Did carry trades hamper quantitative easing effectiveness in Japan?

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Abstract

In this paper we investigate how carry trades have affected the efficiency of the Japanese quantitative easing policy between March 1995 and September 2010. During this period, the Japanese economy was stuck in a liquidity trap. To identify monetary policy shocks, we use a data-driven Structural VAR approach. Thus, our results rely only on the statistical properties of the data through a non-Gaussian identification. We show that carry trades have significantly mitigated the impact of the Quantitative Easing policy on the Japanese industrial production and inflation. Our results clearly reveal that carry trades have moderated the way the Japanese unconventional policy has impacted macroeconomic variables, making such a policy less efficient in the presence of carry trades.

Index terms— Carry trades, Unconventional monetary policy, interest rate
JEL classification: C12; C14; C22; C50; C52; C58

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1 Introduction

Measuring the effects of unconventional measures is a trending topic. In the last decade, Cecioni et al. (2011) show evidence that unconventional measures have been effective in influencing financial and macroeconomic variables, however there is still uncertainty around the quantification of those effects. Morgan (2011) investigates the impact of the different Quantitative Easing (QE) episodes in the United-States. His results reveal that QE episodes have exported liquidity in emerging economies. In the same vein, Anya et al. (2017) have shown that an expansionary policy shock significantly increases portfolio flows from the US to emerging economies. More precisely, while implementing unconventional policies, the central bank inject liquidity in the financial system in order to boost credit and growth. Morgan (2011) and Anya et al. (2017) results shed light on the fact that part of these injected liquidity goes abroad. A reflexion on the impact of these capital outflows on the economy appears relevant. In this paper, we argue that part of these liquidities moves abroad through carry trades. Such investments aim at borrowing a low return currency in order to invest it in a high return one. Obviously, QE policies are favorable to carry trades. First, the interest rate remains close to zero all along the period of the policy and secondly there are massive liquidity injections. The idea is to analyze how carry trades, through these capital outflows, have affected the Japanese QE policy.

In the early 90s, the housing market crashed in Japan. Banking and housing markets are closely linked. To support the economy, the Bank of Japan lowered its policy rate to zero in 1995. However, it was not enough to get recovery of the real economy. The policy interest rate stayed close to zero and the Bank of Japan started to implement its QE program. Our study on the effectiveness of the QE-policy in Japan sheds light on the potential averse effects of carry trades. A good understanding on what happened in Japan can help to understand how QE influences economies, which could be relevant for other countries central banks during liquidity trap. For example, the case of the US economy is quite similar. The housing bubble exploded and the banking market was in trouble. To get out the recession, the FED resorted to a QE policy. There are few studies which focus on the effect of unconventional policy on key macroeconomic variables. Generally, they investigate the effect of this policy on financial market variables. Oda and Ueda (2007) use no-arbitrage model of the term structure to asses the effectiveness of the Bank of Japan's policies. Hamilton and Wu (2012) use a model of risk-averse arbitrageurs to show that the maturity structure of debt held by the public might affect the interest rates structure. They show that when the economy is at the zero lower bound, the long run yield is decreased without increasing the short run one. Thus, there is still considerable uncertainty around the quantification of the effects on macroeconomics variables as pointed by Joyce et al. (2012). Recently Meinusch and Tillmann (2016) for the US economy, Weale and Wieladek (2016) for the US and UK economies, Boeckx et al. (2017) for the Euro aera and Schenkelberg and Watzka (2013) for Japan study the effect of unconventional monetary policy (UMP) shock on macroeconomic variables over a sample period during which the economy is in a liquidity trap. They find that an expansionary UMP shock leads to a temporary rise in output and prices in all countries. For the Japanese case, this kind of study has some limits since they do not take into account capital outflows. We contribute to the literature by assuming carry trade to have an impact on UMP. As far as we know, it is the first empirical study which focuses on the potential destabilizing effect of carry-trades on the policy. Our intuition goes in line with Michaelis and Watzka (2017) who find that the impact of QE is time varying. The amount of carry trades is time varying depending on the interest rate differential.

