0.03 (0.47)			0.002 (0.2)			
EFP_{t-5}	-0.001 (-1.25)	-0.04 (-0.71)			-0.003 (-0.31)			
EFP_{t-6}	0.0004 (0.32)				-0.0005 (-0.09)			
EFP_{t-7}	0.001 (0.91)				0.004 (0.34)			
EFP_{t-8}	-0.0001 (-0.12)				-0.002 (-0.26)			
RT_{t-1}	0.001 (0.08)	0.92 (1.63)	-1.77 (-0.97)	0.97 (6.85)***	-0.03 (-0.34)	-0.38 (-2.23)**	3.11 (4.15)***	1.01 (4.28)***
RT_{t-2}	-0.003 (-0.2)	-1.14 (-2.05)*	-0.18 (-0.11)		-0.02 (-0.26)	0.74 (2.83)***	-3.51 (-3.08)***	-0.82 (-2.45)**
RT_{t-3}	-0.01 (-1.02)	0.21 (0.35)	0.43 (0.3)		0.01 (0.2)	-0.60 (-2.96)***	0.91 (0.65)	0.89 (3.55)***
RT_{t-4}		-0.89 (-2.04)*	3.85 (2.69)**		-0.002 (-0.13)	0.15 (0.9)	0.54 (0.37)	
RT_{t-5}		0.10 (0.25)	-2.90 (-3.36)***		0.01 (0.17)	-0.24 (-1.65)	-0.22 (-0.16)	
RT_{t-6}		-1.30 (-4.67)***			0.005 (0.26)	0.13 (1.36)	0.10 (0.08)	
RT_{t-7}		0.01 (0.05)			-0.01 (-0.38)		-2.11 (-2.53)**	
RT_{t-8}		-0.69 (-3.86)***						
$\ln QE_{t-1}$	0.03 (0.89)	-3.17 (-2.52)**	9.45 (1.52)	1.41 (1.35)	-0.03 (-0.14)	1.30 (5.64)***	10.58 (1.86)*	-0.36 (-0.34)
$\ln QE_{t-2}$	0.02 (0.4)	7.51 (3.01)**	-60.01 (-4.24)***	-6.61 (-3.13)***	-0.02 (-0.17)		-54.44 (-4.35)***	-3.73 (-1.83)*
$\ln QE_{t-3}$	0.003 (0.03)	-15.97 (-4.24)***	94.13 (5.46)***	10.26 (4.58)***	0.07 (0.4)		63.27 (4.06)***	7.02 (3.42)***
$\ln QE_{t-4}$	0.005 (0.04)	18.65 (3.84)***	-64.30 (-4.69)***	-6.18 (-5.28)***	0.12 (0.18)		-38.04 (-2.23)**	-4.60 (-4.08)***
$\ln QE_{t-5}$	-0.001 (-0.01)	-12.90 (-3.02)**	13.21 (2.24)**		-0.11 (-0.15)		34.52 (2.04)*	
$\ln QE_{t-6}$	0.07 (0.67)	15.96 (4.23)***			0.11 (0.18)		-37.75 (-2.89)***	
$\ln QE_{t-7}$	-0.08 (-0.91)	-10.27 (-4.01)***			-0.09 (-0.15)		19.75 (3.38)***	
$\ln QE_{t-8}$					-0.05 (-0.5)			
R^2	0.998	0.99	0.91	0.92	0.999	0.98	0.93	0.93
Adj. R^2	0.99	0.97	0.86	0.89	0.99	0.98	0.89	0.90

AIC	-8.12	-0.45	4.27	1.04	-8.78	0.42	4.06	0.98
DW	2.21	2.67	2.12	2.16	2.24	1.12	2.02	2.14
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	43	44	44	44	43	44	44	44

Table 46 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.1.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	3.32 (3.08)**	72.69 (2.64)**	-96.14 (-3.99)***	-35.23 (-0.86)	3.81 (3.23)**	33.96 (1.36)	-95.38 (-3.96)***	-36.44 (-0.91)
$\ln GDP_{t-1}$	0.15 (0.42)	-9.82 (-1.26)	12.31 (4.42)***	3.76 (0.78)	-0.06 (-0.15)	-4.09 (-1.41)	12.23 (4.4)***	3.85 (0.82)
$\ln GDP_{t-2}$	-0.77 (-2.39)*	8.64 (1.2)			-1.00 (-2.59)*			
$\ln GDP_{t-3}$	0.76 (2.93)**	18.86 (2.8)**			0.62 (2.39)*			
$\ln GDP_{t-4}$	0.48 (1.54)	-22.09 (-3.04)**			0.40 (1.3)			
$\ln GDP_{t-5}$	0.60 (1.39)				0.76 (1.67)			
$\ln GDP_{t-6}$	0.06 (0.19)				0.11 (0.35)			
$\ln GDP_{t-7}$	-1.56 (-2.17)*				-1.31 (-1.84)			
$\ln GDP_{t-8}$	0.98 (2.49)*				1.06 (2.67)*			
IR_{t-1}	-0.004 (-0.33)	0.16 (0.79)	-0.47 (-3.05)***	-0.05 (-0.14)	-0.01 (-0.88)	1.70 (8.35)***	-0.48 (-3.06)***	-0.05 (-0.16)
IR_{t-2}	-0.03 (-1.11)	-0.33 (-0.74)		2.10 (3.82)***	-0.01 (-0.5)	-0.66 (-4.42)***		2.20 (4.44)***
IR_{t-3}	0.05 (2.75)**	-0.10 (-0.24)		-3.00 (-5.26)***	0.07 (2.82)**			-3.10 (-6.08)***
IR_{t-4}	-0.09 (-3.4)**	-1.12 (-2.97)**		1.35 (4.33)***	-0.09 (-3.5)**			1.39 (5.07)***
IR_{t-5}	0.03 (1.79)	2.29 (6.17)***			0.04 (1.97)			
IR_{t-6}	0.0004 (0.03)	-1.92 (-7.14)***			0.01 (0.79)			

IR_{t-7}	0.02 (1.85)				0.02 (1.7)			
IR_{t-8}	-0.03 (-2.1)*				-0.04 (-2.3)*			
EFP_{t-1}	-0.002 (-0.13)	-0.12 (-0.59)	0.79 (13.24)***	0.53 (1.82)*	-0.002 (-0.22)	0.25 (1.47)	0.32 (1.67)	0.50 (1.83)*
EFP_{t-2}	0.01 (0.66)	0.03 (0.08)		-1.45 (-2.58)**	-0.01 (-0.34)	-0.43 (-2.88)***		0.66 (2.51)**
EFP_{t-3}	-0.05 (-3.31)**	-0.21 (-0.73)		2.45 (4.58)***	0.01 (0.82)	0.34 (3.5)***		-0.57 (-3.13)***
EFP_{t-4}	0.05 (3.51)**	1.10 (4.23)***		-1.38 (-4.92)***	-0.03 (-2.77)*			
EFP_{t-5}	-0.01 (-0.65)	-2.13 (-6.88)***			0.02 (3.63)**			
EFP_{t-6}	-0.01 (-0.77)	0.95 (3.59)***			-0.003 (-0.29)			
EFP_{t-7}	-0.01 (-1.05)				0.02 (1.67)			
EFP_{t-8}	0.01 (0.7)				-0.02 (-2)			
RT_{t-1}	-0.01 (-0.81)	-0.62 (-5.29)***	-0.16 (-1.77)*	0.92 (7.88)***	-0.01 (-1.26)	0.04 (0.55)	-0.16 (-1.79)*	0.93 (8.42)***
RT_{t-2}	-0.02 (-1.48)	0.52 (2.67)**			-0.01 (-0.79)			
RT_{t-3}	0.03 (3.03)**	-0.56 (-2.95)**			0.03 (3.2)**			
RT_{t-4}	-0.04 (-3.31)**	-0.18 (-1.18)			-0.04 (-3.28)**			
RT_{t-5}	0.01 (2.15)*	0.63 (4.41)***			0.01 (2.19)*			
RT_{t-6}	-0.004 (-0.83)	-0.82 (-7.04)***			-0.003 (-0.54)			
RT_{t-7}	0.001 (0.19)	0.28 (2.68)**			0.01 (0.67)			
RT_{t-8}	0.001 (0.26)	-0.27 (-3.2)***			0.0003 (0.06)			
$\ln QE_{t-1}$	-0.05 (-1.78)	1.17 (1.79)	0.26 (0.46)	-1.54 (-1.27)	-0.06 (-1.91)	-2.39 (-4.32)***	0.25 (0.43)	-1.59 (-1.38)
$\ln QE_{t-2}$	0.15 (1.74)	-1.38 (-1.22)	-1.68 (-2.47)**	0.13 (0.06)	0.11 (1.21)	6.16 (5.48)***	-1.67 (-2.45)**	0.14 (0.06)
$\ln QE_{t-3}$	-0.07 (-0.83)	-1.09 (-0.78)		8.09 (2.91)***	-0.04 (-0.4)	-6.08 (-5.45)***		8.28 (3.06)***
$\ln QE_{t-4}$	0.09 (1.49)	1.19 (0.72)		-11.07 (-3.17)***	0.12 (1.89)	2.67 (5.06)***		-11.36 (-3.43)***
$\ln QE_{t-5}$	-0.12 (-1.84)	-5.07 (-3.17)***		10.25 (3.08)***	-0.16 (-2.21)*			10.43 (3.22)***
$\ln QE_{t-6}$		9.62 (6.1)***		-9.37 (-3.29)***	0.05 (1.15)			-9.41 (-3.4)***
$\ln QE_{t-7}$		-9.56 (-6.75)***		7.94 (3.48)***				7.94 (3.6)***

$\ln QE_{t-8}$		3.74 (5.66)***		-4.61 (-4.32)***				-4.58 (-4.49)***
R^2	0.9996	0.998	0.94	0.96	0.9997	0.99	0.94	0.96
Adj. R^2	0.996	0.99	0.93	0.93	0.996	0.99	0.93	0.94
AIC	-9.60	-1.76	0.57	0.59	-9.77	-0.26	0.57	0.54
DW	3.32	3.41	1.40	2.30	3.30	2.05	1.40	2.33
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	43	44	44	44	43	44	44	44

Table 47 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.1.4 Debt-to-GDP ratio

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.51 (0.12)	-556.74 (-7.84)***	-246.96 (-2.14)**	18.76 (0.37)	7.31 (1.47)	182.99 (6.89)***	-131.56 (-1.78)*	-141.10 (-3.26)***
$\ln GDP_{t-1}$	0.11 (0.18)	-7.84 (-0.75)	128.13 (2.89)***	-3.39 (-0.55)	-0.79 (-1.75)	-20.69 (-7.01)***	20.64 (2.55)**	16.47 (3.39)***
$\ln GDP_{t-2}$	0.30 (0.4)	-4.71 (-0.41)	-95.17 (-2.63)**		-0.45 (-1.2)			
$\ln GDP_{t-3}$	0.06 (0.06)	21.70 (1.69)			0.82 (1.37)			
$\ln GDP_{t-4}$	0.49 (0.58)	32.85 (2.91)**			0.35 (0.76)			
$\ln GDP_{t-5}$	-0.07 (-0.1)	22.00 (2.2)**			-0.46 (-1.07)			
$\ln GDP_{t-6}$	0.23 (0.21)	26.45 (2.78)**			-0.82 (-1.52)			
$\ln GDP_{t-7}$	-0.28 (-0.27)	32.22 (3.14)***			1.03 (1.84)			
$\ln GDP_{t-8}$	0.07 (0.1)	-50.10 (-5.51)***			0.35 (0.97)			
IR_{t-1}	-0.001 (-0.05)	-0.68 (-2.98)**	0.19 (0.22)	0.56 (1.73)*	-0.01 (-1.45)	1.04 (16.78)***	-0.42 (-1.85)*	-0.25 (-2.51)**
IR_{t-2}	-0.01 (-0.41)	-1.05 (-4.02)***	0.77 (0.91)	0.70 (2.21)**	0.01 (0.44)			
IR_{t-3}	0.005 (0.32)	-0.63 (-2.57)**	-0.47 (-0.57)	-0.66 (-2.05)**	-0.002 (-0.13)			
IR_{t-4}	-0.002 (-0.16)	-0.67 (-3.82)***	-0.78 (-1.28)	-0.31 (-0.97)	-0.02 (-1.84)			

IR_{t-5}	0.002 (0.21)	-0.34 (-2.34)**		0.46 (1.65)	0.04 (2.49)*			
IR_{t-6}	-0.01 (-0.71)	-0.97 (-6.19)***		0.43 (1.77)*	0.03 (2.12)			
IR_{t-7}	0.001 (0.09)	-0.97 (-5.8)***			-0.02 (-2.07)			
IR_{t-8}	-0.002 (-0.27)	-0.34 (-2.46)**			-0.03 (-2.57)*			
EFP_{t-1}	-0.001 (-0.36)	-0.12 (-3.31)***	1.00 (22.6)***	0.05 (2.18)**	0.002 (1.02)	0.04 (2.88)***	0.95 (6.07)***	-0.05 (-2.28)**
EFP_{t-2}	0.002 (0.3)	-0.03 (-0.53)			0.001 (0.56)		-0.55 (-2.43)**	
EFP_{t-3}	-0.001 (-0.25)	-0.17 (-3.4)***			0.003 (1.15)		0.59 (3.75)***	
EFP_{t-4}	0.003 (0.43)				0.0001 (0.04)			
EFP_{t-5}	-0.002 (-0.22)				-0.002 (-0.63)			
EFP_{t-6}	0.0004 (0.06)				-0.005 (-1.84)			
EFP_{t-7}	0.001 (0.1)				0.0005 (0.2)			
EFP_{t-8}	-0.003 (-0.63)				-0.002 (-0.88)			
RT_{t-1}	-0.002 (-0.16)	-0.43 (-2.6)**	1.02 (2.78)***	1.01 (8.31)***	-0.01 (-1.33)	-0.19 (-2.45)**	0.28 (0.75)	1.13 (8.19)***
RT_{t-2}	-0.01 (-0.39)	-0.43 (-2.29)**			0.01 (0.83)	0.03 (0.23)	0.30 (0.54)	-0.77 (-3.75)***
RT_{t-3}	0.01 (0.42)	-0.54 (-3.35)***			-0.003 (-0.44)	0.09 (0.58)	-0.19 (-0.35)	0.56 (3.75)***
RT_{t-4}	-0.01 (-0.59)				-0.01 (-2.39)*	-0.23 (-2.01)*	0.44 (0.87)	
RT_{t-5}	0.003 (0.31)				-0.01 (-1.14)		0.11 (0.32)	
RT_{t-6}	-0.001 (-0.15)				-0.0002 (-0.04)			
RT_{t-7}	-0.0001 (-0.02)				0.002 (0.51)			
RT_{t-8}					0.001 (0.21)			
$\ln QE_{t-1}$	0.01 (0.13)	4.33 (4.69)***	-3.99 (-1.46)	0.04 (0.03)	0.07 (1.29)	-2.60 (-2.5)**	-4.91 (-4.73)***	1.55 (1.09)
$\ln QE_{t-2}$	0.07 (0.65)	-2.97 (-2.24)**	-1.21 (-0.39)	-4.94 (-2.16)**	-0.02 (-0.34)	6.27 (3.22)***		-5.79 (-2.37)**
$\ln QE_{t-3}$	-0.04 (-0.33)	2.65 (1.6)		10.14 (4.66)***	0.09 (1.13)	-5.75 (-3.41)***		10.13 (3.61)***
$\ln QE_{t-4}$	-0.01 (-0.07)	-4.43 (-2.3)**		-4.86 (-4)***	-0.02 (-0.26)	3.09 (4.14)***		-8.00 (-2.69)**
$\ln QE_{t-5}$	0.06 (0.52)	0.64 (0.37)			-0.02 (-0.3)			4.61 (1.67)

$\ln QE_{t-6}$	-0.05 (-0.59)	-0.43 (-0.27)			0.06 (1.55)			-5.03 (-1.98)*
$\ln QE_{t-7}$		0.85 (0.61)						4.62 (2.08)**
$\ln QE_{t-8}$		-6.92 (-5.52)***						-3.02 (-2.69)**
R^2	0.997	0.99	0.997	0.92	0.9995	0.99	0.998	0.93
Adj. R^2	0.97	0.98	0.996	0.89	0.99	0.98	0.997	0.89
AIC	-7.57	-0.98	3.08	1.09	-9.40	0.18	2.90	1.07
DW	2.55	1.69	1.61	1.85	2.09	1.06	1.90	2.42
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4
# obs.	43	44	43	44	43	44	43	44

Table 48 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.2 QE proxy: mortgage-backed securities held by the Fed

D.1.2.1 BBB-AAA corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	2.13 (1.06)	141.92 (2.5)**	-55.79 (-2.35)**	-44.97 (-0.86)	1.20 (1.66)	-5.49 (-1.85)*	21.68 (1.05)	14.65 (0.28)
$\ln GDP_{t-1}$	0.77 (2.72)**	-13.70 (-2.42)**	6.08 (2.54)**	3.49 (0.66)	0.31 (1.2)	4.14 (2.93)**	-1.51 (-0.72)	9.96 (1.36)
$\ln GDP_{t-2}$	0.01 (0.02)				0.21 (0.73)	-1.74 (-1.07)		
$\ln GDP_{t-3}$	0.04 (0.13)				0.36 (1.43)	-0.07 (-0.04)		
$\ln GDP_{t-4}$						-1.67 (-1.75)		
IR_{t-1}	-0.01 (-0.62)	0.20 (0.6)	0.40 (2.73)**	0.53 (1.37)	-0.03 (-0.85)	0.96 (4.79)***	0.85 (0.72)	2.67 (1.4)
IR_{t-2}	-0.01 (-1.36)	-0.29 (-1.6)		0.63 (2.1)**	-0.05 (-1.06)	-0.32 (-1.54)	-2.37 (-1.92)*	-0.70 (-0.33)
IR_{t-3}	0.01 (1.42)			-0.41 (-1.88)*	-0.02 (-0.38)			-6.24 (-3.29)***
EFP_{t-1}	-0.004 (-0.43)	-0.02 (-0.1)	0.74 (6.61)***	0.23 (0.92)	-0.003 (-0.62)	0.07 (3.52)***	0.70 (5.05)***	-0.89 (-2.09)*
EFP_{t-2}	-0.01 (-0.81)	-0.39 (-1.42)			0.004 (0.74)	-0.10 (-3.65)***	-0.17 (-1.22)	-0.20 (-0.4)
EFP_{t-3}	-0.01 (-0.98)				-0.004 (-0.82)	0.06 (3.27)***		-0.99 (-1.75)
RT_{t-1}	-0.004 (-0.41)	-0.49 (-2.85)**	0.47 (5.59)***	1.32 (7.55)***	-0.0004 (-0.12)	-0.02 (-1.94)*	0.24 (2.95)***	0.38 (1.72)
RT_{t-2}	-0.01 (-1.55)		-0.30 (-4.07)***		-0.002 (-0.56)		-0.28 (-3.38)***	-0.80 (-4.29)***
RT_{t-3}	0.01 (1.17)				-0.001 (-0.22)			
$\ln QE_{t-1}$	-0.03 (-0.76)	-0.30 (-2.6)**	-0.31 (-5.19)***	0.55 (4.49)***	-0.002 (-0.11)	-0.07 (-3.86)***	-0.44 (-5.34)***	-8.50 (-6.26)***
$\ln QE_{t-2}$	0.01 (0.72)							0.64 (0.31)
$\ln QE_{t-3}$								0.68 (1.61)
R^2	0.99	0.86	0.95	0.89	0.995	0.87	0.95	0.97
Adj. R^2	0.98	0.80	0.94	0.85	0.99	0.77	0.92	0.95
AIC	-7.60	0.51	-0.71	0.84	-7.93	-4.36	-0.49	-0.18
DW	2.12	1.75	1.86	1.78	2.31	2.01	1.64	2.85
Start	2009Q3	2009Q2	2009Q2	2009Q2	2009Q2	2009Q2	2009Q2	2009Q4
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	25	27	27	27	26	27	27	25

Table 49 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.2.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	1.82 (0.59)	73.88 (2.31)**	-1024.84 (-4.46)***	-141.44 (-2.04)*	0.68 (1.32)	-2.88 (-0.93)	-299.75 (-1.65)	-116.39 (-3.02)***
$\ln GDP_{t-1}$	0.75 (2.15)*	-6.56 (-2.08)*	139.42 (4.58)***	19.84 (2.39)**	0.35 (1.46)	2.38 (1.93)*	84.85 (1.61)	23.51 (4.45)***
$\ln GDP_{t-2}$	-0.09 (-0.19)				0.21 (0.8)	-2.08 (-1.96)*	-9.90 (-0.19)	
$\ln GDP_{t-3}$	0.15 (0.48)				0.36 (1.53)		-113.54 (-2.35)**	
$\ln GDP_{t-4}$							83.87 (1.84)*	
IR_{t-1}	-0.004 (-0.24)	0.31 (0.93)	1.12 (0.74)	-0.16 (-0.46)	-0.03 (-0.88)	0.93 (5.84)***	-3.36 (-0.61)	2.15 (1.25)
IR_{t-2}	-0.01 (-1.28)	-0.52 (-2.12)**	1.18 (0.69)	0.92 (4.37)***	-0.07 (-2.01)*			0.96 (0.52)
IR_{t-3}	0.01 (0.99)	0.38 (1.96)*	-0.50 (-0.31)		0.01 (0.39)			-6.61 (-3.84)***
IR_{t-4}			-2.62 (-1.61)					
EFP_{t-1}	0.001 (0.19)	-0.06 (-1.54)	0.37 (1.38)	-0.003 (-0.07)	-0.002 (-0.96)	0.02 (4.31)***	0.87 (4.29)***	-0.15 (-2.19)**
EFP_{t-2}	0.0002 (0.07)				0.001 (1.18)	-0.003 (-0.58)		0.08 (0.97)
EFP_{t-3}	-0.001 (-0.57)							-0.25 (-5.36)***
RT_{t-1}	0.0003 (0.05)	-0.49 (-2.21)**	-0.68 (-3.55)***	1.23 (7.09)***	0.003 (0.73)	0.06 (2.17)*	-0.31 (-2.01)*	1.23 (7.11)***
RT_{t-2}	-0.02 (-1.32)		-1.81 (-1.21)		-0.005 (-1.43)		-2.13 (-3.29)***	-0.98 (-4.69)***
RT_{t-3}	0.02 (0.91)		-0.69 (-0.52)		-0.001 (-0.38)			
RT_{t-4}			-2.64 (-2.43)**					
$\ln QE_{t-1}$	0.01 (0.26)	-0.42 (-2.12)**	-23.89 (-4.09)***	-2.10 (-0.74)	0.01 (0.48)	0.17 (1.76)*	-7.01 (-0.76)	-7.34 (-6.99)***
$\ln QE_{t-2}$	0.003 (0.38)		3.05 (1.97)*	-2.45 (-0.62)		-0.25 (-3.58)***	-8.76 (-0.67)	0.19 (1.04)

$\ln QE_{t-3}$				0.46 (0.23)		0.07 (5.04)***	5.52 (0.86)	
$\ln QE_{t-4}$				0.62 (3.61)***			1.57 (2.97)**	
R^2	0.99	0.86	0.90	0.95	0.995	0.89	0.93	0.97
Adj. R^2	0.98	0.81	0.82	0.92	0.99	0.82	0.85	0.95
AIC	-7.46	0.46	2.79	0.10	-8.03	-4.83	2.44	-0.24
DW	2.03	1.77	2.52	2.96	2.56	2.53	2.70	2.37
Start	2009Q3	2009Q2	2009Q3	2010Q1	2009Q2	2009Q4	2010Q1	2009Q3
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	25	27	26	24	26	25	24	26