Literature analyzing the macroeconomic and financial effects of central bank policies mostly uses vector autoregression models (VARs). Reduced-form VAR are convenient for modeling the joint dynamics of numerous time series. Another kind of VAR models called structural VAR (SVAR) is more appropriate for answering economic questions. Impulse response functions (IRF) can be derived to analyze the dynamics in SVAR models. However, in this framework, economic shocks must be identified. Usually, it is done though restrictions following the economic theory. In the UMP literature, sign restrictions and short-run zero restrictions are the main tools to identify impulse responses. This identification issue is caused by the Gaussian assumption usually made on the joint distribution of the error terms. In this article, we use an identification scheme recently put forth by Lanne et al. (2017). In this approach, the identification is achieved under a non-Gaussian assumption and the independence of the error processes. Hence, this method lead to a statistically identification and the resulting IRF are not economically labeled. To endow the structural shocks with an economic interpretation, we use the method of Lanne and Luoto (2016). This identification process yields more accurate IRF that are found to plausibly satisfy the proposed restrictions. Second, since our model is uniquely identified, the so-called model identification problem (see e.g. Fry and Pagan 2011) disappears and reporting the results of impulse response analysis is straightforward.

Our results are quite simple and very intuitive: part of the liquidity injected by the Bank of Japan has been exported through carry trades. These capital outflows enhanced by carry trades alter the way the policy affect macroeconomic variables. Interestingly, in the presence of carry trades, the QE policy is less efficient and does not increase significantly neither inflation nor industrial production.

In a first section, we present how carry trades are linked to quantitative easing policies, then we introduce our SVAR model. Sections 4 and 5 present the results and robustness checks respectively and section 6 concludes.

2 Quantitative easing and carry trades

After the global financial crisis, the United-States have implemented unconventional monetary policies. A few years later, the European Central Bank also resorted to such a policy. Then, investigating the effectiveness of such policies becomes a crucial issue. In order to investigate how these unconventional policies perform by considering the foreign exchange market, it seems natural to consider Japan which has massively implemented such policies. In 1998, Japan registered negative inflation rate, leading monetary authorities to set the short run interest rate to zero in 1999. The Bank of Japan (BoJ) not only decreased the short run interest but also announced that it would remain at this level until the end of deflation. The thing is that deflation was still there, thus in 2001 the BoJ resorted to quantitative easing by increasing the current account balance target. More precisely, the BoJ increased and maintained liquidity supply by using the current account balances at the BoJ. The BoJ massively used this kind of policy until 2011[1]. Interestingly, potential investors knew that the BoJ would not change its policy until the end of deflation which is highly relevant while talking about carry trades. Indeed, given that part of the gain of carry traders is the interest differential, knowing that the interest rate would remain close to zero increases their appetite for such positions on the foreign exchange market.

In this paper, we analyze how capital outflows enhanced by carry trades

[1]See Ueda (2012) for the timing and exhaustive details of the different QE episodes used by the BoJ

affected the Japanese quantitative easing policy. Recall that carry trades aim at borrowing a low return currency to invest the amount borrowed in high return currencies. Countries implementing unconventional policies have low interest rates which make them source countries for carry trades. Carry traders borrow in these countries to invest in high interest rate countries. The gain is obviously the interest rate differential adjusted to exchange rate changes. Hence, the return of a carry trade[2] (in log), with the Japanese Yen as the source currency is

$$z_t = i_t^* - i_t + s_t - s_{t-1},$$

with i_t the Japanese interest rate, i_t^* the foreign interest rate and $s_t - s_{t-1}$ the change in the current exchange rate. An increase in s_t represents a depreciation of the Japanese Yen.

From what presented above, it becomes straightforward that unconventional monetary policies lead the domestic currency to be the borrowed one (source country) in carry trades. Then, given that investors borrow in domestic currency (Japanese Yen) to invest in foreign currencies, such investments will lead to capital outflows. Figure 1 highlights carry trade activity during QE episodes between 2000 and 2007. Excess returns of carry trades are largely positive during this period as net future positions of non commercial traders at the Chicago Mercantile Exchange. The idea of this paper is that carry trades, by enhancing capital outflows, will hamper quantitative easing effectiveness. Indeed, the central bank injects liquidities in the banking sector in order to boost credit and growth. However these liquidity are exported in high yield currencies country through carry trades. The benefit from this policy would be mitigated in the sense that the injected liquidity would not rise credit and growth as much as expected both by monetary authorities and agents.

[2] In figure 1, the return of a carry trade portfolio composed of ten investment currencies is represented.

3 Structural VAR for the Japanese economy

3.1 The model

To analyze the effects of carry-trades on the effectiveness of the Japanese monetary policy, we estimate a simple reduced-form VAR model:

$$Y_t = C + \sum_{i=1}^{p} A_i Y_{t-i} + u_t \tag{1}$$

where C is a vector of intercepts, Y_t is a vector of n endogenous variables, A_i is a $n \times n$ matrix of autoregressive coefficients of $Y_t - i$ and u_t is a vector of residuals. We consider the following macroeconomic variables in the VAR system:

$$Y_t = [\mathrm{CPI}_t; \mathrm{IP}_t; \mathrm{RES}_t; \mathrm{LTY}_t; \mathrm{REER}_t; \mathrm{CT}_t]' \tag{2}$$

where CPI_t denotes the core consumer price index, IP_t the Japanese industrial production index, RES_t the bank reserves held at the Bank of Japan, LTY_t the 10-year yield of Japanese government bonds, REER_t the real effective exchange rate of the Yen against other currencies and CT_t the proxy of carry trade activity. In this model, the reduced-form error terms are related to the uncorrelated structural errors ε_t according to:

$$\varepsilon_t = B^{-1} u_t. \tag{3}$$

To compare our results with Schenkelberg and Watzka (2013), the VAR model is estimated by Bayesian methods using monthly data. The sample starts in July 1995 and finish in March 2010. We choose this period for two main reasons. First, the Bank of Japan began to use account balances in 1995 as a monetary policy instrument. During this period, we consider that Japan has been at the

Zero Lower Bound (ZLB) during the whole sample. The Japanese call rate reached 0.5% around 1995. Accordingly, the only monetary policy tool during our sample period is the bank reserves held at the Bank of Japan. Secondly, in 2010, speculators have found many other funding countries to make carry trades like United States since all major central banks have low interest rates. We use the same number of lags, $p = 6$ as Schenkelberg and Watzka (2013). It seems to be sufficient to capture the dynamics of the model. Autocorrelation tests do not reject the null of no remaining autocorrelation up to 10 lags for all the variables[3]. Finally, we seasonally adjust and de-trend the variables.

3.2 Non-Gaussian identification

We apply here the method of identification developed by Lanne et al. (2017) which rely only on the statistical properties of the data. This approach has a lot of advantages and only few drawbacks compared to the approach of sign restrictions. If numerous models fit wll the data, the latter method can fail to identify a unique model (Fry and Pagan 2011). Moreover, IRF are driven by an implicit prior as shown by Baumeister and Hamilton (2015). The method used in this paper yields to a unique identification. In equation (3), matrix $\mathbf{B}$ contains the contemporaneous relations of the structural errors ε_t. This matrix is assumed nonsingular. Moreover, each component is independent in time with zero mean and a finite variance. In another way, we assume that each error term is a sequence of stationary random vectors independently distributed and at most one of them has a Gaussian marginal distribution. Lanne et al. (2017) show that under the non-Gaussian assumption of the structural error term, matrix $\mathbf{B}$ is uniquely identified. With this identification, we can compute the structural shocks and their impulse responses but they are not labeled and do not have economic meanings. To determine which shock corresponds to a QE

[3]Results are available upon demand to the authors.

shock, we first make assumptions on how the variables should react after it. Then, we compute for each shock the conditional probability to satisfy these restrictions. The structural shock which owns the highest posterior probability to satisfy the restrictions is labeled QE shock. Finally, the interpretation of the impulse responses of that shock is straightforward. Such identification methods has been used by Puonti (2016) who studies the impact of an UMP shocks for United States, Japan and Euro area but does not focus on the impact of carry trades activity. Turnip (2017) uses it to test identifying restrictions commonly used in small open economy structural vector autoregression (SVAR) models.

3.3 Data and statistics

The data are collected through three main sources. As a measure of reserves, we include the average outstanding current account balances (CABs) held by financial institutions at the BoJ. The main objective of the BoJ is the CABs target which is mainly constituted of central bank reserves. We include the 10-year government bond yield. These two series have been obtained on the BoJ website. As a proxy of inflation, we use the core consumer price index obtained from Thomson-Reuters inflation (base 2005). It measures the development of consumer prices excluding energy and food. To proxy the economic activity at monthly frequency, we use a measure of the Japanese industrial production (base 2005). The index of the real effective exchange rate of the Yen against other currencies is obtained on the Bank for International Settlements (BIS) website. The six time series are represented in Figure 1. To compute the excess returns of carry trade portfolio, we follow the methodology of Lustig and Verdelhan (2007) and Husted et al. (2017) among others. We use daily data on spot exchange rates and 3-month interest rates for the following countries: Australia, Canada, Euro, Japan, New Zealand, Norway, Switzerland, Sweden, the United Kingdom and the United States of America. All data comes from Thomson Reuters and Eikon database. For all currencies, except the Euro, the beginning of the sample is July 1995 and the end of the sample is March 2010. In our main portfolio, all currencies are equally weighted. We calculate daily excess returns, in Yens, over corresponding-maturity Japan interest rates on these portfolios. We then compute the unconditional mean of the excess returns, by portfolio at monthly frequency. More specifically, we compute the "Hold One Quarter" excess returns over corresponding-maturity Japan interest rates (daily) as