Table 50 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.2.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	4.01 (1.5)	135.92 (2.94)**	224.40 (3.71)***	14.35 (0.34)	1.01 (1.16)	-6.41 (-1.19)	41.29 (1.13)	14.50 (0.35)
$\ln GDP_{t-1}$	0.08 (0.27)	-4.10 (-0.3)	-27.98 (-1.79)*	-2.54 (-0.6)	0.44 (1.68)	4.81 (3.86)***	-3.71 (-0.99)	-2.56 (-0.6)
$\ln GDP_{t-2}$	-0.03 (-0.09)	-11.83 (-0.93)	-7.37 (-0.43)		0.13 (0.47)	0.83 (0.6)		
$\ln GDP_{t-3}$	0.47 (1.64)		-11.90 (-0.75)		0.32 (1.36)	-1.18 (-0.92)		
$\ln GDP_{t-4}$			21.13 (1.65)			-3.41 (-3.29)***		
IR_{t-1}	-0.06 (-1.16)	-0.50 (-0.3)	-1.37 (-0.77)	-0.90 (-0.43)	-0.01 (-0.33)	0.62 (4.4)***	0.41 (0.22)	-0.91 (-0.43)
IR_{t-2}	-0.07 (-1.64)	0.78 (0.41)			-0.08 (-1.99)*			
IR_{t-3}	-0.01 (-0.34)	4.08 (3.26)***			0.02 (0.69)			
EFP_{t-1}	0.06 (1.14)	0.53 (0.32)	1.30 (0.77)	1.26 (0.61)	0.001 (0.11)	0.06 (2.08)*	0.56 (1.7)	0.36 (0.98)
EFP_{t-2}	0.06 (1.43)	-0.95 (-0.49)		0.50 (1.75)*	-0.01 (-0.95)	-0.08 (-2.01)*	-0.35 (-1.4)	0.50 (1.74)*
EFP_{t-3}	0.02 (0.64)	-4.01 (-3.08)***		-0.30 (-1.46)	0.004 (0.98)	-0.05 (-1.89)*	0.15 (0.81)	-0.30 (-1.46)
RT_{t-1}	0.0003 (0.05)	-0.49 (-2.21)**	-0.68 (-3.55)***	1.23 (7.09)***	0.003 (0.73)	0.06 (2.17)*	-0.31 (-2.01)*	1.23 (7.11)***
RT_{t-2}	-0.01 (-0.93)	0.29 (1.15)	0.53 (3.18)***		-0.01 (-1.39)	-0.05 (-1.62)		
RT_{t-3}	0.01 (1.1)				0.003 (0.81)	-0.07 (-2.79)**		
$\ln QE_{t-1}$	0.04 (1.63)	1.49 (2.89)**	2.21 (2.9)**	0.56 (4.38)***	0.01 (0.65)	-0.16 (-2.01)*	-0.19 (-1.66)	0.56 (4.39)***
$\ln QE_{t-2}$	0.01 (0.21)		0.02 (0.11)			-0.08 (-4.2)***		
$\ln QE_{t-3}$	-0.004 (-0.82)							
R^2	0.997	0.92	0.90	0.88	0.995	0.92	0.83	0.88
Adj. R^2	0.99	0.87	0.83	0.84	0.99	0.83	0.77	0.84
AIC	-8.21	0.19	0.33	0.87	-7.97	-4.75	0.61	0.87
DW	3.06	1.92	2.16	1.72	2.43	2.03	1.72	1.71
Start	2009Q4	2009Q2	2009Q3	2009Q2	2009Q2	2009Q3	2009Q2	2009Q2
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	24	27	26	27	26	26	27	27

Table 51 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the

interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.2.4 Debt-to-GDP ratio

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	-1.26 (-0.49)	202.79 (2.25)**	201.98 (1.16)	-59.32 (-0.96)	1.27 (1.24)	-14.35 (-3.66)***	122.68 (1.02)	354.44 (6.82)***
$\ln GDP_{t-1}$	0.44 (1.4)	-20.30 (-2.19)**	120.16 (2.8)**	5.29 (0.81)	0.23 (0.74)	1.60 (3.57)***	141.06 (3.43)***	-30.64 (-5.55)***
$\ln GDP_{t-2}$	0.94 (2.45)**		-138.30 (-3.17)***		0.47 (1.26)		-151.08 (-3.56)***	
$\ln GDP_{t-3}$	-0.24 (-0.63)				0.16 (0.47)			
$\ln GDP_{t-4}$								
IR_{t-1}	0.02 (1.91)*	0.12 (0.3)	-0.48 (-0.57)	0.54 (1.41)	-0.03 (-0.87)	0.95 (6.49)***	4.82 (1.13)	1.61 (0.74)
IR_{t-2}	-0.01 (-1.93)*	-0.57 (-2.1)*	0.31 (0.63)	0.53 (1.87)*	-0.07 (-1.81)*	-0.31 (-2.04)*		-1.59 (-0.79)
IR_{t-3}	0.01 (2.84)**	0.52 (2.13)**		-0.42 (-1.91)*	-0.002 (-0.04)			-8.73 (-5.87)***
IR_{t-4}								-2.93 (-2.1)*
EFP_{t-1}	-0.002 (-1.49)	-0.07 (-0.86)	1.02 (5.63)***	-0.04 (-0.98)	-0.001 (-1.02)	-0.01 (-5.3)***	1.01 (5.86)***	-0.05 (-1.63)
EFP_{t-2}	0.004 (2.72)**	0.04 (0.52)	-0.69 (-3.52)***		0.002 (1.29)		-0.71 (-3.88)***	0.06 (1.28)
EFP_{t-3}	-0.001 (-1.26)	-0.004 (-0.05)	0.62 (4.25)***		-0.001 (-0.89)		0.64 (4.64)***	0.19 (5.04)***
EFP_{t-4}		0.08 (1.1)						
RT_{t-1}	0.01 (1.73)	-0.73 (-2.73)**	-0.14 (-0.27)	1.42 (6.24)***	-0.001 (-0.27)	0.03 (1.95)*	0.07 (0.24)	-0.08 (-0.52)
RT_{t-2}	-0.01 (-1.39)							-0.42 (-2.83)**
RT_{t-3}								-0.81 (-4.3)***
$\ln QE_{t-1}$	0.03 (0.57)	-0.44 (-2.17)**	-1.47 (-2.75)**	0.61 (3.79)***	0.01 (1.06)	0.26 (2.66)**	-1.42 (-2.91)***	-0.47 (-0.26)
$\ln QE_{t-2}$	-0.04 (-1.18)				-0.001 (-0.21)	-0.33 (-4.22)***		-11.04 (-4.16)***
$\ln QE_{t-3}$	-0.001 (-0.3)					0.07 (4.86)***		6.58 (5.37)***
$\ln QE_{t-4}$								0.16 (1.00)
R^2	0.997	0.87	0.99	0.89	0.99	0.86	0.99	0.99
Adj. R^2	0.99	0.79	0.99	0.85	0.99	0.80	0.99	0.98
AIC	-8.35	0.62	2.34	0.83	-7.97	-4.72	2.21	-1.30

DW	2.58	1.77	1.96	1.83	2.42	2.75	2.10	1.91
Start	2009Q4	2009Q2	2009Q2	2009Q2	2009Q3	2009Q4	2009Q2	2010Q1
End	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4
# obs.	24	27	26	27	25	25	26	24

Table 52 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.3 QE proxy: Treasury & mortgage-backed securities held by the Fed

D.1.3.1 BBB-AAA corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	1.51 (0.55)	-74.50 (-2.66)**	-47.44 (-2.05)*	41.64 (1.2)	6.13 (1.58)	-52.51 (-1.72)*	-55.97 (-2.66)**	76.17 (1.67)
$\ln GDP_{t-1}$	0.60 (1.46)	10.98 (3.3)***	25.42 (2.57)**	-6.76 (-1.73)*	-0.12 (-0.15)	-12.23 (-1.45)	6.62 (2.71)**	24.37 (1.43)
$\ln GDP_{t-2}$	-0.25 (-0.71)		-21.16 (-2.31)**		0.16 (0.22)	-3.67 (-0.42)		-33.42 (-2.23)**
$\ln GDP_{t-3}$	0.58 (1.2)				0.05 (0.04)	23.03 (3.16)***		
$\ln GDP_{t-4}$	0.25 (0.41)				-0.62 (-0.69)			
$\ln GDP_{t-5}$	-0.54 (-0.82)				-0.55 (-0.59)			
$\ln GDP_{t-6}$	-0.35 (-0.49)				0.32 (0.26)			
$\ln GDP_{t-7}$	-0.01 (-0.02)				1.06 (1.46)			
$\ln GDP_{t-8}$	0.58 (0.97)				0.004 (0.00)			
IR_{t-1}	0.004 (0.34)	0.50 (2.14)**	0.36 (2.56)**	0.27 (0.84)	-0.004 (-0.27)	1.43 (7.61)***	-0.10 (-1.53)	-0.56 (-1.84)*
IR_{t-2}	-0.02 (-1.58)	-0.40 (-1.36)		0.57 (1.64)	0.01 (0.61)	-0.50 (-1.28)		0.60 (2.06)**
IR_{t-3}	0.01 (0.53)	0.10 (0.31)			-0.03 (-0.86)	0.20 (0.44)		
IR_{t-4}	-0.01 (-0.84)	-0.19 (-0.6)			0.01 (0.18)	0.10 (0.24)		
IR_{t-5}	0.02 (1.57)	0.36 (1.4)			0.04 (1.17)	-0.59 (-2.41)**		
IR_{t-6}	-0.003 (-0.39)	-0.54 (-2.5)**			-0.05 (-1.41)			
IR_{t-7}	-0.003 (-0.24)				0.03 (0.83)			
IR_{t-8}	-0.01 (-0.94)				-0.02 (-0.51)			
EFP_{t-1}	-0.001 (-0.11)	-0.41 (-1.71)	0.83 (3.38)***	0.18 (0.51)	-0.01 (-0.28)	0.12 (0.62)	0.04 (0.15)	-0.21 (-0.49)
EFP_{t-2}	-0.02 (-1.08)	-0.48 (-1.75)*	0.89 (3.32)***	0.74 (2.29)**	0.003 (0.08)	-0.72 (-3.3)***	0.88 (4.08)***	0.94 (2.59)**
EFP_{t-3}	-0.01 (-0.45)	0.12 (0.41)	-0.77 (-3.49)***		0.02 (0.79)	0.71 (3.06)***		
EFP_{t-4}	0.01 (1.05)	0.37 (1.29)	1.10 (3.18)***		-0.01 (-0.27)	-0.65 (-3.52)***		

EFP_{t-5}	-0.02 (-1.39)	-0.28 (-1.2)	-0.90 (-2.54)**		0.01 (0.43)			
EFP_{t-6}	0.01 (1.22)	0.13 (0.6)	0.56 (2.29)**		-0.01 (-0.92)			
EFP_{t-7}	0.001 (0.13)	0.32 (1.92)*			-0.004 (-0.52)			
EFP_{t-8}					-0.002 (-0.18)			
RT_{t-1}	0.01 (1.17)	-0.03 (-0.12)	0.43 (2.83)***	0.85 (2.82)***	-0.001 (-0.05)	0.07 (0.52)	0.50 (3.44)***	1.05 (4.25)***
RT_{t-2}	-0.01 (-0.93)	0.29 (1.14)	-0.64 (-4.03)***	-0.84 (-3.58)***	0.005 (0.16)	0.16 (1.61)	-0.58 (-4.2)***	-1.16 (-5.04)***
RT_{t-3}	0.01 (0.86)	-0.0003 (0.00)		0.78 (4.19)***	-0.01 (-0.55)			0.60 (3.72)***
RT_{t-4}	-0.01 (-1.29)	-0.67 (-1.94)*			-0.01 (-0.6)			
RT_{t-5}	0.01 (0.8)	0.70 (2.91)***			-0.004 (-0.29)			
RT_{t-6}	-0.002 (-0.14)	-0.61 (-3.52)***			0.01 (0.75)			
RT_{t-7}	0.001 (0.06)				0.002 (0.18)			
RT_{t-8}	-0.01 (-1.07)							
$\ln QE_{t-1}$	-0.003 (-0.04)	0.02 (0.02)	1.81 (2.32)**	-2.02 (-1.72)*	-0.04 (-0.59)	-2.81 (-4.71)***	0.73 (1.17)	-0.52 (-0.42)
$\ln QE_{t-2}$	0.06 (0.59)	1.52 (0.96)	-8.70 (-5.62)***	-1.22 (-0.67)	0.14 (1.12)	6.16 (5.68)***	-3.80 (-3.38)***	-3.99 (-1.98)*
$\ln QE_{t-3}$	0.01 (0.08)	-3.35 (-2.8)**	10.48 (5.15)***	4.67 (4.72)***	-0.10 (-0.79)	-5.24 (-5.16)***	2.57 (3.57)***	5.35 (4.36)***
$\ln QE_{t-4}$	-0.15 (-1.63)		-6.58 (-3.21)***		-0.08 (-0.72)	2.57 (3.15)***		
$\ln QE_{t-5}$	0.08 (0.72)		4.61 (2.95)***		0.16 (0.83)	-1.78 (-3.09)***		
$\ln QE_{t-6}$			-3.39 (-2.96)***		0.03 (0.19)			
$\ln QE_{t-7}$			2.14 (3.32)***		-0.04 (-0.52)			
R^2	0.999	0.98	0.95	0.92	0.999	0.996	0.91	0.91
Adj. R^2	0.99	0.96	0.92	0.89	0.99	0.99	0.89	0.87
AIC	-8.48	-0.10	0.04	1.04	-8.49	-0.62	0.30	1.22
DW	2.45	2.34	2.32	2.02	2.75	2.58	1.73	2.05
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	43	44	44	44	43	44	44	44

Table 53 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.

AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.3.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	8.30 (0.78)	-79.71 (-3.04)***	-256.40 (-1.26)	162.44 (2.96)***	6.42 (1.62)	125.67 (6.21)***	-594.14 (-4.2)***	-233.66 (-3.69)***
$\ln GDP_{t-1}$	0.39 (0.67)	12.81 (3.84)***	23.94 (1.03)	-13.90 (-0.78)	0.13 (0.35)	-15.09 (-6.36)***	74.47 (4.59)***	28.91 (3.83)***
$\ln GDP_{t-2}$	0.13 (0.17)			-27.33 (-1.45)	-0.48 (-1.04)			
$\ln GDP_{t-3}$	-1.15 (-0.51)			-40.64 (-2.15)**	-0.25 (-0.58)			
$\ln GDP_{t-4}$	-2.06 (-0.57)			14.17 (0.72)	-0.49 (-1.17)			
$\ln GDP_{t-5}$	-2.28 (-0.86)			12.88 (0.65)	-0.11 (-0.21)			
$\ln GDP_{t-6}$	1.13 (0.52)			5.91 (0.32)	0.71 (1.28)			
$\ln GDP_{t-7}$	2.18 (0.78)			29.28 (2.29)**	0.42 (0.78)			
$\ln GDP_{t-8}$	1.81 (0.52)				0.33 (0.49)			
IR_{t-1}	-0.02 (-0.37)	0.55 (2.9)***	1.77 (1.36)	0.29 (1.02)	-0.01 (-0.64)	1.15 (20.64)***	-1.79 (-3.75)***	0.31 (1.3)
IR_{t-2}	0.01 (0.35)	-0.35 (-1.55)			0.01 (0.3)			-0.86 (-2.9)***
IR_{t-3}	-0.02 (-0.7)	-0.29 (-1.16)			0.01 (0.33)			
IR_{t-4}	-0.01 (-0.54)	-0.20 (-0.74)			-0.01 (-0.64)			
IR_{t-5}	0.002 (0.07)	0.21 (0.87)			0.03 (1.23)			
IR_{t-6}	-0.004 (-0.21)	-0.86 (-4.18)***			-0.03 (-0.97)			
IR_{t-7}	-0.05 (-0.76)				0.02 (0.86)			
IR_{t-8}	0.002 (0.11)				-0.01 (-1.06)			
EFP_{t-1}	-0.01 (-0.77)	-0.11 (-4.82)***	0.50 (1.94)*	-0.15 (-2.76)**	-0.001 (-0.57)	0.09 (4.23)***	0.30 (2.1)**	-0.16 (-3.75)***
EFP_{t-2}	-0.01 (-0.63)		0.71 (1.77)*	0.18 (2.29)**	-0.001 (-0.5)			0.05 (0.79)
EFP_{t-3}	0.01 (0.71)		-0.16 (-0.49)	-0.09 (-1.7)	0.005 (2.31)*			-0.15 (-3.3)***

EFP_{t-4}	-0.003 (-0.34)		0.35 (2.02)*		-0.003 (-1.22)			
EFP_{t-5}	-0.00004 (-0.01)				0.001 (0.68)			
EFP_{t-6}	0.003 (0.58)				0.001 (0.41)			
EFP_{t-7}	-0.001 (-0.15)				-0.001 (-0.58)			
EFP_{t-8}	-0.001 (-0.63)				-0.0004 (-0.27)			
RT_{t-1}	0.02 (0.83)	0.19 (1.19)	3.78 (2.71)**	1.57 (5.66)***	-0.01 (-0.72)	-0.23 (-3.27)***	0.46 (0.88)	1.58 (7.15)***
RT_{t-2}	0.03 (0.56)	0.45 (2.7)**	-6.66 (-3.35)***	-1.35 (-3.49)***	0.005 (0.58)			-0.88 (-2.81)***
RT_{t-3}	-0.04 (-0.75)	-0.63 (-2.45)**	3.11 (2.25)**	0.37 (0.99)	-0.01 (-1.64)			0.74 (2.28)**
RT_{t-4}	-0.04 (-0.91)	-0.38 (-1.35)		0.70 (2.02)*	-0.001 (-0.05)			0.35 (1.21)
RT_{t-5}	-0.003 (-0.07)	0.58 (2.45)**		-0.69 (-2.43)**				-0.50 (-1.86)*
RT_{t-6}	0.02 (0.51)	-0.86 (-4.87)***		0.28 (1.34)				0.37 (1.73)*
RT_{t-7}	-0.05 (-0.86)			-0.31 (-2.34)**				-0.59 (-4.21)***
RT_{t-8}	-0.01 (-0.21)							
$\ln QE_{t-1}$	-0.06 (-0.37)	1.61 (1.99)*	-7.52 (-1.27)	-1.76 (-1.6)	-0.06 (-1.07)	-0.84 (-1.94)*	-8.09 (-5.49)***	2.12 (2.08)**
$\ln QE_{t-2}$	0.14 (0.63)	-0.73 (-0.54)	-17.01 (-1.76)*	-3.55 (-1.81)*	0.09 (1.08)	2.21 (4.03)***		-4.53 (-2.86)***
$\ln QE_{t-3}$	-0.32 (-0.68)	-4.20 (-3.19)***	25.76 (4.53)***	7.34 (4.84)***	-0.03 (-0.39)			2.69 (1.46)
$\ln QE_{t-4}$	-0.12 (-0.89)	3.37 (2.57)**			-0.05 (-0.69)			-2.21 (-1.36)
$\ln QE_{t-5}$	0.37 (0.8)	-2.43 (-3)***			0.14 (1.56)			1.83 (1.2)
$\ln QE_{t-6}$	0.11 (0.4)				0.001 (0.02)			-2.86 (-3.22)***
$\ln QE_{t-7}$	-0.10 (-0.64)				-0.03 (-0.9)			
$\ln QE_{t-8}$	0.03 (0.58)				0.01 (0.56)			
R^2	0.999	0.98	0.88	0.95	0.999	0.98	0.80	0.96
Adj. R^2	0.98	0.97	0.83	0.91	0.99	0.98	0.77	0.94
AIC	-8.87	-0.19	4.44	0.96	-8.55	0.30	4.63	0.58
DW	3.10	2.37	1.61	2.50	2.69	1.09	1.75	2.64
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	43	44	44	44	43	44	44	44

Table 54 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.3.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	3.12 (1.1)	223.73 (3.17)***	-130.55 (-5.57)***	18.06 (0.59)	3.12 (1.13)	-111.08 (-2.9)***	20.85 (0.44)	-114.03 (-1.78)*
$\ln GDP_{t-1}$	0.07 (0.21)	-2.11 (-0.19)	16.12 (5.98)***	-3.06 (-0.9)	0.06 (0.18)	2.10 (0.22)	0.76 (0.13)	11.48 (1.62)
$\ln GDP_{t-2}$	-0.04 (-0.12)	-14.68 (-1.56)			-0.07 (-0.2)	-11.41 (-1.07)		
$\ln GDP_{t-3}$	0.90 (2.39)*	14.80 (1.74)			0.93 (2.41)*	10.32 (0.94)		
$\ln GDP_{t-4}$	0.18 (0.61)	-19.51 (-2.01)*			0.19 (0.62)	-5.70 (-0.52)		
$\ln GDP_{t-5}$	-0.41 (-1.11)				-0.39 (-1.05)	-1.20 (-0.11)		
$\ln GDP_{t-6}$	-0.72 (-1.42)				-0.75 (-1.41)	19.92 (2.35)**		
$\ln GDP_{t-7}$	0.25 (0.72)				0.25 (0.74)			
$\ln GDP_{t-8}$	0.43 (1.26)				0.44 (1.27)			
IR_{t-1}	0.01 (0.81)	0.97 (2.7)**	-0.32 (-2.17)**	-0.07 (-0.23)	0.01 (0.87)	0.78 (3.05)***	-1.33 (-4.89)***	-0.59 (-1.27)
IR_{t-2}	-0.003 (-0.13)	-2.83 (-3.2)***		0.84 (2.49)**	-0.003 (-0.11)	-0.05 (-0.16)	-0.71 (-1.79)*	1.87 (3.44)***
IR_{t-3}	-0.02 (-0.81)	1.63 (1.84)*			-0.02 (-0.8)	0.64 (2.2)**	0.53 (0.78)	
IR_{t-4}	-0.02 (-0.72)	-1.00 (-1.61)			-0.03 (-0.76)	-0.11 (-0.34)	-0.31 (-0.45)	
IR_{t-5}	0.06 (2.12)	0.31 (0.56)			0.06 (2.16)*	0.22 (0.83)	0.19 (0.35)	
IR_{t-6}	-0.03 (-1.68)	-0.20 (-0.44)			-0.03 (-1.71)	-0.56 (-2.04)*	1.06 (1.63)	
IR_{t-7}	0.03 (1.96)	-0.55 (-1.63)			0.03 (1.97)	-0.47 (-2.39)**	0.42 (0.54)	
IR_{t-8}	-0.03 (-2.33)*				-0.03 (-2.38)*		-1.36 (-2.59)**	
EFP_{t-1}	-0.002	-0.76	0.85	0.27	0.01	0.11	-0.35	0.11

	(-0.16)	(-2.56)**	(16.38)***	(3.73)***	(1.32)	(0.64)	(-1.62)	(0.35)
EFP_{t-2}	-0.01 (-0.65)	1.73 (2.7)**			-0.02 (-2.05)	-0.27 (-1.52)	0.06 (0.33)	1.21 (3.33)***
EFP_{t-3}	0.02 (0.98)	-1.59 (-2.52)**			-0.003 (-0.28)	0.48 (2.79)**	-0.14 (-0.86)	0.58 (1.91)*
EFP_{t-4}	0.01 (0.38)	0.71 (1.4)			-0.01 (-1.24)	-0.13 (-1.11)	0.22 (1.42)	-0.03 (-0.12)
EFP_{t-5}	-0.04 (-1.81)	-0.26 (-0.54)			0.02 (2.49)*		-0.35 (-3.28)***	-0.37 (-1.55)
EFP_{t-6}	0.03 (1.81)	-1.28 (-2.38)**			0.005 (0.69)			0.18 (0.79)
EFP_{t-7}	-0.02 (-1.65)	0.66 (1.79)*			0.01 (0.6)			0.34 (1.87)*
EFP_{t-8}	0.01 (1.13)				-0.02 (-2.08)			
RT_{t-1}	0.01 (1.32)	-0.04 (-0.2)	0.002 (0.02)	0.80 (3.96)***	0.01 (1.39)	-0.07 (-0.85)	-0.60 (-6.1)***	0.41 (1.56)
RT_{t-2}	-0.001 (-0.15)	-0.29 (-1.07)	-0.14 (-0.76)	-0.44 (-2.26)**	-0.001 (-0.13)			-0.10 (-0.47)
RT_{t-3}	-0.004 (-0.42)	-0.21 (-0.82)	0.25 (1.12)	0.92 (5.61)***	-0.004 (-0.45)			1.24 (5.87)***
RT_{t-4}	-0.02 (-1.99)	-0.23 (-0.99)	-0.38 (-1.57)		-0.02 (-1.95)			
RT_{t-5}	0.01 (0.81)	0.59 (2.51)**	0.47 (1.97)*		0.01 (0.85)			
RT_{t-6}	0.004 (0.59)	-1.35 (-7.15)***	-0.33 (-1.41)		0.004 (0.62)			
RT_{t-7}	0.01 (1.26)		0.38 (2.51)**		0.01 (1.26)			
RT_{t-8}	-0.01 (-2.27)*				-0.01 (-2.23)*			
$\ln QE_{t-1}$	-0.02 (-0.44)	5.15 (3.86)***	-0.72 (-1.02)	-2.30 (-2.76)***	-0.02 (-0.47)	-1.61 (-4.1)***	3.52 (3.43)***	-3.93 (-3.78)***
$\ln QE_{t-2}$	0.12 (2.15)*	-5.71 (-2.58)**	0.43 (0.32)	-0.48 (-0.38)	0.11 (2.12)		-4.56 (-2.06)*	0.89 (0.59)
$\ln QE_{t-3}$	-0.01 (-0.08)	-1.63 (-0.93)	0.46 (0.33)	4.87 (4)***	0.002 (0.03)		0.28 (0.13)	4.62 (3.47)***
$\ln QE_{t-4}$	-0.18 (-2.58)*	7.60 (3.37)***	-1.42 (-0.94)	-1.56 (-2.24)**	-0.18 (-2.58)*		0.62 (0.3)	-1.85 (-2.48)**
$\ln QE_{t-5}$	0.06 (0.87)	-5.49 (-4.77)***	-1.45 (-1.07)		0.06 (0.81)		0.63 (0.26)	
$\ln QE_{t-6}$	0.04 (0.78)		0.98 (0.91)		0.05 (0.8)		-2.37 (-1.28)	
$\ln QE_{t-7}$			2.64 (2.3)**				1.96 (2.45)**	
$\ln QE_{t-8}$			-2.64 (-4.25)***				-1.59 (-4.06)***	
R^2	0.9996	0.99	0.97	0.92	0.9996	0.99	0.99	0.95
Adj. R^2	0.996	0.98	0.95	0.90	0.996	0.99	0.98	0.91
AIC	-9.65	-0.98	0.31	0.97	-9.66	-0.11	-0.48	0.91