$$(m - 0.25)i_{t+65} - mi_t - [(m - 0.25)i^{\star}_{t+65} - mi^{\star}_t] + s_{t+65} - s_t. \tag{4}$$

i_t and $i^{\star}_t$ represent respectively the 3-month interest rates of Japan and foreign countries. s_t is the nominal exange rates between the Yen and foreign currency. Since we use the 3-month interest rate, $m = 0.25$, we have

$$0.25(i^{\star}_t - i_t) + s_{t+65} - s_t. \tag{5}$$

Figure 1 exhibits the monthly time series of the portfolio excess returns. In section 5, we rebalance our portfolio with only the three currencies which give the highest excess returns: New-Zealand, Australia and Canada.

4 Results

4.1 Non Gaussian assumption and shock identification

Table 1 reports the estimates of the scale (σ_i) and the degree of freedom (λ_i) parameters corresponding to the errors of each equation i. It suggests clear deviations from normality, which is required for identification.

To disentangle the unconventional monetary policy shock among the n statistically identified ones, we check which shock satisfies the sign restrictions of Schenkelberg and Watzka (2013) among the n statistically identified ones. This procedure is explained in Lanne and Luoto (2016). The monetary policy shock should have a nonnegative impact on prices and reserves. The IRF with the highest probability to satisfy these restrictions is labeled as a QE shock. We compute the posterior probability of each structural shock satisfying the restrictions on the first six lags ($h = 0, \dots, 6$) and $h = 0, \dots, 12$. The results are reported in Table 1. There is only one shock with a high posterior probability which is the unique candidate for the QE shock. This shock supports the sign restriction with a probability around 0.39 and 0.44.

4.2 Impulse Response analysis

The aim of this paper is to investigate whether carry-trade activity affected the Japanese unconventional monetary policy. To answer this question, we estimate a model represented by (1), (2) and (3) and compute the IRF of a QE shock. The results are reported in figure 2.

Regarding the IRF, the QE shock affects slightly inflation (approximately 0.01%). This positive impact lasts ten months and is not significant at each period. Overall, our results suggest that the QE shock does not raise inflation sufficiently which allows to conclude that the unconventional policy has not been able to reach its objective to stop deflation. Such a result is in line with Schenkelberg and Watzka (2013) and highlights that in the presence of carry trades, the impact of the QE shock on inflation is even lower.

The literature suggests that non conventional policies reduce activity in a first time and increase it after a delay (see among others, Lenza and Reichlin 2010). Our results reproduce well the reduction in industrial production brought by the QE shock in a first time. However, the shock does not raise industrial production significantly. Such a result is linked to carry trades. Indeed, by increasing liquidity the QE policy allows to boost the flow of credit to the economy (see Bowman et al. (2015) for a deep analysis of the credit channel) which raise the output. Interestingly, in the presence of carry trades, part of the injected liquidity goes abroad which cancel the positive effect on credit and growth. This result reveals that through capital outflows, carry trades make the quantitative easing policy even less efficient concerning the stimulation of growth.

The real exchange rate represents an important channel of transmission in the sense that carry trades are affected and affect this variable. Our results reveal that the domestic currency appreciates after the shock during few months, then it depreciates. This result is due to the fact that a monetary policy shock affects the economy with a lag. Figure 2 shows that the whole impact is a depreciation of the Japanese yen, thus the QE shock leads to a depreciation of the domestic currency. Carry trades explain this depreciation, indeed these investments leads to capital outflows depreciating the currency.

One of the theoretical effect of a quantitative easing policy is the way it could change investors' expectations. Indeed, with such a policy, central banks want investors to expect a future lower interest rate in order to boost growth. According to our results this has not been the case in Japan in the sense that the QE shock does not affect significantly the long term yield.

The IRF have revealed that carry trades did not have a negligible impact on the Japanese quantitative easing policy. In the following section, we discuss how these effects of carry trades hampered the Japanese QE policy.