DW	2.08	2.43	2.09	2.15	2.13	2.28	2.75	2.10
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	43	44	44	44	43	44	44	44

Table 55 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.3.4 Debt-to-GDP ratio

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	2.57 (1.55)	-257.70 (-4.27)***	384.58 (2.57)**	97.61 (2.67)**	7.66 (4.44)**	-188.43 (-2.47)**	-636.12 (-2.76)**	148.68 (2.96)***
$\ln GDP_{t-1}$	-0.94 (-2.22)*	-4.27 (-0.26)	166.56 (4.38)***	-8.29 (-2.2)**	-1.00 (-2.24)	-37.06 (-2.19)**	153.66 (3.38)***	-17.60 (-3.17)***
$\ln GDP_{t-2}$	0.29 (0.33)	41.88 (2.31)**	-283.89 (-7.02)***		-0.72 (-2.97)*	24.80 (1.68)	-77.84 (-1.5)	
$\ln GDP_{t-3}$	-0.51 (-0.67)	42.41 (2.04)*	89.34 (1.68)		0.52 (2.09)	46.35 (3.23)***		
$\ln GDP_{t-4}$	0.98 (1.74)	18.65 (0.84)	-148.43 (-2.83)**		-0.81 (-2.22)	25.30 (1.91)*		
$\ln GDP_{t-5}$	-0.004 (-0.01)	19.23 (1.08)	62.22 (1.36)		-1.23 (-3.24)*	-1.26 (-0.09)		
$\ln GDP_{t-6}$	1.28 (1.54)	21.26 (1.28)	-130.79 (-2.88)***		-0.62 (-1.66)	-18.42 (-1.51)		
$\ln GDP_{t-7}$	0.22 (0.5)	-39.92 (-3.03)***	95.89 (2.63)**		2.09 (7.09)**	2.72 (0.23)		
$\ln GDP_{t-8}$	-0.60 (-0.65)	-57.44 (-3.87)***	102.40 (2.83)**		1.48 (2.84)	-22.06 (-2.2)**		
IR_{t-1}	-0.01 (-0.75)	-0.18 (-0.93)	1.86 (5.02)***	-0.18 (-0.53)	-0.01 (-2.1)	1.27 (5.42)***	1.16 (1.51)	0.10 (0.3)
IR_{t-2}	0.002 (0.26)			0.40 (0.89)	-0.02 (-2.41)	0.33 (0.67)	-1.99 (-2.09)**	0.70 (1.36)
IR_{t-3}	-0.01 (-0.83)			0.69 (1.86)*	0.01 (0.97)	-0.97 (-3.17)***		-2.21 (-4.62)***
IR_{t-4}	-0.01 (-0.65)				-0.02 (-2.24)			1.30 (2.84)***
IR_{t-5}	0.0003 (0.05)				0.04 (4.81)**			0.38 (1.16)
IR_{t-6}	0.003 (0.49)				0.06 (2.54)			
IR_{t-7}	-0.01				-0.05			

	(-0.99)				(-4.12)*			
IR_{t-8}	0.003 (0.34)				-0.03 (-2.26)			
EFP_{t-1}	-0.004 (-1.32)	-0.13 (-1.87)*	1.59 (9.48)***	0.003 (0.05)	0.005 (2.68)	-0.10 (-2.67)**	0.91 (5.14)***	0.002 (0.06)
EFP_{t-2}	0.0005 (0.13)	-0.10 (-0.85)	-0.92 (-3.26)***	-0.01 (-0.13)	0.0005 (0.29)			
EFP_{t-3}	-0.01 (-1.62)	0.03 (0.24)	1.36 (4.24)***	0.19 (2.64)**	0.002 (0.89)			
EFP_{t-4}	0.004 (0.62)	0.15 (1.17)	-1.15 (-3.26)***		-0.01 (-4.12)*			
EFP_{t-5}	-0.003 (-0.98)	0.06 (0.52)	0.94 (3.02)***		-0.01 (-3.16)*			
EFP_{t-6}	0.004 (0.71)	0.29 (3.39)***	-1.17 (-4.41)***		-0.01 (-4.66)**			
EFP_{t-7}	0.004 (1.3)		0.41 (2.63)**		0.002 (1.14)			
EFP_{t-8}					-0.001 (-0.88)			
RT_{t-1}	-0.01 (-0.45)	-0.55 (-3.86)***	1.15 (4.25)***	0.67 (2.82)***	-0.01 (-4.13)*	0.11 (0.69)	1.53 (2.86)***	0.76 (4.6)***
RT_{t-2}	0.002 (0.4)	0.86 (4.58)***	-1.26 (-4.46)***	-0.83 (-3.06)***	-0.005 (-2.28)	0.61 (2.91)***	-0.82 (-1.18)	
RT_{t-3}	0.01 (1.18)	-0.20 (-1.04)		0.87 (2.89)***	-0.01 (-1.79)	-0.37 (-1.77)*	-0.22 (-0.33)	
RT_{t-4}	-0.002 (-0.21)	-0.01 (-0.03)		0.30 (0.93)	-0.01 (-3.29)*	0.30 (1.21)	1.09 (1.69)	
RT_{t-5}	-0.005 (-0.53)	0.12 (0.58)		-0.57 (-1.89)*	0.01 (4.5)**	-0.22 (-1)		
RT_{t-6}	0.01 (1.45)	-0.45 (-2.8)**		0.32 (1.22)	0.01 (4.94)**	0.01 (0.07)		
RT_{t-7}	-0.02 (-1.2)			-0.05 (-0.22)	0.01 (1.71)	0.25 (2.08)*		
RT_{t-8}				-0.32 (-2.13)**	0.003 (1.71)			
$\ln QE_{t-1}$	0.03 (1.86)	2.36 (2.74)**	-10.53 (-6.1)***	-4.60 (-3.74)***	0.07 (2.09)	0.99 (0.8)	1.77 (0.38)	-2.01 (-1.59)
$\ln QE_{t-2}$	0.07 (1.31)	-1.58 (-1.22)	2.18 (0.93)	-0.99 (-0.57)	-0.03 (-0.94)	2.23 (1.44)	-8.86 (-1.82)*	3.50 (3.86)***
$\ln QE_{t-3}$	0.02 (0.38)	-3.01 (-2.14)**	1.35 (0.51)	6.26 (3.72)***	0.04 (1.55)	0.01 (0.01)	6.12 (1.6)	
$\ln QE_{t-4}$	-0.04 (-0.75)	0.52 (0.37)	2.04 (0.83)	-3.01 (-3.27)***	0.11 (2.68)	-0.58 (-0.39)	-1.63 (-0.4)	
$\ln QE_{t-5}$	0.09 (1.49)	-4.02 (-3.53)***	-2.29 (-0.92)		0.01 (0.19)	-2.77 (-2.11)**	-3.26 (-0.95)	
$\ln QE_{t-6}$	-0.05 (-0.61)	-4.20 (-2.97)***	11.26 (4.11)***		0.15 (4.85)**		1.04 (0.29)	
$\ln QE_{t-7}$	-0.06 (-1.23)	-1.70 (-2.64)**			0.07 (1.75)		2.93 (0.84)	
$\ln QE_{t-8}$	-0.02				0.004		-4.55	

	(-1.03)				(0.23)		(-2.16)**	
R^2	0.9995	0.99	0.9997	0.95	0.99996	0.99	0.998	0.89
Adj. R^2	0.995	0.97	0.999	0.91	0.999	0.99	0.997	0.86
AIC	-9.46	-0.23	1.69	0.92	-11.95	-0.04	2.96	1.26
DW	2.66	2.74	2.87	2.37	3.66	2.25	1.83	1.93
Start	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1	2005Q1
End	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4
# obs.	43	44	43	44	43	44	43	44

Table 56 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.4 QE proxy: size of the Fed's balance sheet

D.1.4.1 BBB-AAA corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	3.64 (1.24)	506.43 (10.44)***	-129.94 (-5.1)***	-112.19 (-2.3)**	0.12 (0.06)	13.87 (0.66)	-50.05 (-1.28)	-15.34 (-0.32)
$\ln GDP_{t-1}$	0.61 (1.95)*	-4.93 (-0.86)	15.20 (5.85)***	12.26 (2.49)**	1.14 (3.37)***	-1.35 (-0.46)	3.92 (0.71)	5.83 (1.04)
$\ln GDP_{t-2}$	-0.28 (-0.78)	-21.68 (-3.32)***			-0.18 (-0.39)			
$\ln GDP_{t-3}$	0.32 (0.89)	-23.71 (-4.52)***			-0.29 (-0.64)			
$\ln GDP_{t-4}$	-0.01 (-0.03)				0.27 (0.61)			
$\ln GDP_{t-5}$	-0.05 (-0.18)				0.06 (0.15)			
IR_{t-1}	-0.01 (-0.65)	-0.61 (-3.45)***	0.63 (3.68)***	0.86 (2.06)*	-0.003 (-0.24)	-0.72 (-1.15)	3.22 (2.73)**	0.28 (0.59)
IR_{t-2}	-0.02 (-1.75)	-0.72 (-6.22)***		0.84 (2.65)**	-0.01 (-0.49)	-0.55 (-0.85)	-1.60 (-4.33)***	0.09 (0.15)
IR_{t-3}	0.02 (1.09)	0.23 (2.22)**		-0.56 (-2.38)**	0.03 (0.96)	1.05 (4.39)***		-1.03 (-3.01)***
IR_{t-4}	-0.002 (-0.25)	0.01 (0.06)			-0.004 (-0.15)			
IR_{t-5}	0.001 (0.22)	-0.76 (-7.19)***			-0.01 (-1.06)			
EFP_{t-1}	-0.01 (-0.58)	1.16 (5.73)***	0.85 (5.71)***	-0.03 (-0.11)	0.01 (0.38)	-0.11 (-1.23)	0.44 (1.96)*	0.06 (0.2)
EFP_{t-2}	-0.003 (-0.22)	-1.13 (-5.25)***			-0.004 (-0.27)		-0.06 (-0.21)	-0.62 (-2.07)**
EFP_{t-3}	-0.01 (-1.2)	0.46 (3.41)***			-0.003 (-0.28)		0.79 (3.1)***	
EFP_{t-4}	0.003 (0.5)	-1.18 (-9.02)***			0.01 (0.69)			
EFP_{t-5}	-0.001 (-0.06)	-0.47 (-5.31)***			-0.01 (-0.8)			
RT_{t-1}	-0.001 (-0.23)	-1.36 (-12.64)***	0.28 (2.96)***	1.42 (7.67)***	-0.0004 (-0.06)	0.05 (1.06)	0.57 (4.79)***	0.80 (7.18)***
RT_{t-2}	-0.01 (-1.48)				-0.01 (-0.84)	-0.06 (-0.79)	-0.38 (-2.4)**	
RT_{t-3}	0.01 (0.95)				0.01 (0.92)	0.04 (0.63)	0.04 (0.24)	
RT_{t-4}					-0.004 (-0.63)	-0.02 (-0.62)	-0.16 (-1.13)	
RT_{t-5}					0.002 (0.34)		-0.17 (-1.71)	

$\ln QE_{t-1}$	0.0004 (0.01)	0.39 (0.96)	-2.15 (-5.59)***	-3.32 (-4.37)***	-0.002 (-0.06)	-0.65 (-0.8)	2.99 (1.87)*	-2.60 (-4.4)***
$\ln QE_{t-2}$	0.02 (0.56)	0.70 (1.46)	1.80 (4.5)***	0.09 (0.11)		-0.90 (-1.02)	0.60 (0.67)	
$\ln QE_{t-3}$		-5.89 (-9.39)***	-1.45 (-3.65)***	2.52 (3.27)***		1.59 (5.47)***	-2.80 (-5.27)***	
$\ln QE_{t-4}$		4.42 (8.3)***	0.16 (0.45)	-0.67 (-0.93)		-0.09 (-0.37)		
$\ln QE_{t-5}$			0.34 (1.08)	0.67 (1.12)				
R^2	0.99	0.99	0.96	0.92	0.99	0.96	0.97	0.82
Adj. R^2	0.98	0.98	0.94	0.87	0.97	0.92	0.94	0.76
AIC	-7.30	-1.60	-0.37	0.87	-6.90	-2.10	-0.29	1.35
DW	2.22	2.56	1.64	2.00	2.59	1.23	2.54	1.73
Start	2008Q1	2008Q3	2008Q4	2008Q4	2007Q4	2008Q3	2008Q2	2007Q4
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	31	30	29	29	32	30	31	33

Table 57 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.4.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	12.70 (1.67)	212.88 (2.77)**	-1182.50 (-7.77)***	-113.88 (-3.16)***	1.56 (2.6)**	4.61 (0.22)	-729.51 (-3.6)***	-14.04 (-0.34)
$\ln GDP_{t-1}$	0.35 (0.97)	-19.77 (-2.51)**	140.97 (8.78)***	12.53 (3.33)***	0.68 (2.76)**	-0.35 (-0.12)	94.17 (3.74)***	26.59 (1.43)
$\ln GDP_{t-2}$	-0.01 (-0.02)				0.01 (0.02)			-20.09 (-1.08)
$\ln GDP_{t-3}$	0.79 (1.18)				-0.05 (-0.18)			
$\ln GDP_{t-4}$	-0.57 (-1.13)				0.04 (0.14)			
$\ln GDP_{t-5}$	-0.85 (-1.79)				0.12 (0.55)			
IR_{t-1}	-0.01 (-0.27)	-0.54 (-1.18)	4.01 (2.88)***	0.83 (1.82)*	-0.02 (-2.18)**	-0.73 (-1.47)	9.27 (2.42)**	0.02 (0.04)
IR_{t-2}	-0.08 (-2.49)	0.44 (0.94)		0.83 (2.62)**	0.01 (1.13)	-0.34 (-0.68)	-9.39 (-3.62)***	0.33 (0.42)
IR_{t-3}	-0.03 (-1.37)	0.02 (0.05)		-0.55 (-2.18)**	0.01 (0.77)	0.92 (5.13)***		-1.23 (-2.3)**

IR_{t-4}	0.02 (1.03)	-0.39 (-1.04)						
IR_{t-5}	0.06 (2.32)	-0.56 (-2.77)**						
EFP_{t-1}	-0.01 (-1.54)	0.12 (2.61)**	0.79 (5.64)***	-0.01 (-0.21)	-0.001 (-2.13)**	-0.01 (-1.57)	0.75 (6.37)***	0.04 (0.78)
EFP_{t-2}	0.003 (0.76)	-0.21 (-2.63)**						0.06 (0.75)
EFP_{t-3}	-0.0002 (-0.06)	0.06 (0.98)						-0.19 (-2.72)**
EFP_{t-4}	-0.005 (-1.15)	0.10 (1.45)						
EFP_{t-5}	-0.003 (-1.23)	-0.11 (-3.36)***						
RT_{t-1}	0.02 (0.75)	-1.37 (-3.37)***	1.50 (1.95)*	1.41 (6.89)***	0.002 (0.58)	0.003 (0.16)	-0.07 (-0.13)	0.79 (2.88)***
RT_{t-2}	-0.06 (-2.09)	1.14 (2.56)**			-0.001 (-0.21)			-0.98 (-2.65)**
RT_{t-3}	-0.03 (-1.57)	-0.24 (-0.56)			0.0004 (0.11)			0.84 (3.08)***
RT_{t-4}	0.02 (0.77)	-0.66 (-1.7)			-0.001 (-0.59)			
RT_{t-5}	0.04 (2.38)							
$\ln QE_{t-1}$	0.12 (1.98)	-0.77 (-2.91)**	-11.47 (-3.24)***	-3.22 (-3.35)***	-0.01 (-0.64)	-0.64 (-0.98)	10.81 (1.96)*	-3.09 (-4.48)***
$\ln QE_{t-2}$	0.08 (1.74)		-3.55 (-1.18)	0.08 (0.11)	0.04 (3.16)***	-0.65 (-0.88)	-22.62 (-4.67)***	
$\ln QE_{t-3}$	-0.03 (-0.5)		-0.66 (-0.21)	2.41 (2.97)***		1.29 (4.93)***		
$\ln QE_{t-4}$	-0.09 (-1.38)		2.74 (0.96)	-0.68 (-0.96)		-0.06 (-0.32)		
$\ln QE_{t-5}$	-0.09 (-1.48)		0.12 (0.05)	0.65 (1.11)				
R^2	0.999	0.95	0.95	0.92	0.99	0.96	0.84	0.89
Adj. R^2	0.99	0.91	0.93	0.87	0.99	0.93	0.80	0.82
AIC	-8.84	0.13	3.75	0.87	-7.64	-2.26	4.69	1.14
DW	2.77	2.70	1.49	1.98	2.53	1.31	2.29	1.89
Start	2008Q4	2007Q4	2008Q4	2008Q4	2008Q1	2008Q3	2008Q1	2007Q4
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	28	33	29	29	31	30	32	33

Table 58 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.

AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.

****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.4.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	3.70 (1.6)	-241.31 (-2.38)**	-84.59 (-0.85)	-194.74 (-5.49)***	3.69 (1.6)	-3.37 (-0.17)	-195.03 (-2.29)**	-201.52 (-5.68)***
$\ln GDP_{t-1}$	0.83 (2.96)**	19.30 (1.49)	13.89 (1.08)	24.06 (5.91)***	0.85 (3)**	0.50 (0.2)	0.59 (0.05)	24.70 (6.05)***
$\ln GDP_{t-2}$	-0.05 (-0.14)	2.09 (0.15)			-0.06 (-0.16)		10.05 (0.69)	
$\ln GDP_{t-3}$	-0.39 (-1.09)	-5.20 (-0.38)			-0.38 (-1.06)		-6.02 (-0.4)	
$\ln GDP_{t-4}$	0.34 (0.96)	-12.25 (-0.83)			0.34 (0.94)		-2.62 (-0.17)	
$\ln GDP_{t-5}$	-0.17 (-0.53)	29.84 (2.57)**			-0.18 (-0.56)		24.90 (2.03)*	
IR_{t-1}	0.01 (0.56)	-2.28 (-3.1)**	-1.03 (-0.55)	0.86 (1.8)*	0.01 (0.51)	0.12 (0.36)	-1.84 (-3.46)***	0.97 (1.98)*
IR_{t-2}	-0.03 (-1.63)	1.96 (1.98)*	2.07 (1.56)	0.82 (1.87)*	-0.03 (-1.61)	-0.45 (-1.23)	2.72 (3.06)***	0.68 (1.55)
IR_{t-3}	0.02 (1.73)	2.18 (1.95)*	-0.87 (-1.39)	-1.46 (-5.13)***	0.02 (1.72)	1.31 (8.06)***	0.26 (0.36)	-1.34 (-4.95)***
IR_{t-4}	0.01 (0.76)	-2.53 (-2.91)**	-0.45 (-1.04)		0.01 (0.71)	-0.56 (-3.01)***	-2.29 (-3.1)***	
IR_{t-5}	-0.01 (-0.63)	-0.45 (-2.32)**	-0.25 (-1.24)		-0.01 (-0.57)			
EFP_{t-1}	-0.01 (-0.83)	2.01 (3.33)***	0.96 (0.5)	-0.33 (-1)	-0.002 (-0.27)	0.02 (0.39)	0.25 (0.91)	0.61 (1.89)*
EFP_{t-2}	0.02 (1.27)	-0.93 (-1.24)	-1.84 (-1.79)*	-0.15 (-0.37)	-0.02 (-1.67)		0.95 (2.42)**	0.40 (1.84)*
EFP_{t-3}	-0.02 (-2.23)**	-1.19 (-1.67)	1.38 (2.3)**	1.17 (4.18)***	-0.003 (-0.38)		0.47 (1.18)	
EFP_{t-4}	-0.01 (-0.52)	1.93 (2.9)**	0.45 (1.29)		0.004 (0.65)		-0.61 (-1.86)*	
EFP_{t-5}	0.01 (0.6)				-0.0004 (-0.1)		-0.35 (-2.25)**	
RT_{t-1}	0.004 (0.66)	-1.29 (-4.15)***	-1.09 (-3.64)***	1.18 (8.25)***	0.004 (0.61)	-0.0004 (-0.01)	-0.96 (-4.53)***	1.18 (8.12)***
RT_{t-2}	-0.01 (-1.78)*	0.96 (2.8)**	0.72 (2.13)**		-0.01 (-1.74)		1.15 (3.41)***	
RT_{t-3}		0.67 (1.54)					0.10 (0.32)	
RT_{t-4}		-0.65 (-2.53)**					-0.51 (-2.18)**	
RT_{t-5}								
$\ln QE_{t-1}$	0.04	-3.25	-0.88	-2.70	0.04	-0.27	-4.14	-2.67

	(1.53)	(-2.56)**	(-0.35)	(-5.5)***	(1.52)	(-0.56)	(-3.81)***	(-5.36)***
$\ln QE_{t-2}$		-2.21 (-1.61)	0.73 (0.45)			-1.01 (-1.9)*		
$\ln QE_{t-3}$			-2.95 (-3.5)***			1.95 (8.23)***		
$\ln QE_{t-4}$						-0.76 (-2.38)**		
$\ln QE_{t-5}$								
R^2	0.99	0.96	0.91	0.88	0.99	0.97	0.95	0.88
Adj. R^2	0.98	0.90	0.82	0.84	0.98	0.95	0.87	0.83
AIC	-7.20	0.01	0.32	0.98	-7.19	-2.55	0.22	1.00
DW	2.12	2.57	2.09	1.99	2.10	1.96	2.51	1.86
Start	2007Q4	2008Q1	2008Q2	2007Q4	2007Q4	2008Q3	2007Q4	2007Q4
End	2015Q3	2015Q4	2015Q4	2015Q4	2015Q3	2015Q4	2015Q4	2015Q4
# obs.	32	32	31	33	32	30	33	33

Table 59 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.1.4.4 Debt-to-GDP ratio

Dep. variable:	$\ln GDP_t$	IR_t	EFP_t	RT_t	$\ln GDP_t$	IR_t	EFP_t	RT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	3.04 (1.98)*	101.83 (2.91)***	136.94 (0.98)	-130.28 (-3.77)***	2.64 (2.36)**	13.07 (0.97)	-1343.37 (-3.76)***	186.93 (1.89)*
$\ln GDP_{t-1}$	0.26 (0.82)	-7.81 (-2.28)**	167.73 (2.61)**	13.09 (3.44)***	0.33 (0.97)	-1.27 (-0.68)	165.85 (3.36)***	-28.33 (-2.06)*
$\ln GDP_{t-2}$	0.75 (1.89)*		-180.89 (-3.1)***		0.58 (1.44)			
$\ln GDP_{t-3}$	-0.81 (-1.41)				-0.63 (-1.14)			
$\ln GDP_{t-4}$	0.58 (0.96)				0.33 (0.59)			
$\ln GDP_{t-5}$	-0.13 (-0.33)				0.08 (0.28)			
IR_{t-1}	0.004 (0.51)	-0.06 (-0.2)	-1.02 (-0.63)	0.85 (1.94)*	-0.01 (-0.54)	-0.64 (-2.17)**	8.32 (1.3)	9.83 (5.05)***
IR_{t-2}	-0.02 (-2.46)**	-0.53 (-2.52)**	0.92 (0.57)	0.66 (1.35)	0.01 (1.36)	-0.27 (-1.6)	-8.81 (-1.2)	-5.86 (-4.67)***
IR_{t-3}	0.01 (2.01)*	0.55 (3.06)***				0.92 (8.33)***	10.97 (1.54)	
IR_{t-4}	0.004 (0.52)						4.69 (0.87)	
IR_{t-5}	-0.003 (-0.65)						-13.93 (-3.67)***	
EFP_{t-1}	-0.005 (-2.77)**	-0.001 (-0.01)	1.28 (4.91)***	-0.01 (-0.35)	-0.003 (-2)*	0.01 (2.01)*	0.33 (1.71)	-0.23 (-2.67)**
EFP_{t-2}	0.01 (1.78)	0.005 (0.08)	-1.03 (-3.66)***		0.004 (1.61)			0.11 (1.61)
EFP_{t-3}	-0.004 (-1.18)	0.04 (0.85)	0.63 (2.91)***		-0.003 (-1.02)			
EFP_{t-4}	0.001 (0.54)				0.001 (0.34)			
EFP_{t-5}	0.002 (0.93)				0.001 (0.97)			
RT_{t-1}	0.004 (0.86)	-0.75 (-4.02)***	-0.77 (-0.67)	1.40 (4.13)***	0.0003 (0.13)	-0.03 (-1.24)	1.94 (3.78)***	1.35 (7.75)***
RT_{t-2}	-0.01 (-2.77)**		1.22 (1.29)	-0.28 (-0.72)	-0.002 (-0.7)		-1.30 (-1.25)	
RT_{t-3}	0.004 (1.2)			0.52 (3.09)***			-0.27 (-0.34)	
RT_{t-4}	0.002 (0.63)						1.42 (3.29)***	
RT_{t-5}	0.0001 (0.03)							
$\ln QE_{t-1}$	-0.005	0.79	6.83	-3.09	-0.02	-0.76	12.69	11.80

	(-0.33)	(1.39)	(2.56)**	(-3.93)***	(-0.74)	(-1.99)*	(1.46)	(4.57)***
$\ln QE_{t-2}$	0.03 (1.92)*	-0.55 (-0.85)	-2.27 (-0.6)	0.65 (0.51)	0.03 (2.49)**	-0.65 (-2.34)**	-22.76 (-2.34)**	-9.19 (-5.28)***
$\ln QE_{t-3}$		-1.93 (-3.24)***	-4.62 (-1.7)	1.20 (1.66)	0.02 (1.21)	1.30 (6.01)***	12.79 (1.34)	1.18 (1.52)
$\ln QE_{t-4}$				-0.45 (-0.54)			5.79 (0.71)	2.65 (3.69)***
$\ln QE_{t-5}$				1.63 (2.41)**			-21.90 (-3.87)***	
R^2	0.997	0.91	0.99	0.93	0.995	0.98	0.998	0.89
Adj. R^2	0.99	0.86	0.99	0.88	0.99	0.97	0.99	0.84
AIC	-8.14	0.34	3.24	0.77	-7.83	-2.29	2.29	1.03
DW	2.56	1.81	1.69	2.32	2.85	1.27	2.14	1.90
Start	2008Q1	2008Q2	2008Q2	2008Q4	2008Q2	2008Q2	2008Q4	2008Q3
End	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4	2015Q3	2015Q4
# obs.	31	31	30	29	30	31	28	30

Table 60 | Two simultaneous equations (VAR) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. Equations within the VAR model have different lag-lengths as in Hsiao (1979). The specifications are based on the best overall F-statistic of a Wald test of joint significance of the independent variables.

AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.

****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.2 Cointegrating relationships

D.2.1 10-year bond rate

D.2.1.1 Corporate bond spreads

QE proxy↓	IR proxy→	10-year bond rate							
	EFP proxy→	BBB-AAA corporate bond spread				High yield (≤CCC-AAA) corporate bond spread			
	Dep. var.→ Indep. ↓	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}
Treasury securities held by the Fed	QE_{t-1}	0.24 (-3.76)***	5.91 (-2.79)***	-6.52 (4.25)***	3.33 (-3.63)***	0.06 (-1.32)	-0.06 (0.04)	-26.33 (3.30)***	4.36 (-2.80)***
	$trend$	-0.003 (1.32)	-0.21 (2.70)***	0.19 (-3.30)***	-0.10 (3.00)***	0.003 (-1.87)**	-0.01 (0.23)	0.55 (-2.14)**	-0.12 (2.30)**
	$constant$	6.37	-72.65	86.51	-39.41	8.70	4.57	358.26	-53.38
Mortgage-backed securities held by the Fed	QE_{t-1}	0.00 (-0.23)	-0.51 (0.58)	-2.39 (7.59)***	-0.65 (0.87)	-0.03 (3.77)***	3.38 (-3.81)***	-25.91 (6.93)***	-1.92 (2.21)**
	$trend$	0.01 (-12.60)***	0.03 (-0.61)	0.07 (-3.44)***	-0.11 (2.24)**	0.01 (-11.08)***	-0.19 (2.62)**	1.60 (-5.33)***	-0.07 (0.94)
	$constant$	9.42	8.42	32.22	17.81	9.79	-37.31	307.31	33.78
Treasury & mortgage-backed securities	QE_{t-1}	-0.22 (6.81)***	-6.71 (4.32)***	4.72 (-4.36)***	8.86 (-4.90)***	-0.26 (3.83)***	-7.91 (5.19)***	13.54 (-2.52)**	11.85 (-4.92)***
	$trend$	0.01 (-8.81)***	0.28 (-3.51)***	-0.24 (4.26)***	-0.40 (4.33)***	0.02 (-5.06)***	0.36 (-4.49)***	-0.76 (2.70)***	-0.57 (4.51)***
	$constant$	12.30	90.66	-58.87	-110.54	12.82	105.46	-161.83	-148.10
Size of the Fed's balance sheet	QE_{t-1}	-0.28 (5.85)***	-21.65 (4.29)***	12.94 (-5.20)***	35.45 (-4.15)***	0.33 (-3.12)***	40.47 (-3.92)***	-18.30 (1.06)	-69.64 (3.45)***
	$trend$	0.02 (-8.62)***	1.08 (-4.82)***	-0.69 (6.24)***	-1.90 (5.01)***	-0.02 (3.81)***	-2.95 (5.13)***	-1.15 (1.21)	5.35 (-4.77)***
	$constant$	13.06	284.40	-164.92	-451.96	5.61	-490.64	320.47	843.97

Table 61 | Cointegrating equations between real GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing. Different proxies are used for the interest rate, the external finance premium and quantitative easing. The proxy for risk tolerance is always the equity risk premium. Each combination results in 4 cointegrating equations. Each column in a section is an equation. The numbers represent coefficients. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.

D.2.1.2 Yield curve rate spread & debt-to-GDP ratio

	IR proxy→	10-year bond rate							
	EFP proxy→	10-year – 3-month yield spread				Debt-to-GDP ratio			
	Dep. var.→								
QE proxy↓	Indep. ↓	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}
Treasury securities held by the Fed	QE_{t-1}	-0.11 (2.54)**	-6.54 (3.58)***	-1.16 (1.39)	12.79 (-3.56)***	-0.08 (2.55)**	-4.93 (6.24)***	31.77 (-6.90)***	4.95 (-4.48)***
	$trend$	0.01 (-5.16)***	0.20 (-3.01)***	0.05 (-1.58)	-0.46 (3.56)***	0.01 (-4.47)***	0.07 (-2.64)**	0.29 (-1.93)**	-0.12 (3.42)***
	$constant$	10.90	88.51	16.81	-160.70	10.60	69.69	-367.10	-61.19
Mortgage-backed securities held by the Fed	QE_{t-1}	-0.03 (3.10)***	5.29 (-8.05)***	5.18 (-7.92)***	-4.26 (10.46)***	-0.05 (4.52)***	3.53 (-8.77)***	33.53 (-3.76)***	-0.58 (0.57)
	$trend$	0.01 (-14.64)***	-0.29 (8.18)***	-0.28 (7.95)***	0.12 (-5.37)***	0.01 (-15.35)***	-0.26 (11.48)***	-2.56 (5.06)***	-0.18 (3.16)***
	$constant$	9.74	-59.81	-58.74	59.30	9.97	-36.48	-271.30	19.73
Treasury & mortgage-backed securities	QE_{t-1}	-0.13 (8.04)***	-4.61 (5.83)***	1.03 (-1.29)	10.38 (-7.03)***	-0.02 (1.04)	-2.26 (3.62)***	38.03 (-10.78)***	8.20 (-5.16)***
	$trend$	0.01 (-11.84)***	0.17 (-4.26)***	-0.04 (0.87)	-0.47 (6.26)***	0.004 (-4.36)***	0.04 (-1.42)	-0.61 (3.46)***	-0.35 (4.42)***
	$constant$	11.22	63.88	-11.59	-130.28	9.76	34.08	-440.79	-102.59
Size of the Fed's balance sheet	QE_{t-1}	-0.003 (0.56)	11.42 (-20.27)***	11.74 (-22.33)***	-23.78 (9.20)***	1.40 (-2.68)**	130.04 (-2.86)***	-889.70 (2.69)**	-204.25 (2.78)***
	$trend$	0.01 (-25.68)***	-0.44 (23.04)***	-0.45 (24.91)***	0.81 (-9.12)***	-0.02 (0.60)	-2.30 (0.91)	14.60 (-0.79)	3.32 (-0.81)
	$constant$	9.49	-150.41	-155.25	327.83	-10.43	-1833.80	12695.83	2899.33

*Table 62 | Cointegrating equations between real GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing. Different proxies are used for the interest rate, the external finance premium and quantitative easing. The proxy for risk tolerance is always the equity risk premium. Each combination results in 4 cointegrating equations. Each column in a section is an equation. The numbers represent coefficients. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.2.2 13-week Treasury Bill rate

D.2.2.1 Corporate bond spreads

QE proxy↓	IR proxy→	13-week Treasury Bill rate							
	EFP proxy→	BBB-AAA corporate bond spread				High yield (≤CCC-AAA) corporate bond spread			
	Dep. var.→ Indep. ↓	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}
Treasury securities held by the Fed	QE_{t-1}	-0.004 (0.24)	0.22 (-0.16)	-0.21 (0.35)	4.92 (-4.29)***	-0.05 (2.27)**	-2.93 (1.67)	-2.85 (0.66)	7.75 (-5.08)***
	$trend$	0.003 (-5.67)***	-0.09 (1.89)**	0.02 (-0.75)	-0.12 (2.92)***	0.004 (-5.60)***	-0.02 (0.40)	0.21 (-1.45)	-0.16 (3.17)***
	$constant$	9.57	0.70	3.88	-61.03	10.23	42.46	42.82	-99.05
Mortgage-backed securities held by the Fed	QE_{t-1}	0.01 (-1.36)	0.19 (-5.43)***	-1.44 (8.93)***	-3.57 (16.13)***	0.01 (-2.43)**	0.14 (-8.57)***	-0.88 (0.44)	-4.92 (12.76)***
	$trend$	0.01 (-20.68)***	-0.01 (6.30)***	0.01 (-0.83)	0.07 (-5.82)***	0.01 (-17.94)***	-0.01 (10.24)***	-0.08 (0.61)	0.13 (-5.11)***
	$constant$	9.36	-2.15	21.32	51.53	9.31	-1.51	23.76	68.18
Treasury & mortgage-backed securities	QE_{t-1}	-0.14 (7.15)***	-6.11 (4.35)***	5.71 (-5.68)***	18.30 (-7.28)***	-0.27 (4.92)***	-11.42 (3.88)***	-37.85 (3.48)***	21.58 (-4.93)***
	$trend$	0.01 (-10.41)***	0.22 (-3.15)***	-0.28 (5.51)***	-0.87 (6.86)***	0.02 (-6.15)***	0.52 (-3.34)***	2.13 (-3.71)***	-1.10 (4.78)***
	$constant$	11.31	81.58	-71.73	-231.32	12.90	148.65	485.97	-271.17
Size of the Fed's balance sheet	QE_{t-1}	0.13 (-5.20)***	-1.00 (5.51)***	-3.82 (3.71)***	-63.56 (6.12)***	0.02 (-1.19)	-0.61 (3.45)***	-1.45 (0.08)	-10.55 (3.35)***
	$trend$	-0.001 (0.86)	0.04 (-5.71)***	0.07 (-1.90)**	2.62 (-6.86)***	0.01 (-6.98)***	0.01 (-0.55)	2.12 (-2.30)**	0.05 (-0.33)
	$constant$	7.67	13.61	55.68	850.72	9.20	9.19	-42.58	158.25

Table 63 | Cointegrating equations between real GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing. Different proxies are used for the interest rate, the external finance premium and quantitative easing. The proxy for risk tolerance is always the equity risk premium. Each combination results in 4 cointegrating equations. Each column in a section is an equation. The numbers represent coefficients. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.

D.2.2.2 Yield curve rate spread & debt-to-GDP ratio

QE proxy↓	IR proxy→	13-week Treasury Bill rate							
	EFP proxy→	10-year – 3-month yield spread				Debt-to-GDP ratio			
	Dep. var.→ Indep. ↓	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}	$\ln GDP_{t-1}$	IR_{t-1}	EFP_{t-1}	RT_{t-1}
Treasury securities held by the Fed	QE_{t-1}	-0.11 (2.56)**	-5.36 (2.50)**	-1.08 (1.30)	12.83 (-3.57)***	-0.06 (5.50)***	-1.62 (1.62)	42.05 (-5.75)***	9.73 (-5.28)***
	$trend$	0.01 (-5.17)***	0.15 (-1.95)**	0.04 (-1.49)	-0.46 (3.57)***	0.01 (-14.53)***	-0.05 (1.35)	-0.20 (0.79)	-0.27 (4.33)***
	$constant$	10.92	71.43	15.82	-161.20	10.24	24.92	-496.19	-123.46
Mortgage-backed securities held by the Fed	QE_{t-1}	-0.02 (2.94)***	0.11 (-5.19)***	4.80 (-7.98)***	-4.13 (9.64)***	0.05 (-4.15)***	0.23 (-6.72)***	-42.68 (4.62)***	-9.17 (6.71)***
	$trend$	0.01 (-15.16)***	-0.01 (8.19)***	-0.26 (8.00)***	0.11 (-4.78)***	0.003 (-4.36)***	-0.01 (8.27)***	2.85 (-5.93)***	0.36 (-5.12)***
	$constant$	9.71	-1.11	-54.24	57.69	8.86	-2.57	580.42	118.09
Treasury & mortgage-backed securities	QE_{t-1}	-0.13 (8.02)***	-5.52 (4.92)***	1.03 (-1.29)	10.41 (-7.03)***	-0.15 (6.53)***	-1.10 (0.71)	73.00 (-5.83)***	1.65 (-1.05)
	$trend$	0.01 (-11.80)***	0.20 (-3.55)***	-0.03 (0.86)	-0.47 (6.26)***	0.01 (-9.19)***	-0.06 (0.71)	-2.54 (3.91)***	0.02 (-0.25)
	$constant$	11.22	73.86	-11.57	-130.57	11.45	18.52	-882.25	-20.04
Size of the Fed's balance sheet	QE_{t-1}	-0.003 (0.48)	-0.31 (1.82)**	11.70 (-20.50)***	-23.61 (8.58)***	0.03 (-2.44)**	-0.48 (2.36)**	-43.15 (5.04)***	-12.89 (6.94)***
	$trend$	0.01 (-24.06)***	0.003 (-0.57)	-0.45 (22.88)***	0.80 (-8.50)***	0.004 (-5.46)***	0.01 (-0.97)	2.02 (-4.62)***	0.42 (-4.48)***
	$constant$	9.49	4.63	-154.68	325.45	8.99	7.13	655.94	179.72

*Table 64 | Cointegrating equations between real GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing. Different proxies are used for the interest rate, the external finance premium and quantitative easing. The proxy for risk tolerance is always the equity risk premium. Each combination results in 4 cointegrating equations. Each column in a section is an equation. The numbers represent coefficients. t-statistics are reported in parenthesis. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3 Vector error correction models

D.3.1 QE proxy: Treasury securities held by the Fed

D.3.1.1 BBB-AAA corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.006 (2.35)**	-0.106 (-0.67)	0.153 (0.88)	-0.242 (-1.01)	0.005 (4.06)***	0.164 (2.84)***	-0.078 (-1.02)	-0.254 (-2.02)*
$ECT\ GDP_{t-1}$	-0.055 (-0.40)	15.063 (1.74)*	-17.371 (-1.82)*	-12.429 (-0.94)	-0.545 (-3.99)***	-1.673 (-0.26)	18.153 (2.08)**	36.581 (2.56)**
$ECT\ IR_{t-1}$	-0.003 (-0.40)	-1.232 (-2.81)**	0.535 (1.11)	0.363 (0.55)	0.004 (3.05)***	-0.178 (-2.52)**	-0.078 (-0.83)	-0.169 (-1.10)
$ECT\ EFP_{t-1}$	-0.005 (-0.68)	-0.923 (-1.87)*	-0.013 (-0.02)	-0.239 (-0.32)	0.001 (0.41)	-0.269 (-1.52)	-0.064 (-0.27)	0.095 (0.25)
$ECT\ RT_{t-1}$	-0.003 (-2.76)**	0.020 (0.28)	-0.026 (-0.33)	0.005 (0.05)	-0.004 (-3.14)***	0.044 (0.65)	0.037 (0.41)	0.163 (1.09)
$\Delta \ln GDP_{t-1}$	-0.514 (-2.13)**	-9.731 (-0.64)	8.148 (0.49)	14.822 (0.64)	-0.021 (-0.14)	-17.197 (-2.34)**	0.751 (0.08)	20.630 (1.28)
$\Delta \ln GDP_{t-2}$	-0.350 (-1.64)	7.142 (0.54)	-2.416 (-0.16)	0.178 (0.01)	0.003 (0.02)	-14.530 (-2.03)*	3.566 (0.38)	18.508 (1.19)
$\Delta \ln GDP_{t-3}$	-0.277 (-1.42)	3.912 (0.32)	-2.887 (-0.21)	7.689 (0.41)				
$\Delta \ln GDP_{t-4}$	0.068 (0.36)	-9.196 (-0.79)	-11.335 (-0.88)	25.391 (1.43)				
ΔIR_{t-1}	-0.002 (-0.44)	0.132 (0.43)	-0.006 (-0.02)	0.272 (0.58)	0.0002 (0.06)	0.264 (1.40)	0.725 (2.89)***	1.070 (2.60)**
ΔIR_{t-2}	-0.009 (-1.84)*	0.146 (0.47)	0.203 (0.60)	0.167 (0.36)	-0.001 (-0.20)	0.964 (4.01)***	-1.116 (-3.49)***	-1.406 (-2.68)**
ΔIR_{t-3}	-0.002 (-0.53)	0.406 (1.55)	-0.177 (-0.61)	-0.272 (-0.68)				
ΔIR_{t-4}	-0.002 (-0.46)	0.285 (1.13)	-0.321 (-1.16)	-0.379 (-0.99)				
ΔEFP_{t-1}	-0.002 (-0.30)	0.332 (0.66)	-0.187 (-0.34)	0.372 (0.49)	0.001 (0.31)	0.210 (1.12)	-0.253 (-1.01)	0.003 (0.01)
ΔEFP_{t-2}	0.001 (0.11)	0.261 (0.64)	-0.022 (-0.05)	0.027 (0.04)	0.003 (0.99)	0.262 (1.56)	-0.365 (-1.64)	-0.859 (-2.35)**
ΔEFP_{t-3}	-0.006 (-1.13)	0.265 (0.79)	-0.122 (-0.33)	0.251 (0.49)				
ΔEFP_{t-4}	-0.004 (-0.81)	0.140 (0.51)	0.007 (0.02)	0.174 (0.42)				
ΔRT_{t-1}	-0.001 (-0.14)	-0.505 (-1.78)*	0.544 (1.74)*	0.363 (0.84)	0.002 (0.72)	-0.210 (-1.77)*	0.470 (2.98)***	0.365 (1.41)
ΔRT_{t-2}	-0.004 (-1.04)	-0.075 (-0.30)	0.448 (1.60)	-0.167 (-0.43)	0.0004 (0.20)	0.006 (0.06)	0.108 (0.81)	-0.342 (-1.57)
ΔRT_{t-3}	0.002 (0.54)	0.044 (0.17)	0.078 (0.28)	-0.201 (-0.52)				

ΔRT_{t-4}	-0.002 (-0.66)	-0.121 (-0.53)	0.229 (0.91)	0.253 (0.73)				
$\Delta \ln QE_{t-1}$	-0.008 (-0.31)	1.468 (0.96)	-0.039 (-0.02)	0.612 (0.26)	-0.031 (-1.95)*	-3.112 (-4.10)***	3.558 (3.53)***	3.756 (2.27)**
$\Delta \ln QE_{t-2}$	0.067 (2.24)**	3.920 (2.10)**	-6.746 (-3.29)***	-5.094 (-1.80)*	0.011 (0.66)	2.917 (3.66)***	-2.312 (-2.18)**	-0.758 (-0.44)
$\Delta \ln QE_{t-3}$	-0.035 (-1.28)	-1.487 (-0.86)	5.461 (2.86)***	7.016 (2.66)**				
$\Delta \ln QE_{t-4}$	0.046 (1.58)	1.428 (0.79)	-3.586 (-1.80)*	-0.533 (-0.19)				
R^2	0.78	0.69	0.68	0.73	0.73	0.81	0.65	0.59
Adj. R^2	0.53	0.34	0.30	0.42	0.62	0.73	0.50	0.41
AIC	-7.70	0.57	0.76	1.41	-7.98	-0.24	0.33	1.33
DW	2.21	2.23	2.14	2.37	2.09	2.06	2.09	2.31
Start	2004Q2	2004Q2	2004Q2	2004Q2	2003Q4	2003Q4	2003Q4	2003Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	46	46	46	46	48	48	48	48

Table 65 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.1.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.007 (3.70)***	0.067 (0.51)	0.515 (0.46)	-0.153 (-0.76)	0.007 (4.83)***	0.209 (2.90)***	-0.563 (-0.80)	-0.168 (-1.05)
$ECT\ GDP_{t-1}$	-0.282 (-2.56)**	13.306 (1.83)*	66.318 (1.08)	1.895 (0.17)	-0.391 (-3.05)***	3.862 (0.58)	151.776 (2.34)**	18.684 (1.27)
$ECT\ IR_{t-1}$	0.004 (1.05)	-0.685 (-2.50)**	-4.306 (-1.86)*	-0.359 (-0.86)	0.002 (1.67)	-0.181 (-2.47)**	-1.164 (-1.62)	-0.204 (-1.26)
$ECT\ EFP_{t-1}$	-0.0002 (-0.52)	-0.014 (-0.47)	-0.306 (-1.22)	-0.078 (-1.70)	-0.00002 (-0.07)	-0.002 (-0.15)	-0.259 (-1.73)*	-0.074 (-2.17)**
$ECT\ RT_{t-1}$	-0.003 (-1.84)*	-0.195 (-1.78)*	-1.522 (-1.64)	-0.111 (-0.66)	-0.004 (-5.25)***	-0.075 (-1.83)*	0.965 (2.40)**	0.205 (2.25)**
$\Delta \ln GDP_{t-1}$	-0.348 (-1.69)	-17.106 (-1.26)	-13.973 (-0.12)	14.429 (0.69)	-0.310 (-1.74)*	-24.810 (-2.70)**	41.837 (0.46)	24.589 (1.20)
$\Delta \ln GDP_{t-2}$	-0.214 (-0.97)	-8.339 (-0.57)	-72.363 (-0.59)	3.870 (0.17)	-0.192 (-1.17)	-20.929 (-2.48)**	59.363 (0.72)	16.887 (0.90)
$\Delta \ln GDP_{t-3}$	-0.147 (-0.78)	-3.968 (-0.32)	-86.977 (-0.82)	4.682 (0.24)				
ΔIR_{t-1}	0.003 (0.60)	0.135 (0.44)	2.054 (0.79)	0.275 (0.58)	-0.002 (-0.55)	0.421 (2.21)**	5.101 (2.73)**	0.332 (0.78)
ΔIR_{t-2}	-0.004 (-1.04)	0.172 (0.61)	1.868 (0.78)	0.163 (0.38)	0.003 (0.72)	0.724 (3.01)***	-5.723 (-2.43)**	-0.264 (-0.49)
ΔIR_{t-3}	-0.001 (-0.32)	0.381 (1.61)	-0.154 (-0.08)	-0.141 (-0.39)				
ΔEFP_{t-1}	-0.002 (-2.07)**	-0.045 (-0.77)	0.748 (1.52)	0.124 (1.39)	-0.001 (-2.24)**	0.002 (0.06)	0.386 (1.41)	0.016 (0.25)
ΔEFP_{t-2}	-0.00004 (-0.05)	-0.058 (-1.15)	0.080 (0.19)	0.080 (1.03)	-0.00003 (-0.05)	-0.020 (-0.63)	-0.364 (-1.18)	0.036 (0.51)
ΔEFP_{t-3}	-0.00004 (-0.06)	-0.009 (-0.17)	-0.275 (-0.65)	0.019 (0.24)				
ΔRT_{t-1}	0.011 (2.16)**	-0.133 (-0.41)	1.110 (0.40)	0.110 (0.22)	0.005 (2.19)**	-0.076 (-0.59)	1.150 (0.92)	0.193 (0.68)
ΔRT_{t-2}	0.003 (0.65)	0.536 (1.67)	-1.689 (-0.62)	-0.755 (-1.53)	0.003 (1.29)	0.221 (1.64)	-1.201 (-0.91)	-0.603 (-2.02)*
ΔRT_{t-3}	0.002 (0.39)	0.092 (0.31)	1.133 (0.45)	0.026 (0.06)				
$\Delta \ln QE_{t-1}$	-0.033 (-1.76)*	0.901 (0.74)	14.098 (1.37)	1.128 (0.60)	-0.030 (-2.07)**	-2.197 (-2.99)***	17.007 (2.36)**	0.797 (0.49)
$\Delta \ln QE_{t-2}$	0.033 (1.47)	0.864 (0.58)	-26.718 (-2.14)**	-2.216 (-0.98)	0.012 (0.88)	2.057 (2.96)***	-14.372 (-2.11)**	0.046 (0.03)
$\Delta \ln QE_{t-3}$	-0.024 (-1.28)	-1.077 (-0.86)	27.057 (2.57)**	5.319 (2.79)***				
R^2	0.74	0.59	0.63	0.63	0.75	0.80	0.70	0.54
Adj. R^2	0.55	0.30	0.36	0.37	0.65	0.71	0.58	0.34
AIC	-7.78	0.61	4.87	1.46	-8.05	-0.16	4.40	1.43

DW	1.87	2.24	1.83	2.24	2.34	2.10	2.22	1.96
Start	2004Q1	2004Q1	2004Q1	2004Q1	2003Q4	2003Q4	2003Q4	2003Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	47	47	47	47	48	48	48	48

Table 66 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.1.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.005 (4.58)***	-0.047 (-0.65)	-0.234 (-3.38)***	-0.219 (-1.91)*	0.005 (4.59)***	0.184 (3.38)***	-0.235 (-3.41)***	-0.217 (-1.89)*
$ECT\ GDP_{t-1}$	-0.509 (-4.66)***	-5.999 (-0.78)	-9.442 (-1.30)	22.781 (1.89)*	-0.507 (-4.65)***	3.215 (0.56)	-8.944 (-1.23)	22.570 (1.86)*
$ECT\ IR_{t-1}$	0.001 (0.22)	-0.866 (-4.09)***	-0.554 (-2.75)***	0.872 (2.61)**	0.001 (0.22)	-0.313 (-1.90)*	-0.577 (-2.76)***	0.906 (2.61)**
$ECT\ EFP_{t-1}$	-0.005 (-3.73)***	-0.258 (-2.75)***	-0.400 (-4.48)***	0.325 (2.20)**	-0.004 (-1.21)	-0.167 (-0.89)	-0.956 (-4.03)***	1.208 (3.07)***
$ECT\ RT_{t-1}$	-0.006 (-3.70)***	-0.479 (-4.44)***	-0.351 (-3.43)***	0.681 (4.01)***	-0.006 (-3.70)***	-0.127 (-1.57)	-0.349 (-3.41)***	0.686 (4.03)***
$\Delta \ln GDP_{t-1}$	-0.098 (-0.78)	-7.591 (-0.87)	14.877 (1.79)*	30.817 (2.24)**	-0.098 (-0.78)	-22.003 (-3.36)***	14.903 (1.80)*	31.054 (2.25)**
$\Delta \ln GDP_{t-2}$	-0.057 (-0.46)	1.138 (0.13)	19.336 (2.36)**	25.189 (1.86)*	-0.057 (-0.47)	-18.025 (-2.80)***	19.473 (2.39)**	25.003 (1.84)*
ΔIR_{t-1}	0.006 (1.29)	0.282 (0.93)	-0.401 (-1.39)	0.460 (0.96)	0.006 (1.31)	0.677 (2.89)***	-0.411 (-1.38)	0.443 (0.90)
ΔIR_{t-2}	-0.011 (-2.33)**	0.028 (0.08)	-0.680 (-2.11)**	-0.882 (-1.65)	-0.012 (-2.36)**	0.723 (2.79)***	-0.703 (-2.14)**	-0.873 (-1.60)
ΔEFP_{t-1}	-0.003 (-1.04)	0.083 (0.41)	0.492 (2.56)**	-0.720 (-2.26)**	0.003 (0.85)	0.269 (1.66)	0.088 (0.43)	-0.266 (-0.78)
ΔEFP_{t-2}	0.006 (1.55)	0.109 (0.42)	0.789 (3.21)***	0.501 (1.23)	-0.006 (-2.14)**	0.033 (0.24)	0.104 (0.60)	-0.374 (-1.29)
ΔRT_{t-1}	0.006 (2.21)**	0.062 (0.35)	-0.018 (-0.11)	0.014 (0.05)	0.006 (2.23)**	0.079 (0.60)	-0.021 (-0.13)	0.003 (0.01)
ΔRT_{t-2}	-0.001 (-0.54)	0.313 (2.37)**	0.135 (1.08)	-0.781 (-3.75)***	-0.001 (-0.57)	0.179 (1.80)*	0.130 (1.03)	-0.778 (-3.71)***
$\Delta \ln QE_{t-1}$	-0.014 (-1.04)	0.718 (0.76)	2.920 (3.24)***	0.184 (0.12)	-0.014 (-1.04)	-2.160 (-3.04)***	2.921 (3.25)***	0.135 (0.09)
$\Delta \ln QE_{t-2}$	0.012 (0.93)	0.578 (0.67)	-1.791 (-2.17)**	-0.573 (-0.42)	0.012 (0.94)	2.318 (3.56)***	-1.777 (-2.16)**	-0.579 (-0.42)
R^2	0.78	0.60	0.75	0.62	0.78	0.81	0.75	0.61
Adj. R^2	0.68	0.43	0.64	0.45	0.69	0.73	0.64	0.45
AIC	-8.16	0.34	0.24	1.25	-8.16	-0.24	0.24	1.26
DW	2.25	1.95	2.20	2.10	2.25	2.07	2.20	2.10
Start	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	48	48	48	48	48	48	48	48

Table 67 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.1.4 Debt-to-GDP ratio

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.008 (2.13)**	0.076 (0.30)	1.095 (1.65)	0.263 (0.64)	0.005 (2.56)**	0.301 (3.08)***	1.046 (2.85)***	-0.109 (-0.46)
$ECT\ GDP_{t-1}$	0.033 (0.22)	16.889 (1.62)	-57.197 (-2.13)**	-0.772 (-0.05)	-0.506 (-2.98)***	8.242 (1.00)	-27.983 (-0.90)	30.822 (1.55)
$ECT\ IR_{t-1}$	0.005 (1.25)	-0.522 (-1.88)*	0.533 (0.75)	-0.194 (-0.44)	0.004 (2.96)***	-0.168 (-2.79)***	-0.314 (-1.38)	-0.125 (-0.86)
$ECT\ EFP_{t-1}$	0.001 (2.24)**	0.031 (0.74)	-0.177 (-1.63)	-0.011 (-0.16)	-0.0001 (-0.31)	0.036 (1.54)	-0.214 (-2.45)**	0.048 (0.85)
$ECT\ RT_{t-1}$	-0.006 (-2.46)**	-0.202 (-1.20)	1.397 (3.23)***	0.057 (0.21)	-0.003 (-2.14)**	-0.131 (-1.80)*	1.106 (4.03)***	0.072 (0.41)
$\Delta \ln GDP_{t-1}$	-0.529 (-2.34)**	-13.070 (-0.82)	113.019 (2.75)**	-0.768 (-0.03)	-0.180 (-1.10)	-28.674 (-3.59)***	96.587 (3.22)***	25.317 (1.32)
$\Delta \ln GDP_{t-2}$	-0.108 (-0.51)	13.675 (0.92)	-58.722 (-1.54)	-5.806 (-0.25)	0.100 (0.53)	-23.156 (-2.54)**	-43.294 (-1.26)	14.310 (0.65)
$\Delta \ln GDP_{t-3}$	-0.273 (-1.25)	-7.619 (-0.49)	26.875 (0.67)	-1.739 (-0.07)				
ΔIR_{t-1}	-0.004 (-0.93)	-0.102 (-0.34)	-0.529 (-0.68)	0.502 (1.04)	0.001 (0.36)	0.282 (1.82)*	1.003 (1.73)*	0.438 (1.18)
ΔIR_{t-2}	-0.007 (-1.84)*	-0.106 (-0.41)	0.624 (0.94)	0.320 (0.79)	-0.001 (-0.29)	0.756 (4.18)***	0.014 (0.02)	-0.699 (-1.61)
ΔIR_{t-3}	-0.004 (-1.19)	0.249 (1.08)	0.161 (0.27)	0.054 (0.15)				
ΔEFP_{t-1}	-0.001 (-1.11)	-0.102 (-1.09)	0.204 (0.85)	-0.137 (-0.93)	-0.001 (-1.49)	-0.040 (-1.01)	0.209 (1.42)	-0.011 (-0.11)
ΔEFP_{t-2}	0.001 (0.85)	0.040 (0.56)	-0.719 (-3.89)***	-0.082 (-0.71)	0.001 (1.08)	-0.023 (-0.58)	-0.648 (-4.29)***	-0.080 (-0.83)
ΔEFP_{t-3}	0.0004 (0.33)	-0.080 (-0.92)	0.005 (0.02)	-0.057 (-0.42)				
ΔRT_{t-1}	0.003 (0.98)	-0.383 (-1.94)*	-0.665 (-1.31)	0.518 (1.65)	0.002 (0.99)	-0.052 (-0.58)	0.040 (0.12)	0.293 (1.35)
ΔRT_{t-2}	-0.0004 (-0.20)	0.114 (0.70)	-0.182 (-0.43)	-0.319 (-1.23)	0.001 (0.88)	0.141 (1.96)*	-0.336 (-1.24)	-0.534 (-3.09)***
ΔRT_{t-3}	-0.0004 (-0.16)	-0.059 (-0.33)	-0.274 (-0.59)	0.138 (0.48)				
$\Delta \ln QE_{t-1}$	-0.030 (-1.52)	1.163 (0.82)	0.335 (0.09)	1.562 (0.70)	-0.023 (-1.74)*	-2.518 (-3.84)***	-0.022 (-0.01)	1.546 (0.98)
$\Delta \ln QE_{t-2}$	0.023 (1.03)	0.862 (0.54)	-3.306 (-0.80)	-3.697 (-1.45)	0.011 (0.81)	2.177 (3.40)***	1.698 (0.71)	-0.177 (-0.11)
$\Delta \ln QE_{t-3}$	0.003 (0.16)	-0.267 (-0.23)	1.287 (0.43)	5.024 (2.69)**				
R^2	0.75	0.55	0.84	0.57	0.74	0.81	0.83	0.50
Adj. R^2	0.58	0.24	0.74	0.26	0.63	0.73	0.76	0.28
AIC	-7.83	0.69	2.58	1.62	-8.00	-0.23	2.41	1.52

DW	2.13	2.21	1.83	2.13	2.18	2.15	2.06	2.08
Start	2004Q1	2004Q1	2004Q1	2004Q1	2003Q4	2003Q4	2003Q4	2003Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	47	47	47	47	48	48	48	48

Table 68 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.2 QE proxy: mortgage-backed securities held by the Fed

D.3.2.1 BBB-AAA corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.003 (0.71)	-0.872 (-2.37)**	0.076 (0.34)	0.713 (1.76)	0.005 (0.94)	0.005 (0.14)	0.289 (1.67)	0.661 (2.21)*
$ECT\ GDP_{t-1}$	-1.687 (-1.82)	-181.736 (-2.33)**	52.704 (1.10)	104.357 (1.22)	-1.247 (-1.22)	3.663 (0.55)	73.777 (2.33)**	41.552 (0.76)
$ECT\ IR_{t-1}$	-0.006 (-0.75)	-1.240 (-1.76)	0.428 (0.99)	0.328 (0.42)	-0.017 (-0.24)	0.004 (0.01)	-6.887 (-3.23)**	-5.454 (-1.48)
$ECT\ EFP_{t-1}$	0.005 (0.43)	2.557 (2.65)**	-1.212 (-2.04)*	-2.508 (-2.36)**	0.013 (0.67)	-0.008 (-0.06)	-1.894 (-3.10)**	-2.606 (-2.47)**
$ECT\ RT_{t-1}$	-0.008 (-1.20)	-0.102 (-0.18)	-0.040 (-0.11)	-0.893 (-1.40)	-0.001 (-0.16)	-0.029 (-0.57)	0.054 (0.23)	-1.501 (-3.63)***
$\Delta \ln GDP_{t-1}$	0.675 (0.96)	113.762 (1.93)*	-18.774 (-0.52)	-58.792 (-0.91)	0.197 (0.24)	-0.134 (-0.03)	-43.878 (-1.73)	-19.906 (-0.45)
$\Delta \ln GDP_{t-2}$	0.210 (0.53)	51.429 (1.54)	2.790 (0.14)	-22.886 (-0.62)	-0.066 (-0.15)	-1.402 (-0.49)	-13.899 (-1.01)	-4.824 (-0.20)
ΔIR_{t-1}	-0.002 (-0.24)	0.360 (0.65)	0.028 (0.08)	-0.521 (-0.85)	0.030 (0.75)	-0.080 (-0.31)	3.840 (3.14)**	7.859 (3.72)***
ΔIR_{t-2}	-0.013 (-2.19)*	0.222 (0.45)	-0.041 (-0.13)	-0.072 (-0.13)	-0.010 (-0.21)	-0.080 (-0.26)	2.071 (1.38)	6.915 (2.68)**
ΔEFP_{t-1}	0.006 (0.58)	-1.574 (-1.76)	0.626 (1.14)	1.696 (1.72)	-0.002 (-0.15)	0.084 (0.96)	0.414 (1.00)	1.490 (2.08)*
ΔEFP_{t-2}	0.010 (1.06)	-1.337 (-1.69)	0.200 (0.41)	1.568 (1.80)	0.001 (0.06)	0.098 (1.21)	0.098 (0.25)	0.860 (1.30)
ΔRT_{t-1}	0.002 (0.43)	-0.379 (-0.92)	0.328 (1.29)	0.299 (0.66)	0.001 (0.31)	0.004 (0.13)	0.136 (0.99)	0.832 (3.53)***
ΔRT_{t-2}	-0.010 (-1.91)*	0.089 (0.20)	0.104 (0.38)	-0.212 (-0.43)	0.0002 (0.05)	0.013 (0.48)	0.024 (0.18)	0.132 (0.57)
$\Delta \ln QE_{t-1}$	-0.011 (-0.25)	-6.948 (-1.82)	0.911 (0.39)	3.493 (0.83)	-0.010 (-0.23)	0.574 (1.99)*	-0.036 (-0.03)	-1.139 (-0.48)
$\Delta \ln QE_{t-2}$	-0.006 (-0.88)	0.763 (1.27)	-0.066 (-0.18)	-1.115 (-1.69)	0.0004 (0.05)	-0.118 (-2.25)*	0.305 (1.22)	-0.484 (-1.13)
R^2	0.75	0.73	0.74	0.79	0.65	0.79	0.87	0.90
Adj. R^2	0.36	0.31	0.33	0.45	0.12	0.47	0.67	0.75
AIC	-8.30	0.56	-0.41	0.75	-7.98	-4.24	-1.12	-0.03
DW	2.23	1.94	1.90	2.14	2.07	2.52	2.57	3.10
Start	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	24	24	24	24	24	24	24	24

Table 69 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).

AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.2.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	-0.00004 (-0.01)	-0.443 (-1.64)	-0.679 (-0.54)	0.266 (0.82)	0.003 (1.08)	-0.013 (-0.64)	-0.076 (-0.06)	0.438 (2.02)*
$ECT\ GDP_{t-1}$	-2.523 (-2.94)**	-122.698 (-1.82)	-155.977 (-0.50)	42.215 (0.52)	-2.152 (-3.38)***	-0.909 (-0.21)	-20.281 (-0.08)	41.296 (0.90)
$ECT\ IR_{t-1}$	-0.007 (-0.82)	-1.403 (-2.08)*	-3.222 (-1.02)	0.214 (0.26)	-0.066 (-1.91)*	-0.341 (-1.47)	-7.445 (-0.54)	-7.503 (-3.01)**
$ECT\ EFP_{t-1}$	0.004 (2.97)**	0.114 (1.10)	-0.336 (-0.69)	-0.111 (-0.88)	0.004 (2.96)**	0.016 (1.55)	-0.358 (-0.60)	-0.346 (-3.18)**
$ECT\ RT_{t-1}$	-0.004 (-0.66)	-0.279 (-0.54)	-4.219 (-1.74)	-0.786 (-1.26)	0.003 (0.76)	0.004 (0.13)	-1.134 (-0.63)	-1.201 (-3.68)***
$\Delta \ln GDP_{t-1}$	1.270 (1.99)*	66.848 (1.34)	240.960 (1.03)	-5.005 (-0.08)	0.639 (1.36)	2.346 (0.75)	86.068 (0.46)	-15.059 (-0.45)
$\Delta \ln GDP_{t-2}$	0.477 (1.29)	26.796 (0.93)	165.846 (1.23)	3.228 (0.09)	0.105 (0.35)	-0.381 (-0.19)	46.293 (0.39)	-5.920 (-0.27)
ΔIR_{t-1}	-0.003 (-0.41)	-0.157 (-0.30)	1.598 (0.65)	0.042 (0.07)	0.076 (2.31)**	0.272 (1.24)	5.813 (0.45)	6.976 (2.95)**
ΔIR_{t-2}	-0.013 (-2.09)*	0.010 (0.02)	0.482 (0.21)	0.063 (0.10)	-0.004 (-0.14)	0.012 (0.06)	-4.150 (-0.34)	6.415 (2.86)**
ΔEFP_{t-1}	-0.001 (-0.43)	-0.025 (-0.20)	0.284 (0.49)	0.048 (0.32)	-0.003 (-1.82)	0.006 (0.52)	0.108 (0.17)	0.104 (0.92)
ΔEFP_{t-2}	0.001 (0.85)	-0.165 (-1.62)	0.444 (0.93)	0.228 (1.86)*	-0.003 (-1.77)	-0.006 (-0.57)	0.169 (0.29)	0.195 (1.82)
ΔRT_{t-1}	-0.003 (-0.40)	-0.845 (-1.38)	2.734 (0.96)	0.728 (0.99)	0.0003 (0.07)	-0.032 (-1.34)	1.149 (0.81)	0.837 (3.24)**
ΔRT_{t-2}	-0.019 (-2.33)**	0.179 (0.28)	-1.840 (-0.63)	-0.551 (-0.73)	-0.001 (-0.22)	0.007 (0.31)	-1.562 (-1.26)	-0.106 (-0.47)
$\Delta \ln QE_{t-1}$	-0.061 (-1.54)	-4.511 (-1.45)	-15.665 (-1.08)	0.404 (0.11)	-0.069 (-2.44)**	0.124 (0.65)	-8.426 (-0.75)	-0.388 (-0.19)
$\Delta \ln QE_{t-2}$	-0.005 (-1.17)	0.270 (0.84)	-0.450 (-0.30)	-0.472 (-1.22)	-0.002 (-0.58)	-0.055 (-2.53)**	-0.503 (-0.39)	0.045 (0.19)
R^2	0.75	0.77	0.65	0.78	0.81	0.88	0.70	0.90
Adj. R^2	0.37	0.41	0.12	0.44	0.52	0.70	0.22	0.75
AIC	-8.32	0.41	3.49	0.78	-8.60	-4.80	3.36	-0.05
DW	2.25	2.20	2.17	2.50	2.31	2.97	1.99	2.49
Start	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	24	24	24	24	24	24	24	24

Table 70 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.2.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.005 (1.92)*	-0.435 (-1.75)	-0.417 (-1.74)	0.295 (1.07)	0.005 (1.91)*	-0.019 (-1.09)	-0.409 (-1.71)	0.290 (1.05)
$ECT\ GDP_{t-1}$	-1.812 (-2.73)**	-56.726 (-0.95)	-56.544 (-0.98)	-29.439 (-0.44)	-1.811 (-2.70)**	-0.699 (-0.16)	-53.804 (-0.93)	-31.523 (-0.47)
$ECT\ IR_{t-1}$	-0.187 (-4.44)***	3.888 (1.03)	4.379 (1.20)	-6.708 (-1.60)	-0.187 (-4.44)***	-0.483 (-1.80)	4.175 (1.15)	-6.639 (-1.58)
$ECT\ EFP_{t-1}$	0.168 (4.24)***	-4.634 (-1.30)	-5.137 (-1.49)	6.273 (1.59)	-0.019 (-2.60)**	0.006 (0.14)	-0.781 (-1.26)	-0.426 (-0.59)
$ECT\ RT_{t-1}$	-0.008 (-1.37)	-0.026 (-0.05)	-0.008 (-0.02)	-1.033 (-1.69)	-0.008 (-1.35)	-0.020 (-0.51)	0.003 (0.01)	-1.042 (-1.70)
$\Delta \ln GDP_{t-1}$	0.585 (1.10)	37.376 (0.78)	34.844 (0.75)	21.017 (0.39)	0.582 (1.08)	3.032 (0.89)	32.836 (0.71)	22.353 (0.42)
$\Delta \ln GDP_{t-2}$	0.115 (0.33)	18.092 (0.58)	18.019 (0.60)	8.185 (0.24)	0.121 (0.35)	-0.034 (-0.02)	17.551 (0.59)	8.550 (0.25)
ΔIR_{t-1}	0.108 (3.48)***	-5.659 (-2.02)*	-6.060 (-2.24)*	7.221 (2.32)**	0.109 (3.46)***	0.401 (2.01)*	-6.072 (-2.25)*	7.242 (2.32)**
ΔIR_{t-2}	0.047 (1.45)	-2.639 (-0.90)	-2.896 (-1.02)	3.351 (1.03)	0.048 (1.47)	0.217 (1.05)	-2.941 (-1.05)	3.402 (1.05)
ΔEFP_{t-1}	-0.105 (-3.35)***	5.243 (1.85)*	5.618 (2.05)*	-6.924 (-2.20)*	0.003 (0.65)	0.014 (0.48)	-0.405 (-0.99)	0.272 (0.58)
ΔEFP_{t-2}	-0.055 (-1.75)	2.101 (0.74)	2.424 (0.89)	-2.628 (-0.84)	-0.008 (-1.86)*	-0.071 (-2.54)**	-0.449 (-1.18)	0.709 (1.62)
ΔRT_{t-1}	-0.00005 (-0.01)	-0.747 (-1.75)	-0.782 (-1.90)*	0.646 (1.37)	0.00005 (0.01)	0.027 (0.89)	-0.770 (-1.90)*	0.634 (1.35)
ΔRT_{t-2}	-0.010 (-2.03)*	-0.208 (-0.47)	-0.197 (-0.46)	0.075 (0.15)	-0.010 (-2.07)*	-0.018 (-0.58)	-0.189 (-0.45)	0.066 (0.14)
$\Delta \ln QE_{t-1}$	-0.069 (-2.05)*	-0.268 (-0.09)	-0.460 (-0.16)	-4.542 (-1.35)	-0.069 (-2.04)*	0.166 (0.77)	-0.406 (-0.14)	-4.598 (-1.37)
$\Delta \ln QE_{t-2}$	0.007 (2.44)**	0.056 (0.23)	0.110 (0.46)	-0.166 (-0.60)	0.007 (2.43)**	-0.056 (-3.22)**	0.129 (0.55)	-0.179 (-0.66)
R^2	0.82	0.77	0.79	0.82	0.82	0.90	0.79	0.82
Adj. R^2	0.54	0.42	0.46	0.54	0.53	0.73	0.48	0.54
AIC	-8.63	0.38	0.31	0.59	-8.62	-4.92	0.29	0.58
DW	3.15	2.18	2.21	2.88	3.13	2.22	2.24	2.89
Start	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	24	24	24	24	24	24	24	24

Table 71 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.2.4 Debt-to-GDP ratio