4.3 Discussion

Our analysis shows that carry trades have affected the quantitative easing effectiveness in Japan and help to understand how such investments could act this way. According to the results explained in the previous section carry trades have altered the impact of the policy on several variables. Let us present how this impact of carry trades on different variables could hamper quantitative easing effectiveness.

First, through capital outflows, the impact of the policy on inflation is smaller when we account for carry trades. Indeed, it is straightforward that injection of liquidity should tend to increase prices. However, given that carry trades export such liquidity, this positive effect on prices is mathematically reduced. In the same vain the short run negative effect on industrial production is higher while considering carry trades. Such an effect is also due to the capital flight enhanced by carry trades. Notice that these two effects on inflation and output are linked. Obviously, given that output decreases more in the short run (with carry trades), it is logical that the pressure on prices is also smaller.

Our results revealed that a QE shock leads to a depreciation of the Japanese Yen. This result highlights that carry trades alter the impact of the QE policy. Indeed, this depreciation can be explained by capital outflows enhanced by carry trades.

According to our analysis, the 10-year interest rate does not respond significantly to the QE shock. Hanson and Stein (2015) explains that changes in the 10 year rate could be decomposed in expected changes in the 10 year rate and changes in the 10 year real term premium. An increase in carry trades return raise the term premium in the sense that it becomes far more attractive to invest in the short run. Thus, after a QE shock, which increases carry trades return, the long run rate tends to increase. However, the aim of the central bank is to lower expectations in the long run rate in order to boost growth. Thus, on the one hand the policy reduces the long run rate while, on the other hand, carry trades increase it. These two effects compensate which lead to the non significant effect of the QE shock on the long term yield. This effect of carry trades on the 10 year rate also hamper quantitative easing effectiveness in the sense that the positive effect of the QE, through agents expectations of a lower long run rate is canceled.

Overall our results reveal that carry trades have affected the way the Japanese QE has affected the economy. According to our results, carry trades are able to explain part of the low impact of the inefficiency of the unconventional monetary policy in Japan.

5 Robustness checks

In this section, we reestimate our SVAR model by changing the sample period and using two alternative proxies for carry trades.

5.1 A smaller portfolio

All along the paper we represented carry trade activity thanks to a portfolio composed of ten currencies. In order to check the robustness of our results, we construct a portfolio composed of the three most attractive currencies concerning carry trades (New-Zealand Dollar, Australian Dollar and Canadian Dollar). The results are presented in figure 3.

The results are similar to what we found with a larger portfolio. Thus, our results are robust with an alternative portfolio of currencies. Such a result is not surprising in the sense that it is logical that carry trades affect the macroeconomic variables in the same way while only considering the main currencies and sheds light on the robustness of our methodology.

5.2 Positions on the Foreign exchange market

In order to go further in our robustness investigation, we reestimate our SVAR model with a third proxy for carry trades. We follow Brunnermeier et al. (2009) and use the net position of non-commercial (speculative) traders in exchange rate futures on the Chicago Mercantile Exchange. More precisely, we use the difference between long and short positions on Japanese Yen. If the difference is negative, speculative traders sell Yen reflecting increasing capital outflows. As shown by figure 4, there has been, in majority, more short than long positions during the whole sample. It can be interpreted by a large activity of Japanese sourced carry trade. Importantly, figure 4 shows that with this alternative proxy the QE shock affects the two main variables (industrial production and inflation) in the same way. Even with this new proxy, our results reveal that carry trades have hampered quantitative easing effectiveness in the sense that inflation increases less while accounting for such investments. Moreover, in line with what presented in our central analysis, in the presence of carry trades, the industrial production does not raise, even after some lags. Another striking point is the fact that, with this proxy which mathematically accounts for capital inflows, the Japanese Yen does not depreciate anymore which explains why inflation raises less than with our previous proxy.

5.3 The sample size

The last step concerning our robustness analysis is to consider a smaller sample size. We restrict it from March 2001 to March 2006, the QE-period. However, during this period, the number of observation is equal to 60 and is too small to get accurate results. We thus extend this period from January 2000 to January 2008 (97 observations). Figure 5 shows that our main results are similar for this smaller sample. However, the QE shock does not affect significantly the macroeconomic variables, which is easily explainable by the small sample size coupled by the presence of the crisis in the studied period.

6 Conclusions

The main objective of this paper has been to bring to the literature a plausible explanation of the ineffective monetary policy in Japan during the last decade. The QE measures adopted by the Bank of Japan have suffered of speculative positions taken by foreign exchange traders. In this paper, we argue that carry trade activity, which has been very intensive during the 2000s, is a major determinant of this inefficiency.