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	-0.003 (-0.82)	-0.390 (-1.20)	1.965 (1.25)	0.341 (0.70)	0.0004 (0.10)	0.048 (1.37)	2.319 (1.52)	0.776 (1.75)
$ECT\ GDP_{t-1}$	-1.617 (-2.43)**	-148.886 (-2.74)**	160.353 (0.61)	89.641 (1.10)	-1.849 (-3.91)***	6.354 (1.60)	268.165 (1.56)	9.275 (0.19)
$ECT\ IR_{t-1}$	-0.005 (-0.72)	-0.961 (-1.80)	-1.283 (-0.50)	0.408 (0.51)	-0.007 (-0.21)	-0.966 (-3.25)**	2.919 (0.23)	-8.212 (-2.20)*
$ECT\ EFP_{t-1}$	-0.002 (-1.47)	-0.323 (-3.80)***	0.406 (0.99)	0.289 (2.28)**	-0.002 (-2.92)**	0.006 (0.98)	0.967 (3.84)***	0.231 (3.16)**
$ECT\ RT_{t-1}$	-0.005 (-0.73)	1.432 (2.69)**	-2.164 (-0.85)	-1.951 (-2.46)**	-0.002 (-0.61)	-0.017 (-0.51)	-4.281 (-2.93)**	-1.629 (-3.84)***
$\Delta \ln GDP_{t-1}$	0.635 (1.11)	65.466 (1.39)	56.606 (0.25)	-35.896 (-0.51)	0.465 (1.08)	-4.371 (-1.21)	14.329 (0.09)	-12.679 (-0.28)
$\Delta \ln GDP_{t-2}$	1.086 (3.14)**	-32.311 (-1.14)	-139.917 (-1.03)	53.400 (1.26)	0.765 (2.20)*	-4.557 (-1.56)	-94.192 (-0.75)	-11.139 (-0.30)
ΔIR_{t-1}	0.012 (2.15)*	-1.403 (-3.13)**	-0.797 (-0.37)	1.139 (1.70)	0.048 (1.80)	0.557 (2.48)**	1.539 (0.16)	9.648 (3.43)***
ΔIR_{t-2}	-0.0001 (-0.01)	-1.140 (-3.06)**	0.796 (0.44)	1.291 (2.32)**	0.020 (0.74)	0.363 (1.60)	2.578 (0.26)	5.201 (1.83)
ΔEFP_{t-1}	-0.001 (-0.60)	0.263 (2.65)**	0.093 (0.19)	-0.301 (-2.04)*	-0.001 (-1.01)	-0.005 (-0.64)	-0.457 (-1.25)	-0.225 (-2.13)*
ΔEFP_{t-2}	0.003 (4.16)***	-0.091 (-1.43)	-0.922 (-3.03)**	0.069 (0.73)	0.002 (2.36)**	-0.012 (-1.55)	-0.982 (-2.92)**	-0.133 (-1.36)
ΔRT_{t-1}	0.014 (2.00)*	-2.645 (-4.65)***	0.324 (0.12)	2.397 (2.82)**	0.005 (1.74)	0.003 (0.13)	2.971 (3.05)**	0.948 (3.35)***
ΔRT_{t-2}	0.002 (0.28)	-1.528 (-2.99)**	0.792 (0.32)	1.506 (1.97)*	0.003 (1.15)	0.047 (1.88)*	2.017 (1.89)*	0.147 (0.47)
$\Delta \ln QE_{t-1}$	-0.041 (-1.33)	-1.599 (-0.63)	-0.037 (0.00)	-0.870 (-0.23)	-0.033 (-2.04)*	0.379 (2.77)**	3.711 (0.63)	-2.862 (-1.67)
$\Delta \ln QE_{t-2}$	0.002 (0.99)	-0.398 (-1.96)*	0.490 (0.50)	0.189 (0.62)	0.001 (0.30)	-0.026 (-1.80)	0.802 (1.27)	-0.010 (-0.05)
R^2	0.89	0.89	0.83	0.84	0.88	0.88	0.84	0.87
Adj. R^2	0.73	0.72	0.56	0.59	0.70	0.70	0.59	0.67
AIC	-9.15	-0.34	2.80	0.46	-9.06	-4.79	2.73	0.26
DW	2.83	3.03	1.71	2.80	3.18	3.06	2.19	2.66
Start	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4	2009Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	24	24	24	24	24	24	24	24

Table 72 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.3 QE proxy: Treasury & mortgage-backed securities held by the Fed

D.3.3.1 BBB-AAA corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.007 (1.29)	-0.735 (-1.62)	-0.049 (-0.12)	1.163 (1.77)*	0.007 (4.27)***	0.254 (3.34)***	-0.208 (-1.97)*	-0.001 (-0.01)
$ECT\ GDP_{t-1}$	-0.056 (-0.44)	-6.599 (-0.59)	-19.353 (-1.91)*	9.955 (0.61)	-0.017 (-0.10)	14.165 (1.73)*	-6.190 (-0.55)	-2.043 (-0.11)
$ECT\ IR_{t-1}$	-0.005 (-1.59)	-0.937 (-3.10)***	0.470 (1.73)*	0.715 (1.63)	0.001 (0.71)	-0.222 (-2.99)***	0.035 (0.34)	0.230 (1.32)
$ECT\ EFP_{t-1}$	-0.016 (-2.35)**	-1.205 (-1.99)*	-0.168 (-0.31)	1.685 (1.92)*	-0.001 (-0.50)	-0.013 (-0.09)	-0.358 (-1.74)*	0.767 (2.19)**
$ECT\ RT_{t-1}$	0.001 (0.45)	0.083 (0.34)	0.061 (0.28)	-0.501 (-1.44)	-0.001 (-0.59)	0.002 (0.03)	0.132 (1.63)	-0.211 (-1.53)
$\Delta \ln GDP_{t-1}$	-0.734 (-2.75)**	2.472 (0.11)	34.860 (1.66)	-0.741 (-0.02)	-0.417 (-2.32)**	-30.597 (-3.43)***	21.305 (1.73)*	26.640 (1.27)
$\Delta \ln GDP_{t-2}$	-0.759 (-3.06)***	15.897 (0.73)	23.646 (1.21)	-25.221 (-0.80)	-0.268 (-1.73)*	-30.266 (-3.93)***	22.877 (2.15)**	14.628 (0.81)
$\Delta \ln GDP_{t-3}$	-0.320 (-1.23)	29.773 (1.30)	-1.390 (-0.07)	-62.276 (-1.88)*				
$\Delta \ln GDP_{t-4}$	0.123 (0.56)	20.731 (1.07)	-7.389 (-0.43)	-32.571 (-1.16)				
ΔIR_{t-1}	0.003 (0.93)	0.379 (1.24)	-0.327 (-1.19)	-0.264 (-0.59)	0.006 (1.64)	0.695 (3.84)***	0.265 (1.06)	0.509 (1.20)
ΔIR_{t-2}	-0.005 (-1.31)	0.204 (0.64)	-0.170 (-0.59)	0.095 (0.20)	-0.008 (-2.01)*	0.363 (1.77)*	-0.511 (-1.80)*	-0.942 (-1.95)*
ΔIR_{t-3}	-0.003 (-0.87)	0.300 (1.10)	0.115 (0.47)	0.387 (0.98)				
ΔIR_{t-4}	-0.006 (-1.90)*	0.015 (0.05)	0.005 (0.02)	0.241 (0.59)				
ΔEFP_{t-1}	0.013 (2.83)**	0.229 (0.55)	-0.330 (-0.88)	-0.773 (-1.27)	0.006 (1.60)	0.402 (2.11)**	-0.431 (-1.64)	-0.381 (-0.85)
ΔEFP_{t-2}	0.007 (1.63)	-0.244 (-0.65)	0.306 (0.90)	-0.204 (-0.37)	-0.001 (-0.20)	-0.225 (-1.60)	0.137 (0.70)	-0.356 (-1.07)
ΔEFP_{t-3}	-0.002 (-0.49)	0.214 (0.59)	-0.441 (-1.34)	-0.564 (-1.07)				
ΔEFP_{t-4}	0.0001 (0.02)	0.105 (0.42)	0.296 (1.33)	0.075 (0.21)				
ΔRT_{t-1}	0.001 (0.21)	0.118 (0.46)	0.208 (0.91)	0.105 (0.29)	-0.001 (-0.73)	-0.211 (-2.19)**	0.488 (3.67)***	0.526 (2.32)**
ΔRT_{t-2}	-0.002 (-0.61)	0.603 (2.30)**	-0.232 (-0.99)	-0.680 (-1.80)*	0.001 (0.32)	0.183 (1.97)*	-0.081 (-0.63)	-0.695 (-3.17)***
ΔRT_{t-3}	0.005 (1.67)	0.595 (2.10)**	0.154 (0.61)	0.018 (0.04)				
ΔRT_{t-4}	-0.001 (-0.19)	0.154 (0.49)	0.001 (0.00)	0.191 (0.42)				

$\Delta \ln QE_{t-1}$	-0.006 (-0.30)	2.934 (1.59)	0.273 (0.16)	-6.109 (-2.29)**	-0.008 (-0.52)	-1.670 (-2.22)**	1.920 (1.85)*	-1.042 (-0.59)
$\Delta \ln QE_{t-2}$	0.050 (2.14)**	5.115 (2.47)**	-4.352 (-2.34)**	-8.466 (-2.82)**	0.028 (2.45)**	2.248 (3.98)***	-1.984 (-2.55)**	-3.305 (-2.49)**
$\Delta \ln QE_{t-3}$	0.041 (2.00)*	1.765 (0.99)	1.564 (0.98)	0.672 (0.26)				
$\Delta \ln QE_{t-4}$	0.012 (0.87)	-0.063 (-0.05)	-1.539 (-1.38)	-0.448 (-0.25)				
R^2	0.90	0.71	0.80	0.77	0.78	0.83	0.66	0.57
Adj. R^2	0.78	0.38	0.57	0.50	0.68	0.76	0.51	0.38
AIC	-8.45	0.51	0.29	1.25	-8.15	-0.33	0.31	1.37
DW	2.07	2.22	2.20	2.05	2.29	2.19	1.95	2.10
Start	2004Q2	2004Q2	2004Q2	2004Q2	2003Q4	2003Q4	2003Q4	2003Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	46	46	46	46	48	48	48	48

Table 73 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.3.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.009 (2.27)**	-0.255 (-0.93)	3.531 (2.07)*	0.561 (1.32)	0.008 (1.66)	0.186 (0.85)	1.527 (0.90)	0.519 (1.11)
$ECT\ GDP_{t-1}$	-0.00001 (0.00)	5.485 (1.50)	-42.318 (-1.86)*	-3.317 (-0.59)	-0.039 (-0.09)	-10.024 (-0.48)	372.086 (2.31)**	89.407 (2.01)*
$ECT\ IR_{t-1}$	-0.003 (-0.45)	-1.105 (-2.65)**	-1.371 (-0.53)	0.356 (0.55)	0.002 (0.69)	-0.111 (-0.71)	-2.868 (-2.36)**	-0.670 (-1.99)*
$ECT\ EFP_{t-1}$	-0.001 (-1.12)	-0.060 (-1.23)	-0.230 (-0.76)	-0.010 (-0.13)	-0.0001 (-0.16)	0.029 (1.03)	-0.807 (-3.73)***	-0.152 (-2.54)**
$ECT\ RT_{t-1}$	-0.003 (-1.20)	-0.426 (-2.23)**	-1.665 (-1.40)	0.084 (0.28)	-0.001 (-0.30)	-0.141 (-0.92)	1.674 (1.41)	0.437 (1.33)
$\Delta \ln GDP_{t-1}$	-0.642 (-2.60)**	-11.511 (-0.64)	37.159 (0.33)	2.968 (0.11)	-0.580 (-1.37)	-7.015 (-0.36)	-328.448 (-2.18)**	-91.097 (-2.18)**
$\Delta \ln GDP_{t-2}$	-0.560 (-2.15)**	3.991 (0.21)	-71.642 (-0.61)	-25.349 (-0.87)	-0.444 (-1.26)	-13.411 (-0.82)	-221.419 (-1.75)*	-82.398 (-2.36)**
$\Delta \ln GDP_{t-3}$	-0.227 (-0.90)	15.540 (0.85)	-272.459 (-2.39)**	-48.951 (-1.72)*	-0.154 (-0.52)	-7.449 (-0.54)	-158.902 (-1.49)	-53.436 (-1.81)*
$\Delta \ln GDP_{t-4}$	0.058 (0.27)	8.092 (0.53)	-182.924 (-1.92)*	-20.621 (-0.87)	0.119 (0.46)	3.498 (0.29)	-10.581 (-0.11)	-1.094 (-0.04)
ΔIR_{t-1}	0.001 (0.20)	0.378 (1.10)	2.223 (1.05)	0.239 (0.45)	0.004 (0.51)	0.453 (1.30)	3.935 (1.46)	0.643 (0.86)
ΔIR_{t-2}	-0.002 (-0.38)	0.699 (2.03)*	-0.760 (-0.36)	-0.364 (-0.68)	-0.006 (-0.77)	0.040 (0.11)	5.726 (2.00)*	1.359 (1.71)
ΔIR_{t-3}	-0.001 (-0.34)	0.519 (1.63)	3.163 (1.61)	0.181 (0.37)	0.004 (0.51)	0.349 (0.92)	-5.368 (-1.84)*	-1.154 (-1.43)
ΔIR_{t-4}	-0.005 (-1.27)	0.097 (0.33)	1.961 (1.09)	0.150 (0.33)	-0.008 (-0.86)	0.596 (1.45)	-4.817 (-1.51)	-0.615 (-0.70)
ΔEFP_{t-1}	0.001 (1.12)	0.018 (0.24)	-0.178 (-0.39)	-0.059 (-0.52)	0.001 (1.35)	0.089 (2.82)**	-0.069 (-0.28)	-0.003 (-0.04)
ΔEFP_{t-2}	0.001 (0.65)	-0.094 (-1.58)	0.574 (1.56)	0.133 (1.45)	-0.0003 (-0.33)	-0.047 (-1.19)	0.383 (1.24)	0.125 (1.46)
ΔEFP_{t-3}	0.001 (1.27)	-0.017 (-0.37)	-0.819 (-2.83)**	-0.053 (-0.73)	0.002 (1.92)*	0.115 (3.02)***	-1.192 (-4.05)***	-0.197 (-2.42)**
ΔEFP_{t-4}	0.0002 (0.38)	0.031 (0.66)	0.295 (1.00)	-0.018 (-0.25)	-0.0002 (-0.17)	0.013 (0.25)	-0.396 (-1.02)	-0.143 (-1.33)
ΔRT_{t-1}	-0.0003 (-0.07)	0.049 (0.14)	4.541 (2.08)**	0.567 (1.04)	-0.003 (-0.87)	-0.281 (-1.92)*	1.529 (1.35)	0.090 (0.29)
ΔRT_{t-2}	-0.0002 (-0.04)	1.075 (3.13)***	-4.253 (-2.00)*	-1.134 (-2.13)**	0.0004 (0.11)	0.077 (0.45)	-0.433 (-0.32)	-0.331 (-0.89)
ΔRT_{t-3}	0.002 (0.41)	0.620 (1.66)	3.623 (1.57)	0.079 (0.14)	-0.001 (-0.35)	-0.315 (-1.90)*	3.708 (2.89)***	0.648 (1.82)*
ΔRT_{t-4}	-0.005 (-1.07)	-0.113 (-0.31)	2.953 (1.32)	0.658 (1.18)	-0.002 (-0.62)	-0.019 (-0.11)	2.584 (1.93)*	0.959 (2.59)**
$\Delta \ln QE_{t-1}$	-0.027	2.151	-9.218	-2.632	-0.030	-2.904	13.664	1.303

	(-1.35)	(1.46)	(-1.01)	(-1.15)	(-0.82)	(-1.72)	(1.04)	(0.36)
$\Delta \ln QE_{t-2}$	0.048 (2.38)**	2.695 (1.83)*	-36.468 (-3.99)***	-5.386 (-2.36)**	0.028 (0.76)	1.115 (0.65)	2.172 (0.16)	2.255 (0.62)
$\Delta \ln QE_{t-3}$	0.004 (0.18)	0.175 (0.11)	12.223 (1.28)	2.984 (1.26)	0.014 (0.69)	-0.180 (-0.20)	13.026 (1.86)*	4.278 (2.20)**
$\Delta \ln QE_{t-4}$	0.006 (0.36)	-0.804 (-0.72)	2.832 (0.41)	1.716 (0.99)	0.005 (0.39)	0.857 (1.34)	-1.378 (-0.28)	1.579 (1.15)
R^2	0.85	0.71	0.86	0.74	0.84	0.90	0.91	0.79
Adj. R^2	0.68	0.38	0.70	0.43	0.67	0.79	0.80	0.55
AIC	-8.07	0.51	4.16	1.38	-8.04	-0.38	3.72	1.15
DW	2.13	2.04	2.18	2.01	2.11	2.13	2.22	2.26
Start	2004Q2	2004Q2	2004Q2	2004Q2	2004Q2	2004Q2	2004Q2	2004Q2
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	46	46	46	46	46	46	46	46

Table 74 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.3.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.006 (5.26)***	-0.025 (-0.25)	-0.249 (-2.51)**	-0.115 (-0.86)	0.006 (5.29)***	0.220 (3.06)***	-0.250 (-2.51)**	-0.114 (-0.85)
$ECT\ GDP_{t-1}$	0.007 (0.05)	-12.875 (-1.17)	-32.013 (-2.87)***	-8.188 (-0.54)	0.010 (0.07)	18.644 (2.31)**	-31.736 (-2.84)***	-8.784 (-0.58)
$ECT\ IR_{t-1}$	-0.004 (-1.97)*	-0.606 (-3.46)***	-0.218 (-1.23)	1.148 (4.77)***	-0.004 (-1.98)*	-0.392 (-2.94)***	-0.223 (-1.21)	1.194 (4.80)***
$ECT\ EFP_{t-1}$	-0.003 (-1.89)*	-0.248 (-2.25)**	-0.465 (-4.15)***	0.142 (0.94)	-0.007 (-2.48)**	-0.170 (-1.03)	-0.678 (-2.98)***	1.303 (4.24)***
$ECT\ RT_{t-1}$	-0.004 (-2.69)**	-0.384 (-3.06)***	-0.357 (-2.81)***	0.427 (2.48)**	-0.004 (-2.70)**	-0.028 (-0.31)	-0.355 (-2.79)***	0.429 (2.50)**
$\Delta \ln GDP_{t-1}$	-0.471 (-3.42)***	-6.801 (-0.61)	23.718 (2.10)**	40.086 (2.62)**	-0.471 (-3.44)***	-29.751 (-3.63)***	23.653 (2.09)**	40.619 (2.66)**
$\Delta \ln GDP_{t-2}$	-0.282 (-2.15)**	0.680 (0.06)	30.325 (2.82)***	20.043 (1.38)	-0.283 (-2.17)**	-29.215 (-3.75)***	30.410 (2.83)***	19.944 (1.37)
ΔIR_{t-1}	0.013 (2.64)**	0.104 (0.26)	-0.818 (-2.04)**	-0.199 (-0.37)	0.013 (2.68)**	0.916 (3.07)***	-0.843 (-2.04)**	-0.250 (-0.45)
ΔIR_{t-2}	-0.014 (-3.15)***	0.120 (0.34)	-0.336 (-0.93)	-0.928 (-1.91)*	-0.014 (-3.20)***	0.475 (1.78)*	-0.354 (-0.96)	-0.930 (-1.87)*
ΔEFP_{t-1}	-0.006 (-1.91)*	0.122 (0.52)	0.648 (2.73)**	-0.488 (-1.52)	0.007 (2.33)**	0.389 (2.04)**	-0.177 (-0.67)	-0.706 (-1.99)*
ΔEFP_{t-2}	0.012 (2.98)***	-0.044 (-0.14)	0.313 (0.97)	0.258 (0.59)	-0.002 (-0.89)	0.103 (0.71)	-0.028 (-0.14)	-0.672 (-2.48)**
ΔRT_{t-1}	0.007 (2.79)***	-0.040 (-0.19)	-0.208 (-0.96)	-0.098 (-0.34)	0.007 (2.83)***	0.164 (1.05)	-0.212 (-0.98)	-0.116 (-0.40)
ΔRT_{t-2}	0.001 (0.60)	0.300 (1.92)*	0.006 (0.04)	-1.045 (-4.87)***	0.001 (0.55)	0.293 (2.53)**	0.002 (0.01)	-1.049 (-4.86)***
$\Delta \ln QE_{t-1}$	0.014 (1.08)	-0.243 (-0.24)	-0.067 (-0.06)	-1.597 (-1.14)	0.014 (1.10)	-0.174 (-0.23)	-0.072 (-0.07)	-1.663 (-1.19)
$\Delta \ln QE_{t-2}$	0.015 (1.87)*	0.517 (0.81)	-0.988 (-1.53)	-2.167 (-2.48)**	0.015 (1.87)*	1.471 (3.15)***	-0.982 (-1.52)	-2.182 (-2.50)**
R^2	0.82	0.57	0.69	0.69	0.82	0.80	0.69	0.69
Adj. R^2	0.74	0.38	0.56	0.55	0.75	0.72	0.56	0.56
AIC	-8.37	0.41	0.44	1.05	-8.38	-0.20	0.45	1.05
DW	2.46	2.04	2.13	1.92	2.45	2.31	2.13	1.92
Start	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4	2003Q4
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	48	48	48	48	48	48	48	48

Table 75 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.

t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.3.4 Debt-to-GDP ratio

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Treasury & mortgage-backed securities held by the Fed							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.007 (4.39)***	-0.001 (-0.01)	0.781 (2.76)***	-0.038 (-0.22)	0.010 (2.18)**	0.508 (1.69)	-1.016 (-1.09)	0.313 (0.50)
$ECT\ GDP_{t-1}$	-0.118 (-1.28)	15.954 (2.21)**	-47.458 (-2.90)***	-15.797 (-1.61)	-0.133 (-0.33)	14.591 (0.56)	-85.960 (-1.07)	6.635 (0.12)
$ECT\ IR_{t-1}$	-0.002 (-1.10)	-0.562 (-3.23)***	1.504 (3.81)***	1.166 (4.93)***	0.001 (0.55)	-0.353 (-3.15)***	0.369 (1.06)	0.024 (0.11)
$ECT\ EFP_{t-1}$	-0.001 (-1.94)*	0.066 (1.31)	0.253 (2.22)**	0.066 (0.97)	-0.001 (-0.93)	0.033 (0.63)	-0.057 (-0.35)	-0.002 (-0.01)
$ECT\ RT_{t-1}$	0.0004 (0.24)	-0.310 (-2.13)**	0.259 (0.79)	0.140 (0.71)	0.00001 (0.01)	-0.160 (-1.70)	0.951 (3.25)***	0.028 (0.15)
$\Delta \ln GDP_{t-1}$	-0.490 (-3.47)***	-17.426 (-1.57)	164.222 (6.53)***	47.957 (3.18)***	-0.637 (-1.54)	-34.337 (-1.29)	185.254 (2.24)**	-3.178 (-0.06)
$\Delta \ln GDP_{t-2}$	-0.242 (-1.36)	6.879 (0.49)	-2.610 (-0.08)	14.830 (0.78)	-0.356 (-1.01)	-38.570 (-1.71)	55.479 (0.79)	-28.292 (-0.61)
$\Delta \ln GDP_{t-3}$					-0.088 (-0.26)	-13.442 (-0.63)	128.123 (1.94)*	-23.323 (-0.53)
$\Delta \ln GDP_{t-4}$					-0.171 (-0.62)	-5.097 (-0.29)	91.472 (1.65)	-5.752 (-0.16)
ΔIR_{t-1}	0.004 (1.18)	0.187 (0.78)	-1.558 (-2.87)***	-0.848 (-2.61)**	0.003 (0.82)	0.254 (0.99)	1.208 (1.52)	0.273 (0.52)
ΔIR_{t-2}	-0.001 (-0.24)	0.023 (0.11)	-0.570 (-1.18)	-0.734 (-2.54)**	0.001 (0.12)	0.822 (2.52)**	-0.028 (-0.03)	-0.324 (-0.48)
ΔIR_{t-3}					-0.004 (-0.65)	-0.010 (-0.03)	-1.103 (-0.91)	-0.395 (-0.49)
ΔIR_{t-4}					-0.0004 (-0.05)	0.599 (1.17)	-0.414 (-0.26)	0.001 (0.00)
ΔEFP_{t-1}	-0.0003 (-0.30)	-0.099 (-1.31)	-0.065 (-0.38)	-0.024 (-0.23)	-0.0003 (-0.22)	-0.040 (-0.40)	-0.005 (-0.01)	0.057 (0.27)
ΔEFP_{t-2}	0.0004 (0.54)	-0.011 (-0.20)	-0.682 (-5.20)***	-0.050 (-0.63)	-0.0002 (-0.17)	-0.071 (-0.92)	-0.745 (-3.12)***	-0.075 (-0.47)
ΔEFP_{t-3}					0.001 (0.64)	-0.028 (-0.32)	-0.071 (-0.26)	0.037 (0.20)
ΔEFP_{t-4}					-0.001 (-1.18)	-0.045 (-0.63)	0.058 (0.26)	-0.054 (-0.37)
ΔRT_{t-1}	-0.0002 (-0.08)	0.004 (0.02)	0.017 (0.04)	-0.147 (-0.63)	0.0003 (0.14)	0.020 (0.14)	0.465 (1.08)	0.214 (0.75)
ΔRT_{t-2}	0.002 (0.92)	0.398 (2.32)**	-0.359 (-0.92)	-1.025 (-4.41)***	0.001 (0.31)	0.230 (1.32)	0.138 (0.25)	-0.459 (-1.28)
ΔRT_{t-3}					0.002 (0.96)	0.081 (0.52)	-0.061 (-0.13)	-0.083 (-0.26)
ΔRT_{t-4}					-0.003 (-1.15)	0.098 (0.61)	0.159 (0.32)	0.419 (1.26)
$\Delta \ln QE_{t-1}$	-0.005	1.183	0.277	-2.280	-0.028	-1.711	7.859	-1.185

	(-0.49)	(1.34)	(0.14)	(-1.90)*	(-0.98)	(-0.94)	(1.39)	(-0.32)
$\Delta \ln QE_{t-2}$	0.018 (2.36)**	1.386 (2.31)**	-0.037 (-0.03)	-2.321 (-2.86)***	0.037 (1.42)	2.437 (1.45)	4.506 (0.86)	-3.211 (-0.93)
$\Delta \ln QE_{t-3}$					-0.009 (-0.44)	-0.030 (-0.02)	3.055 (0.75)	2.033 (0.76)
$\Delta \ln QE_{t-4}$					-0.0001 (-0.01)	0.680 (0.77)	0.437 (0.16)	2.353 (1.29)
R^2	0.79	0.53	0.87	0.67	0.86	0.83	0.89	0.66
Adj. R^2	0.71	0.33	0.82	0.53	0.70	0.63	0.77	0.27
AIC	-8.23	0.49	2.13	1.10	-8.14	0.18	2.45	1.63
DW	2.39	2.14	2.04	1.77	2.30	2.08	2.08	2.14
Start	2003Q4	2003Q4	2003Q4	2003Q4	2004Q2	2004Q2	2004Q2	2004Q2
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	48	48	48	48	46	46	46	46

Table 76 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.4 QE proxy: size of the Fed's balance sheet

D.3.4.1 BBB-AAA corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	BBB-AAA corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.006 (1.46)	-0.426 (-1.74)	-0.346 (-1.33)	0.143 (0.38)	-0.002 (-0.68)	-0.206 (-5.29)***	0.107 (0.85)	0.552 (2.42)**
$ECT\ GDP_{t-1}$	-0.138 (-0.37)	-25.179 (-1.13)	-20.618 (-0.86)	-26.128 (-0.75)	-1.221 (-3.55)***	-6.386 (-1.15)	40.405 (2.25)**	61.493 (1.89)*
$ECT\ IR_{t-1}$	-0.018 (-2.09)*	-1.197 (-2.39)**	1.772 (3.31)***	2.562 (3.27)***	0.003 (0.20)	-1.207 (-4.73)***	-0.027 (-0.03)	-0.681 (-0.46)
$ECT\ EFP_{t-1}$	-0.025 (-4.11)***	-0.851 (-2.32)**	1.607 (4.10)***	2.219 (3.87)***	0.002 (0.31)	-0.134 (-1.45)	-0.352 (-1.18)	-1.074 (-2.00)*
$ECT\ RT_{t-1}$	-0.004 (-1.36)	-0.590 (-3.22)***	0.503 (2.57)**	0.731 (2.55)**	-0.003 (-2.51)**	0.008 (0.39)	0.104 (1.57)	0.241 (2.02)*
$\Delta \ln GDP_{t-1}$	-0.143 (-0.43)	13.139 (0.67)	23.375 (1.11)	20.020 (0.65)	0.475 (1.86)*	7.022 (1.70)	-9.869 (-0.74)	-29.340 (-1.22)
$\Delta \ln GDP_{t-2}$	-0.341 (-1.30)	10.796 (0.69)	34.267 (2.06)*	22.045 (0.90)	0.377 (1.97)*	4.924 (1.59)	-0.498 (-0.05)	-18.797 (-1.04)
ΔIR_{t-1}	0.006 (0.71)	-0.473 (-1.01)	-0.176 (-0.35)	0.026 (0.04)	-0.014 (-2.23)**	-0.695 (-6.75)***	1.269 (3.81)***	2.080 (3.46)***
ΔIR_{t-2}	-0.012 (-1.99)*	-0.693 (-1.89)*	0.326 (0.83)	1.157 (2.02)*	-0.023 (-2.70)**	-0.988 (-7.15)***	1.136 (2.54)**	0.390 (0.48)
ΔEFP_{t-1}	0.011 (2.02)*	0.366 (1.11)	-0.612 (-1.73)	-0.607 (-1.17)	0.008 (1.61)	0.189 (2.39)**	0.004 (0.02)	0.459 (0.99)
ΔEFP_{t-2}	0.009 (1.85)*	0.405 (1.36)	-0.746 (-2.34)**	-0.936 (-2.01)*	0.006 (1.69)	0.092 (1.58)	-0.202 (-1.07)	-0.146 (-0.43)
ΔRT_{t-1}	0.003 (0.69)	-0.487 (-2.23)**	0.316 (1.36)	0.483 (1.42)	0.004 (1.40)	-0.039 (-0.92)	0.070 (0.52)	0.064 (0.26)
ΔRT_{t-2}	-0.010 (-3.18)***	-0.222 (-1.15)	0.425 (2.07)*	0.704 (2.34)**	-0.001 (-0.38)	-0.056 (-1.24)	-0.066 (-0.45)	-0.578 (-2.21)**
$\Delta \ln QE_{t-1}$	-0.028 (-1.04)	3.169 (1.99)*	0.109 (0.06)	-2.638 (-1.06)	-0.019 (-0.96)	-0.753 (-2.39)**	0.551 (0.54)	-1.238 (-0.67)
$\Delta \ln QE_{t-2}$	-0.006 (-0.34)	1.103 (1.00)	2.998 (2.55)**	-0.905 (-0.53)	-0.026 (-1.97)*	-1.262 (-5.93)***	3.356 (4.87)***	-0.790 (-0.64)
R^2	0.80	0.72	0.78	0.79	0.86	0.96	0.89	0.85
Adj. R^2	0.62	0.45	0.57	0.59	0.73	0.93	0.79	0.70
AIC	-7.69	0.47	0.60	1.36	-8.04	-2.48	-0.12	1.06
DW	2.18	2.12	1.71	2.02	2.06	1.22	1.53	2.14
Start	2008Q2	2008Q2	2008Q2	2008Q2	2008Q2	2008Q2	2008Q2	2008Q2
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	30	30	30	30	30	30	30	30

Table 77 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is

found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.4.2 High yield (≤CCC-AAA) corporate bond spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	High yield (≤CCC-AAA) corporate bond spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.006 (2.77)**	-0.001 (-0.01)	-1.001 (-1.01)	-0.196 (-0.97)	0.002 (1.33)	-0.209 (-5.78)***	1.231 (2.39)**	0.096 (0.83)
$ECT\ GDP_{t-1}$	-0.026 (-0.09)	-15.100 (-0.88)	-140.368 (-1.05)	-12.533 (-0.46)	-0.556 (-3.05)***	-3.696 (-0.68)	139.147 (1.81)*	6.310 (0.37)
$ECT\ IR_{t-1}$	-0.010 (-1.62)	-0.538 (-1.48)	7.125 (2.51)**	0.830 (1.43)	0.001 (0.21)	-0.641 (-6.01)***	0.275 (0.18)	0.488 (1.44)
$ECT\ EFP_{t-1}$	-0.0004 (-0.98)	-0.045 (-1.70)	0.362 (1.75)*	0.036 (0.84)	-0.0001 (-0.84)	-0.0001 (-0.03)	-0.185 (-4.67)***	-0.020 (-2.31)**
$ECT\ RT_{t-1}$	-0.005 (-1.75)*	-0.374 (-2.03)*	2.978 (2.07)*	0.369 (1.25)	-0.002 (-1.48)	0.001 (0.05)	-0.599 (-1.36)	-0.139 (-1.42)
$\Delta \ln GDP_{t-1}$	-0.226 (-0.88)	-14.826 (-0.92)	164.022 (1.31)	41.227 (1.61)	0.196 (1.09)	15.604 (2.90)***	-150.591 (-1.97)*	3.068 (0.18)
ΔIR_{t-1}	0.007 (0.93)	-0.441 (-0.98)	0.344 (0.10)	0.269 (0.38)	-0.020 (-3.79)***	-0.794 (-5.14)***	13.235 (6.05)***	2.213 (4.52)***
ΔEFP_{t-1}	0.0002 (0.17)	0.148 (1.75)*	-0.742 (-1.13)	-0.181 (-1.35)	0.0003 (0.29)	0.034 (1.17)	-0.305 (-0.74)	-0.106 (-1.16)
ΔRT_{t-1}	0.005 (0.92)	-0.797 (-2.25)**	4.499 (1.63)	0.898 (1.59)	0.001 (0.29)	-0.187 (-2.16)**	3.649 (2.97)***	0.754 (2.75)**
$\Delta \ln QE_{t-1}$	-0.033 (-1.71)	-0.827 (-0.70)	10.870 (1.18)	2.047 (1.08)	-0.038 (-3.11)***	-0.941 (-2.57)**	19.757 (3.80)***	3.952 (3.40)***
R^2	0.63	0.43	0.65	0.56	0.78	0.90	0.84	0.76
Adj. R^2	0.47	0.18	0.50	0.37	0.68	0.85	0.77	0.65
AIC	-7.39	0.87	4.98	1.80	-7.89	-1.10	4.21	1.21
DW	1.96	1.92	2.19	2.01	2.70	3.07	2.39	1.87
Start	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	31	31	31	31	31	31	31	31

Table 78 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.4.3 10-year – 3-month yield curve rate spread

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	10-year – 3-month yield rate spread							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.025 (2.16)*	-1.906 (-2.81)**	-2.066 (-3.10)**	2.417 (3.03)**	0.024 (2.00)*	0.159 (2.51)**	-2.078 (-3.16)**	2.347 (2.82)**
$ECT\ GDP_{t-1}$	-0.569 (-1.17)	-78.541 (-2.74)**	-75.585 (-2.69)**	116.484 (3.47)***	-0.599 (-1.19)	-2.490 (-0.92)	-76.876 (-2.74)**	114.876 (3.24)**
$ECT\ IR_{t-1}$	0.065 (2.67)**	-2.139 (-1.51)	-2.183 (-1.57)	0.440 (0.26)	0.063 (2.55)**	0.050 (0.38)	-2.181 (-1.58)	0.225 (0.13)
$ECT\ EFP_{t-1}$	-0.098 (-2.66)**	3.392 (1.57)	4.084 (1.92)*	-1.354 (-0.53)	-0.032 (-2.02)*	-0.644 (-7.66)***	1.883 (2.15)*	-0.784 (-0.71)
$ECT\ RT_{t-1}$	-0.005 (-1.28)	-0.136 (-0.62)	0.020 (0.10)	0.306 (1.19)	-0.004 (-1.16)	-0.156 (-7.71)***	0.008 (0.04)	0.338 (1.27)
$\Delta \ln GDP_{t-1}$	-0.286 (-0.74)	68.575 (3.01)**	67.042 (3.00)**	-79.416 (-2.97)**	-0.243 (-0.61)	1.520 (0.71)	67.469 (3.05)**	-77.173 (-2.75)**
$\Delta \ln GDP_{t-2}$	-0.614 (-1.35)	77.343 (2.89)**	80.597 (3.07)**	-98.042 (-3.12)**	-0.568 (-1.21)	-3.501 (-1.39)	81.739 (3.12)**	-95.655 (-2.89)**
$\Delta \ln GDP_{t-3}$	-0.479 (-1.59)	29.929 (1.69)	30.813 (1.77)	-47.428 (-2.28)**	-0.455 (-1.46)	-0.916 (-0.55)	31.133 (1.80)	-45.946 (-2.09)*
ΔIR_{t-1}	0.009 (0.25)	-5.116 (-2.38)**	-4.533 (-2.15)*	7.579 (3.00)**	0.006 (0.15)	-0.541 (-2.62)**	-4.636 (-2.16)*	7.445 (2.74)**
ΔIR_{t-2}	0.013 (0.54)	-1.034 (-0.71)	-0.903 (-0.63)	1.156 (0.68)	0.012 (0.48)	-0.145 (-1.05)	-0.972 (-0.68)	1.191 (0.66)
ΔIR_{t-3}	-0.014 (-0.78)	1.108 (1.05)	0.859 (0.83)	-1.541 (-1.24)	-0.014 (-0.77)	0.267 (2.65)**	0.890 (0.85)	-1.612 (-1.22)
ΔEFP_{t-1}	0.040 (1.05)	2.441 (1.10)	1.118 (0.51)	-4.988 (-1.91)*	0.047 (2.39)**	0.730 (7.01)***	-3.395 (-3.13)**	2.425 (1.77)
ΔEFP_{t-2}	0.015 (1.21)	-1.034 (-1.38)	-1.726 (-2.34)**	1.446 (1.64)	0.027 (1.64)	0.548 (6.12)***	-2.641 (-2.83)**	2.542 (2.15)*
ΔEFP_{t-3}	0.031 (1.46)	-2.129 (-1.70)	-2.174 (-1.77)	3.531 (2.40)**	0.016 (1.56)	0.291 (5.13)***	-1.330 (-2.26)*	1.961 (2.63)**
ΔRT_{t-1}	0.021 (2.90)**	-1.158 (-2.73)**	-1.437 (-3.45)***	0.826 (1.66)	0.020 (2.72)**	0.278 (7.07)***	-1.418 (-3.47)***	0.746 (1.44)
ΔRT_{t-2}	0.018 (1.75)	-0.944 (-1.57)	-1.212 (-2.05)*	1.163 (1.65)	0.017 (1.62)	0.260 (4.64)***	-1.214 (-2.08)*	1.118 (1.51)
ΔRT_{t-3}	0.007 (1.45)	-0.230 (-0.84)	-0.404 (-1.50)	0.457 (1.42)	0.007 (1.38)	0.172 (6.68)***	-0.400 (-1.49)	0.445 (1.31)
$\Delta \ln QE_{t-1}$	-0.196 (-2.28)**	7.799 (1.54)	10.871 (2.19)*	-7.278 (-1.23)	-0.191 (-2.14)*	-2.967 (-6.22)***	10.823 (2.18)*	-6.996 (-1.11)
$\Delta \ln QE_{t-2}$	-0.107 (-2.50)**	8.663 (3.46)***	10.532 (4.28)***	-12.602 (-4.28)***	-0.102 (-2.34)**	-1.849 (-7.91)***	10.564 (4.34)***	-12.324 (-4.00)***
$\Delta \ln QE_{t-3}$	-0.085 (-1.83)	5.959 (2.19)*	6.365 (2.38)**	-9.868 (-3.09)**	-0.083 (-1.71)	-0.387 (-1.50)	6.438 (2.40)**	-9.774 (-2.88)**
R^2	0.93	0.90	0.90	0.96	0.93	0.998	0.91	0.95
Adj. R^2	0.78	0.68	0.70	0.87	0.77	0.99	0.71	0.86
AIC	-8.31	-0.16	-0.19	0.16	-8.25	-4.90	-0.21	0.26

DW	2.18	2.17	2.18	2.56	2.20	2.99	2.22	2.58
Start	2008Q3	2008Q3	2008Q3	2008Q3	2008Q3	2008Q3	2008Q3	2008Q3
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	29	29	29	29	29	29	29	29

Table 79 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

D.3.4.4 Debt-to-GDP ratio

Dep. variable:	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t	$\Delta \ln GDP_t$	ΔIR_t	ΔEFP_t	ΔRT_t
QE proxy:	Size of the Fed's balance sheet							
IR proxy:	10-year bond rate				13-week Treasury Bill rate			
EFP proxy:	Debt-to-GDP ratio							
	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.	Coeff.
$constant$	0.010 (4.02)***	0.081 (0.43)	-0.545 (-0.98)	-0.380 (-1.35)	0.003 (1.98)*	-0.191 (-3.45)***	0.721 (1.79)*	0.085 (0.46)
$ECT\ GDP_{t-1}$	0.004 (0.02)	-0.532 (-0.03)	-145.704 (-2.79)**	-28.320 (-1.07)	-0.522 (-3.02)***	3.250 (0.60)	-47.427 (-1.20)	-10.553 (-0.58)
$ECT\ IR_{t-1}$	-0.007 (-1.89)*	-0.082 (-0.31)	2.300 (2.96)***	0.429 (1.09)	0.001 (0.35)	-0.673 (-6.03)***	0.194 (0.24)	0.630 (1.68)
$ECT\ EFP_{t-1}$	0.0002 (0.55)	0.003 (0.08)	-0.391 (-4.02)***	0.021 (0.42)	-0.0001 (-0.16)	0.003 (0.25)	-0.344 (-4.64)***	0.013 (0.37)
$ECT\ RT_{t-1}$	-0.005 (-1.93)*	-0.066 (-0.33)	2.134 (3.63)***	-0.034 (-0.11)	-0.001 (-1.27)	0.023 (0.68)	0.904 (3.59)***	-0.279 (-2.41)**
$\Delta \ln GDP_{t-1}$	-0.509 (-2.02)*	-21.488 (-1.11)	242.824 (4.28)***	55.550 (1.92)*	0.049 (0.26)	9.730 (1.63)	128.911 (2.96)***	15.860 (0.79)
ΔIR_{t-1}	0.007 (1.14)	-0.224 (-0.45)	-1.214 (-0.83)	-0.099 (-0.13)	-0.017 (-3.26)***	-0.765 (-4.64)***	4.207 (3.50)***	2.145 (3.87)***
ΔEFP_{t-1}	-0.003 (-2.63)**	-0.055 (-0.75)	0.613 (2.84)***	0.109 (0.99)	-0.001 (-1.37)	-0.009 (-0.41)	0.302 (1.80)*	0.006 (0.08)
ΔRT_{t-1}	0.007 (2.19)**	-0.270 (-1.03)	-0.850 (-1.10)	0.217 (0.55)	0.002 (1.34)	-0.102 (-1.97)*	0.266 (0.70)	0.524 (2.99)***
$\Delta \ln QE_{t-1}$	-0.036 (-2.29)**	-0.467 (-0.38)	3.936 (1.11)	1.699 (0.94)	-0.035 (-3.85)***	-0.676 (-2.36)**	5.893 (2.82)**	3.114 (3.23)***
R^2	0.71	0.31	0.73	0.54	0.79	0.89	0.80	0.72
Adj. R^2	0.59	0.02	0.61	0.34	0.70	0.85	0.71	0.59
AIC	-7.64	1.05	3.20	1.85	-7.96	-1.07	2.91	1.36
DW	1.87	1.85	1.79	1.78	2.66	2.91	1.85	1.75
Start	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1	2008Q1
End	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3	2015Q3
# obs.	31	31	31	31	31	31	31	31

Table 80 | Two simultaneous equations (VEC) models relating GDP, the interest rate (IR), the external finance premium (EFP), risk tolerance (RT) and quantitative easing (QE) in the United States. The proxies used for quantitative easing, the interest rate and the external finance premium are indicated in rows 2, 3 and 4 respectively. The proxy for risk tolerance is always the equity risk premium. The GDP is real. The lag order of the VEC models is the order for which cointegration is found in a Johansen Cointegration test (Table 11).
AIC and DW stand for Akaike Information Criterion and Durbin-Watson statistic respectively.
t-statistics are reported in parenthesis.
****, ** and * indicate statistical significance at the 1%, 5% and 10% level respectively.*

E Scripts

E.1 Best bivariate ARDL specification of channel entry

```
'This script takes 3 arguments: %0, %1 and %2.
'%0: set this to '1' to automatically save and name the resulting equation
'%1: this is the dependent variable (y)
'%2: this is the independent variable (x)


'show only own log messages
logmode -all logmsg

'be extra sure to create a table for the script output
table(10,2) output
d output
table(10,2) output

'variables saying how many lags to go up to
!xmaxlags = 12
!ymaxlags = 12

'variable to store the "best" number of lags
!xbestlagwald = 0
!ybestlagwald = 1

'variable to store the best number of lags with negative coefficient
!xbestlagwaldn = 0
!ybestlagwaldn = 1

'variable to store the best p-value of a Wald test and the accompanying
Wald statistic
!pbestwald = 1
!bestwald = 0

'variable to store the best p-value of a Wald test and the accompanying
Wald statistic
'with a negative coefficient
!pbestwaldn = 1
!bestwaldn = 0

'create empty equation to be used inside the loop
equation eq

'create variables to hold the long-run effect of x on y
!jointxwald = 0
!jointxwaldn = 0

'count the number of specifications with a negative long-run effect of x on
y
!numneg = 0
'count the number of specifications with a significant long-run effect of x
on y
!numsignwald = 0
'count the number of specifications with a negative and significant long-
run effect of x on y
!numnegsignwald = 0

'set sample to be the !maxlag'th value onwards
smpl 2003M01+!xmaxlags @last

'count the number of estimations
```

```
!iteration = 0

'start looping through every possible specification
for !i=1 to !ymaxlags
 for !j=1 to !xmaxlags
        !iteration = !iteration + 1
        logmsg iteration !iteration 'log the estimation number

        'initialize the table to hold this specification's output
        table eqtable
        d eqtable

        'run regression and temporarily save in the table
        freeze(eqtable) eq.ls {%1} c @trend {%2}(0 to -!j) {%1}(-1 to -!i)

        'calculate sum of x coefs and build Wald expression
        !xsum = 0
        %wald = ""
        for !h=3 to !j+3
            !xsum = !xsum + eq.@coefs(!h)
            %wald = %wald + "c(" + @str(!h) + ") = "
        next
        %wald = %wald + "0"

        'calculate sum of y coefs
        !ysum = 0
        for !k=!j+4 to !j+3+!i
            !ysum = !ysum + eq.@coefs(!k)
        next

        'calculate the long-term effect of x on y
        !jointx = (!xsum/(1-!ysum))

        'perform Wald test and freeze it into a table called waldtable
        freeze(waldtable) eq.wald {%wald}
        'retrieve Wald statistic and p-value from table
        !waldstat = @val(waldtable(6,2))
        !waldp = @val(waldtable(6,4)) ' store wald p-value (which is in
cell 6,4 of the table)
        d waldtable 'delete the table

        if !jointx < 0 then
            'count this specification as one with a negative long-run
effect of x on y
            !numneg = !numneg + 1

            'if this specification's Wald p-value is better than the
current best (with a negative long-run effect)
            if !waldp < !pbestwaldn then
                'record this specification's Wald statistic and p-value as
the current best
                !pbestwaldn = !waldp
                !bestwaldn = !waldstat
                'record this specification's lags as the current best
                !ybestlagwaldn = !i
                !xbestlagwaldn = !j
                'record this specification's long-run effect as belonging
to the current best specification
                !jointxwaldn = !jointx
            endif
        endif
```

```
        if !waldp < 0.1 then
            'count this specification as one with a significant long-run
effect of x on y
            !numsignwald = !numsignwald + 1
            if !jointx < 0 then
                'count this specification as one with a significant and
negative long-run effect of x on y
                !numnegsignwald = !numnegsignwald + 1
            endif
        endif

        'if this specification's Wald p-value is better than the current
best
        if !waldp < !pbestwald then
            'record this specification's Wald statistic and p-value as the
current best
            !pbestwald = !waldp
            !bestwald = !waldstat
            'record this specification's lags as the current best
            !ybestlagwald = !i
            !xbestlagwald = !j
            'record this specification's long-run effect as belonging to
the current best specification
            !jointxwald = !jointx
        endif

    next
next

'show the best specification, regardless of the sign of the long-run effect
of x on y
equation eq_wald
show eq_wald.ls {%1} c @trend {%2}(0 to -!xbestlagwald) {%1}(-1 to -
!ybestlagwald)

'populate the output table with information about this specification
output(1,1) = "Best Wald"
output(2,1) = "Long-run effect: "
output(2,2) = !jointxwald
output(3,1) = "Wald statistic: "
output(3,2) = !bestwald
output(4,1) = "Wald p-value: "
output(4,2) = !pbestwald

'if at least 1 specification with a negative long-run effect of x on y is
found
if !numneg>0 then
    'if the best specification should automatically be named and saved
    if %0 = 1 then
        'some automatic naming rules
        %ypart = ""
        %ypart = @replace(%1,"_close_13w_5d","")
        %ypart = @replace(%ypart,"_3m","")
        %ypart = @replace(%ypart,"_m","")
        %ypart = @replace(%ypart,"_","")
        %ypart = @left(%ypart,24)
        %xpart = ""
        %xpart = @replace(@replace(@replace(%2,"ln_",""),"_w",""),"_","")
        %xpart = @left(%xpart,24)
```

```
        'name the equation and show it
        equation eq_wn_{%ypart}_{%xpart}
        show eq_wn_{%ypart}_{%xpart}.ls {%1} c @trend {%2}(0 to -
!xbestlagwaldn) {%1}(-1 to -!ybestlagwaldn)
    else
        'give the equation a generic name and show it
        equation eq_wald_neg
        show eq wald neg.ls {%1} c @trend {%2}(0 to -!xbestlagwaldn) {%1}(-
1 to -!ybestlagwaldn)
    endif

    'populate the output table with information about this specification
that has a negative long-run effect of x on y
    output(6,1) = "Best Wald, negative long-run effect"
    output(7,1) = "Long-run effect: "
    output(7,2) = !jointxwaldn
    output(8,1) = "Wald statistic: "
    output(8,2) = !bestwaldn
    output(9,1) = "Wald p-value: "
    output(9,2) = !pbestwaldn
endif

'populate the output table with some stats about the procedure
output(11,1) = "Negative long-run effects found: "
output(11,2)= !numneg
output(12,1) = "Significant Wald stats found: "
output(12,2) = !numsignwald
output(13,1) = "Significant negative Wald stats found: "
output(13,2) = !numnegsignwald
output(14,1) = "Number of estimations: "
output(14,2) = !iteration

'show the output table
show output
```

E.2 Best multivariate ARDL specification of channel exit

```
'This script takes 3 arguments: %0, %1 and %2.
'%0: the interest rate proxy
'%1: the external finance premium proxy
'%2: the quantitative easing proxy

'show only own log messages
logmode -all logmsg

'create empty equation to be used inside the loop
equation eq

'some naming conventions
%ir = "fv_"+%0+"_"+%2+"_wn" 'interest rate
%efp = "fv_"+%1+"_"+%2+"_wn" 'external finance premium
%erp = "fv_erp_"+%2+"_wn" 'equity risk premium

'variables saying how many lags to go up to
!irmaxlags = 8
!efpmaxlags = 8
!erpmaxlags = 8

'be extra sure to create a table for the script output
table(10,2) output
d output
table(10,2) output

'variables to store the best number of lags
!irbestlagwald = 0
!efpbestlagwald = 0
!erpbestlagwald = 0

'variables to store the best number of lags where long-run effects are
'negative
!irbestlagwaldn = 0
!efpbestlagwaldn = 0
!erpbestlagwaldn = 0

'variables to store the best p-value of a Wald test and the accompanying
'Wald statistic
!irbestwaldp = 1
!irbestwald = 0
!efpbestwaldp = 1
!efpbestwald = 0
!erpbestwaldp = 1
!erpbestwald = 0

'variable to store the best p-value of a Wald test and the accompanying
'Wald statistic with a negative long-run effects
!irbestwaldpn = 1
!irbestwaldn = 0
!efpbestwaldpn = 1
!efpbestwaldn = 0
!erpbestwaldpn = 1
!erpbestwaldn = 0

'create variables to hold the long-run effects
!jointirwald = 0
!jointefpwald = 0
!jointerpwald = 0
!jointirwaldn = 0
```

```
!jointefpwaldn = 0
!jointerpwaldn = 0

'variables to store the best average p-value of a Wald test
!bestaveragewaldpn = 1
!bestaveragewaldp = 1

'count the number of specifications with a negative long-run effect of x on
y
!numneg = 0

'set sample to be the !maxlag'th value onwards
smpl 2003M01+!irmaxlags @last

'count the number of estimations
!iteration = 0

'start looping through every possible specification
for !irlags=0 to !irmaxlags
    for !efplags=0 to !efpmaxlags
        for !erplags=0 to !erpmaxlags

            !iteration = !iteration + 1
            logmsg iteration !iteration 'log the estimation number

            'run regression
            eq.ls ln_rgdp_q c @trend {%ir}(0 to -!irlags) {%efp}(0 to -
!efplags) {%erp}(0 to -!erplags)

            'calculate sum of ir coeffs and build Wald expression
            !jointir = 0
            %waldir = ""
            for !h=3 to !irlags+3
                !jointir = !jointir + eq.@coefs(!h)
                %waldir = %waldir + "c(" + @str(!h) + ") = "
            next
            %waldir = %waldir + "0"

            'calculate sum of efp coeffs and build Wald expression
            !jointefp = 0
            %waldefp = ""
            for !k=!irlags+4 to !efplags+4+!irlags
                !jointefp = !jointefp + eq.@coefs(!k)
                %waldefp = %waldefp + "c(" + @str(!k) + ") = "
            next
            %waldefp = %waldefp + "0"

            'calculate sum of erp coeffs and build Wald expression
            !jointerp = 0
            %walderp = ""
            for !l=!irlags+!efplags+5 to !efplags+!irlags+!erplags+5
                !jointerp = !jointerp + eq.@coefs(!l)
                %walderp = %walderp + "c(" + @str(!l) + ") = "
            next
            %walderp = %walderp + "0"

            'perform Wald test for ir and freeze it into a table called
            'waldtable
            freeze(waldtable) eq.wald {%waldir}
            !irwaldstat = @val(waldtable(6,2)) 'store Wald stat
            !irwaldp = @val(waldtable(6,4)) 'store Wald p-value
```

```
            d waldtable 'delete the table

            'perform Wald test for efp and freeze it into a table called
            'waldtable
            freeze(waldtable) eq.wald {%waldefp}
            !efpwaldstat = @val(waldtable(6,2)) 'store Wald stat
            !efpwaldp = @val(waldtable(6,4)) 'store Wald p-value
            d waldtable 'delete the table

            'perform Wald test for erp and freeze it into a table called
            'waldtable
            freeze(waldtable) eq.wald {%walderp}
            !erpwaldstat = @val(waldtable(6,2)) 'store Wald stat
            !erpwaldp = @val(waldtable(6,4)) 'store Wald p-value
            d waldtable 'delete the table

            'if all long-run effects are negative
            if !jointir < 0 and !jointefp < 0 and !jointerp < 0 then
                'if the average Wald p-value is better than the current
best
                'with negative long-run effects
                if (!irwaldp + !efpwaldp + !erpwaldp)/3 <
!bestaveragewaldpn then
                    'count this specification
                    !numneg = !numneg + 1
                    'record all lags and stats and p-values as current best
                    'with negative long-run effects
                    !irbestwaldpn = !irwaldp
                    !erpbestwaldpn = !erpwaldp
                    !efpbestwaldpn = !efpwaldp
                    !irbestwaldn = !irwaldstat
                    !efpbestwaldn = !efpwaldstat
                    !erpbestwaldn = !erpwaldstat
                    !irbestlagwaldn = !irlags
                    !efpbestlagwaldn = !efplags
                    !erpbestlagwaldn = !erplags
                    !jointirwaldn = !jointir
                    !jointefpwaldn = !jointefp
                    !jointerpwaldn = !jointerp
                endif
            endif

            'if the average Wald p-value is better than the current best
            'regardless of the sign of the long-run effects
            if (!irwaldp + !efpwaldp + !erpwaldp)/3 < !bestaveragewaldp
then
                'record all lags and stats and p-values as current best
                'regardless of the sign of the long-run effects
                !irbestwaldp = !irwaldp
                !erpbestwaldp = !erpwaldp
                !efpbestwaldp = !efpwaldp
                !irbestwald = !irwaldstat
                !efpbestwald = !efpwaldstat
                !erpbestwald = !erpwaldstat
                !irbestlagwald = !irlags
                !efpbestlagwald = !efplags
                !erpbestlagwald = !erplags
                !jointirwald = !jointir
                !jointefpwald = !jointefp
                !jointerpwald = !jointerp
            endif
```

```
        next
    next
next

'show the best specification, with negative long-run effects
equation eq_wald_neg
show eq wald neg.ls ln rgdp q c @trend {%ir}(0 to -!irbestlagwaldn)
{%efp}(0 to -!efpbestlagwaldn) {%erp}(0 to -!erpbestlagwaldn)

'populate the output table
output(1,1) = "Best Wald, negative long-run effects"
output(2,1) = "IR LTE: "
output(2,2) = !jointirwaldn
output(3,1) = "IR Wald: "
output(3,2) = !irbestwaldn
output(4,1) = "IR Wald p-value: "
output(4,2) = !irbestwaldpn
output(5,1) = "EFP LTE: "
output(5,2) = !jointefpwaldn
output(6,1) = "EFP Wald: "
output(6,2) = !efpbestwaldn
output(7,1) = "EFP Wald p-value: "
output(7,2) = !efpbestwaldpn
output(8,1) = "ERP LTE: "
output(8,2) = !jointerpwaldn
output(9,1) = "ERP Wald: "
output(9,2) = !erpbestwaldn
output(10,1) = "ERP Wald p-value: "
output(10,2) = !erpbestwaldpn

'show the best specification, regardless of the sign of the long-run
effects
equation eq_wald
show eq_wald.ls ln_rgdp_q c @trend {%ir}(0 to -!irbestlagwald) {%efp}(0 to
-!efpbestlagwald) {%erp}(0 to -!erpbestlagwald)
output(12,1) = "Best Wald"
output(13,1) = "IR LTE: "
output(13,2) = !jointirwald
output(14,1) = "IR Wald: "
output(14,2) = !irbestwald
output(15,1) = "IR Wald p-value: "
output(15,2) = !irbestwaldp
output(16,1) = "EFP LTE: "
output(16,2) = !jointefpwald
output(17,1) = "EFP Wald: "
output(17,2) = !efpbestwald
output(18,1) = "EFP Wald p-value: "
output(18,2) = !efpbestwaldp
output(19,1) = "ERP LTE: "
output(19,2) = !jointerpwald
output(20,1) = "ERP Wald: "
output(20,2) = !erpbestwald
output(21,1) = "ERP Wald p-value: "
output(21,2) = !erpbestwaldp

'populate the output table with some stats about the procedure
output(23,1) = "Specifications with negative long-run effects found: "
output(23,2)= !numneg
output(24,1) = "Number of estimations: "
output(24,2) = !iteration
```

```
'show the output table
show output
```

E.3 Best specification of a VAR equation

```
'This script takes 4 arguments: %0, %1, %2 and %3.
'%0: the interest rate proxy
'%1: the external finance premium proxy
'%2: the quantitative easing proxy
'%3: one of 'ir', 'efp', 'erp' or 'gdp', indicating the dependent variable
'of the equation to estimate

'show only own log messages
logmode -all logmsg

'create empty equation to be used inside the loop
equation eq

'specify how many lags to consider, at max
!numlags = 8
if %2 = "ln_mbst_w" then
    !numlags = 4
endif
if %2 = "ln_fed_assets_w" then
    !numlags = 5
endif

'variable saying how many lags to go up to
!gdpmaxlags = !numlags
!irmaxlags = !numlags
!efpmaxlags = !numlags
!erpmaxlags = !numlags
!qemaxlags = !numlags

'be extra sure to create a table for the script output
table(10,2) output
d output
table(10,2) output


'variables to store the best number of lags, regardless of the sign of
'long-run coefficients
!gdpbestlagwald = 0
!irbestlagwald = 0
!efpbestlagwald = 0
!erpbestlagwald = 0
!qebestlagwald = 0
'variables to store the best number of lags, with negative long-run
'coefficients
!gdpbestlagwaldn = 0
!irbestlagwaldn = 0
!efpbestlagwaldn = 0
!erpbestlagwaldn = 0
!qebestlagwaldn = 0

'variables to store the best p-value of a Wald test and the accompanying
'Wald statistic
!gdpbestwaldp = 1
!gdpbestwald = 0
!irbestwaldp = 1
!irbestwald = 0
!efpbestwaldp = 1
!efpbestwald = 0
!erpbestwaldp = 1
!erpbestwald = 0
```

```
!qebestwaldp = 1
!qebestwald = 0

'variable to store the best p-value of a Wald test and the accompanying
'Wald statistic with a negative long-run effects
!gdpbestwaldpn = 1
!gdpbestwaldn = 0
!irbestwaldpn = 1
!irbestwaldn = 0
!efpbestwaldpn = 1
!efpbestwaldn = 0
!erpbestwaldpn = 1
!erpbestwaldn = 0
!qebestwaldpn = 1
!qebestwaldn = 0

'create variables to hold the long-run effects
!jointgdpwald = 0
!jointgdpwaldn = 0
!jointirwald = 0
!jointirwaldn = 0
!jointefpwald = 0
!jointefpwaldn = 0
!jointerpwald = 0
!jointerpwaldn = 0
!jointqewald = 0
!jointqewaldn = 0

'variables to store the best average p-value of a Wald test
!bestaveragewaldpn = 1
!bestaveragewaldp = 1

'count the number of specifications with a negative long-run effect of x on
y
!numneg = 0

'set sample to be the !maxlag'th value onwards
smpl 2003M01+!numlags @last

'count the number of estimations
!iteration = 0

'start looping through every possible specification
for !gdplags = 1 to !gdpmaxlags
    for !irlags = 1 to !irmaxlags
        for !efplags = 1 to !efpmaxlags
            for !erplags = 1 to !erpmaxlags
                for !qelags = 1 to !qemaxlags

                    !iteration = !iteration + 1
                    logmsg iteration !iteration 'log the estimation number
                    'logging considerably slows down this script, so
                    'consider deleting this line

                    'run the regression
                    eq.ls {%0} c ln_rgdp_q(-1 to -!gdplags) {%0}(-1 to -
!irlags) {%1}(-1 to -!efplags) erp_w(-1 to -!erplags) {%2}(-1 to -!qelags)

                    'calculate sum of gdp coefs and build Wald expression
                    !jointgdp = 0
                    %waldgdp = ""
```

```
                    for !h = 2 to 1 + !gdplags
                        !jointgdp = !jointgdp + eq.@coefs(!h)
                        %waldgdp = %waldgdp + "c(" + @str(!h) + ") = "
                    next
                    %waldgdp = %waldgdp + "0"

                    'calculate sum of ir coefs and build Wald expression
                    !jointir = 0
                    %waldir = ""
                    for !h = 2 + !gdplags to 1 + !gdplags + !irlags
                        !jointir = !jointir + eq.@coefs(!h)
                        %waldir = %waldir + "c(" + @str(!h) + ") = "
                    next
                    %waldir = %waldir + "0"

                    'calculate sum of efp coefs and build Wald expression
                    !jointefp = 0
                    %waldefp = ""
                    for !k = 2 + !gdplags + !irlags to 1 + !gdplags +
!irlags+!efplags
                        !jointefp = !jointefp + eq.@coefs(!k)
                        %waldefp = %waldefp + "c(" + @str(!k) + ") = "
                    next
                    %waldefp = %waldefp + "0"


                    'calculate sum of erp coefs and build Wald expression
                    !jointerp = 0
                    %walderp = ""
                    for !l = 2 + !gdplags + !irlags + !efplags to 1 +
!gdplags + !irlags+!efplags+!erplags
                        !jointerp = !jointerp + eq.@coefs(!l)
                        %walderp = %walderp + "c(" + @str(!l) + ") = "
                    next
                    %walderp = %walderp + "0"

                    'calculate sum of qe coefs and build Wald expression
                    !jointqe = 0
                    %waldqe = ""
                    for !k = 2 + !gdplags + !irlags + !efplags + !erplags
to 1 + !gdplags + !irlags + !efplags + !erplags + !qelags
                        !jointqe = !jointqe + eq.@coefs(!k)
                        %waldqe = %waldqe + "c(" + @str(!k) + ") = "
                    next
                    %waldqe = %waldqe + "0"

                    'calculate the long-run coefficients
                    !divisor = 1-!joint{%3}
                    if !divisor = 0 then
                        !divisor = 0.00000001
                    endif
                    !jointgdp = !jointgdp/!divisor
                    !jointir = !jointir/!divisor
                    !jointefp = !jointefp/!divisor
                    !jointerp = !jointerp/!divisor
                    !jointqe = !jointqe/!divisor

                    'initialize the waldtable
                    table waldtable
                    d waldtable
```

```
'perform Wald test for gdp and freeze it into a table
'called waldtable
freeze(waldtable) eq.wald {%waldgdp}
!row = 6
if waldtable(!row,1) = "t-statistic" then
    !row = 7
endif
'store Wald stat and p-value
!gdpwaldstat = @val(waldtable(!row,2))
!gdpwaldp = @val(waldtable(!row,4))
d waldtable     ' delete the table

'perform Wald test for ir and freeze it into a table
'called waldtable
freeze(waldtable) eq.wald {%waldir}
!row = 6
if waldtable(!row,1) = "t-statistic" then
    !row = 7
endif
'store Wald stat and p-value
!irwaldstat = @val(waldtable(!row,2))
!irwaldp = @val(waldtable(!row,4))
d waldtable      ' delete the table

'perform Wald test for efp and freeze it into a table
'called waldtable
freeze(waldtable) eq.wald {%waldefp}
!row = 6
if waldtable(!row,1) = "t-statistic" then
    !row = 7
endif
'store Wald stat and p-value
!efpwaldstat = @val(waldtable(!row,2))
!efpwaldp = @val(waldtable(!row,4))
d waldtable     ' delete the table

'perform Wald test for erp and freeze it into a table
'called waldtable
freeze(waldtable) eq.wald {%walderp}
!row = 6
if waldtable(!row,1) = "t-statistic" then
    !row = 7
endif
'store Wald stat and p-value
!erpwaldstat = @val(waldtable(!row,2))
!erpwaldp = @val(waldtable(!row,4))
d waldtable     ' delete the table

'perform Wald test for qe and freeze it into a table
'called waldtable
freeze(waldtable) eq.wald {%waldqe}
!row = 6
if waldtable(!row,1) = "t-statistic" then
    !row = 7
endif
'store Wald stat and p-value
!qewaldstat = @val(waldtable(!row,2))
!qewaldp = @val(waldtable(!row,4))
d waldtable    ' delete the table

'EITHER
```

```
                    '(the dependent variable is the interest rate,
                    'the external finance premium or the equity risk
                    'premium and the long-run effect of qe is negative)
                    'OR
                    '(the dependent variable is gdp and the long-run effect
                    'of the interest rate, the external finance premium
                    'and the equity risk premium is negative)
                    if ((%3 = "ir" or %3 = "efp" or %3 = "erp") and
(!jointqe < 0)) or ((%3 = "gdp") and (!jointir < 0 and !jointefp < 0 and
!jointerp < 0)) then

                        'if (depending on the dependent variable) the qe
                        'Wald p-value improved, or the average Wald p-value
                        'of the interest rate, external finance premium and
                        'equity risk premium improved
                        if ((%3 = "ir" or %3 = "efp" or %3 = "erp") and
(!qewaldp  < !qebestwaldpn)) or ((%3 = "gdp") and (!irwaldp + !efpwaldp +
!erpwaldp)/3 < !bestaveragewaldpn)) then
                            'count this specification
                            !numneg = !numneg + 1
                            'record all lags and stats and p-values as
                            'current best with negative long-run effects
                            !gdpbestwaldpn = !gdpwaldp
                            !irbestwaldpn = !irwaldp
                            !erpbestwaldpn = !erpwaldp
                            !efpbestwaldpn = !efpwaldp
                            !qebestwaldpn = !qewaldp
                            !gdpbestwaldn = !gdpwaldstat
                            !irbestwaldn = !irwaldstat
                            !efpbestwaldn = !efpwaldstat
                            !erpbestwaldn = !erpwaldstat
                            !qebestwaldn = !qewaldstat
                            !gdpbestlagwaldn = !gdplags
                            !irbestlagwaldn = !irlags
                            !efpbestlagwaldn = !efplags
                            !erpbestlagwaldn = !erplags
                            !qebestlagwaldn = !qelags
                            !jointgdpwaldn = !jointgdp
                            !jointirwaldn = !jointir
                            !jointefpwaldn = !jointefp
                            !jointerpwaldn = !jointerp
                            !jointqewaldn = !jointqe
                        endif

                    endif

                    'if (depending on the dependent variable) the qe
                    'Wald p-value improved, or the average Wald p-value
                    'of the interest rate, external finance premium and
                    'equity risk premium improved
                    if ((%3 = "ir" or %3 = "efp" or %3 = "erp") and
(!qewaldp  < !qebestwaldp)) or ((%3 = "gdp") and (!irwaldp + !efpwaldp +
!erpwaldp)/3 < !bestaveragewaldp)) then
                        'record all lags and stats and p-values as current
                        'best regardless of the sign of the long-run
effects
                        !gdpbestwaldp = !gdpwaldp
                        !irbestwaldp = !irwaldp
                        !erpbestwaldp = !erpwaldp
                        !efpbestwaldp = !efpwaldp
                        !qebestwaldp = !qewaldp
```

```
                        !gdpbestwald = !gdpwaldstat
                        !irbestwald = !irwaldstat
                        !efpbestwald = !efpwaldstat
                        !erpbestwald = !erpwaldstat
                        !qebestwald = !qewaldstat
                        !gdpbestlagwald = !gdplags
                        !irbestlagwald = !irlags
                        !efpbestlagwald = !efplags
                        !erpbestlagwald = !erplags
                        !qebestlagwald = !qelags
                        !jointgdpwald = !jointgdp
                        !jointirwald = !jointir
                        !jointefpwald = !jointefp
                        !jointerpwald = !jointerp
                        !jointqewald = !jointqe
                    endif

                next
            next
        next
    next
next

'determine the dependent variable
%dep = ""
if %3 = "ir" then
    %dep = %0
endif
if %3 = "efp" then
    %dep = %1
endif
if %3 = "erp" then
    %dep = "erp_w" 'name of the erp variable
endif
if %3 = "gdp" then
    %dep = "ln_rgdp_q" 'name of the gdp variable
endif

'show the best specification, with negative long-run effects
equation eq_wald_neg
show eq_wald_neg.ls {%dep} c ln_rgdp_q(-1 to -!gdpbestlagwaldn) {%0}(-1 to
-!irbestlagwaldn) {%1}(-1 to -!efpbestlagwaldn) erp_w(-1 to -
!erpbestlagwaldn) {%2}(-1 to -!qebestlagwaldn)

'populate the output table
output(1,1) = "Best Wald, negative long-run effects"
output(2,1) = "IR LTE: "
output(2,2) = !jointirwaldn
output(3,1) = "IR Wald: "
output(3,2) = !irbestwaldn
output(4,1) = "IR Wald p-value: "
output(4,2) = !irbestwaldpn
output(5,1) = "EFP LTE: "
output(5,2) = !jointefpwaldn
output(6,1) = "EFP Wald: "
output(6,2) = !efpbestwaldn
output(7,1) = "EFP Wald p-value: "
output(7,2) = !efpbestwaldpn
output(8,1) = "ERP LTE: "
output(8,2) = !jointerpwaldn
output(9,1) = "ERP Wald: "
```

```
output(9,2) = !erpbestwaldn
output(10,1) = "ERP Wald p-value: "
output(10,2) = !erpbestwaldpn
output(11,1) = "QE LTE: "
output(11,2) = !jointqewaldn
output(12,1) = "QE Wald: "
output(12,2) = !qebestwaldn
output(13,1) = "QE Wald p-value: "
output(13,2) = !qebestwaldpn

'show the best specification, regardless of the sign of the long-run
effects
equation eq_wald
show eq_wald.ls {%dep} c ln_rgdp_q(-1 to -!gdpbestlagwald) {%0}(-1 to -
!irbestlagwald) {%1}(-1 to -!efpbestlagwald) erp_w(-1 to -!erpbestlagwald)
{%2}(-1 to -!qebestlagwald)

'populate the output table
output(14,1) = "Best Wald"
output(15,1) = "IR LTE: "
output(15,2) = !jointirwald
output(16,1) = "IR Wald: "
output(16,2) = !irbestwald
output(17,1) = "IR Wald p-value: "
output(17,2) = !irbestwaldp
output(18,1) = "EFP LTE: "
output(18,2) = !jointefpwald
output(19,1) = "EFP Wald: "
output(19,2) = !efpbestwald
output(20,1) = "EFP Wald p-value: "
output(20,2) = !efpbestwaldp
output(21,1) = "ERP LTE: "
output(21,2) = !jointerpwald
output(22,1) = "ERP Wald: "
output(22,2) = !erpbestwald
output(23,1) = "ERP Wald p-value: "
output(23,2) = !erpbestwaldp
output(24,1) = "QE LTE: "
output(24,2) = !jointqewald
output(25,1) = "QE Wald: "
output(25,2) = !qebestwald
output(26,1) = "QE Wald p-value: "
output(26,2) = !qebestwaldp

'populate the output table with some stats about the procedure
output(28,1) = "Specifications with negative long-run effects found: "
output(28,2)= !numneg
output(29,1) = "Number of estimations: "
output(29,2) = !iteration

'show the output table
show output
```