Our results have been obtained by applied a novel Bayesian SVAR identification method due to Lanne et al. (2017) to estimate the macroeconomic effects of the Bank of Japans operations. The procedure exploits non-Gaussianity and independence of the structural error terms to uniquely identify the shocks as in. In contrast to the SVAR models in Schenkelberg and Watzka (2013), we find that unconventional monetary policy shock have different macroeconomic effects: the timing, persistence and statistical significance of the output and price responses are quite different. We also show that, in the presence of carry trades, inflation increased less after a QE shock in Japan. Moreover, the Japanese short run output decreased more while accounting for carry trades. Interestingly, the Japanese long term yield is no more affected by the policy when we account for carry trades. The depreciation of the yen corroborates this story in the sense that the depreciation is due to capital outflows enhance by carry trades. Overall, in this paper we show that carry trades have affected the efficiency of the QE policy in Japan. Nowadays, unconventional monetary policies are massively used when growth and inflation are not present. This analysis suggests that central bank should consider the impact of carry trades while implementing such policies.

In line with this issue, it would be interesting to investigate how central banks could implement unconventional policies and evict the negative effects of carry trades at the same time. Given that carry trades are done on the foreign exchange markets, further research could focus on policies on this market (taxes and macroprudential measures among others).

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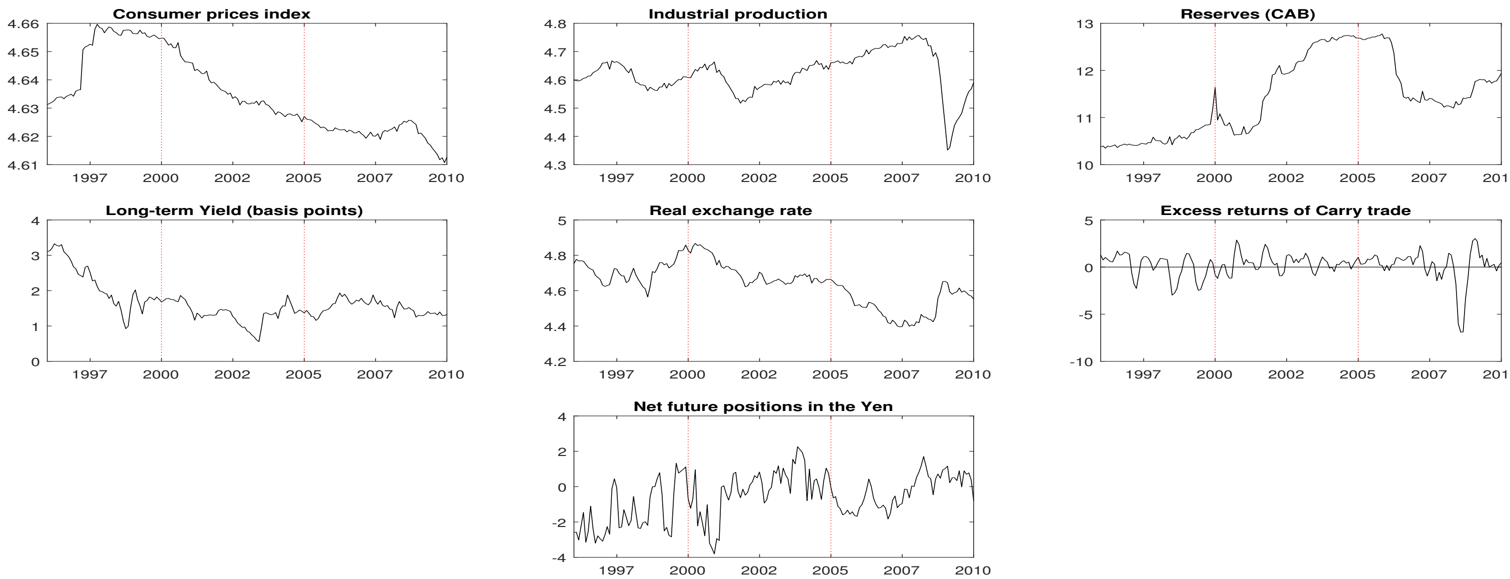

Figure 1: Actual evolution of the variables. The figure displays the evolution of CPI, industrial production, reserves, long-term yield, real exchange rate of the yen, excess returns of carry trades and net positions in the futures market. The red vertical lines indicate the QEP period 2001:032006:03.

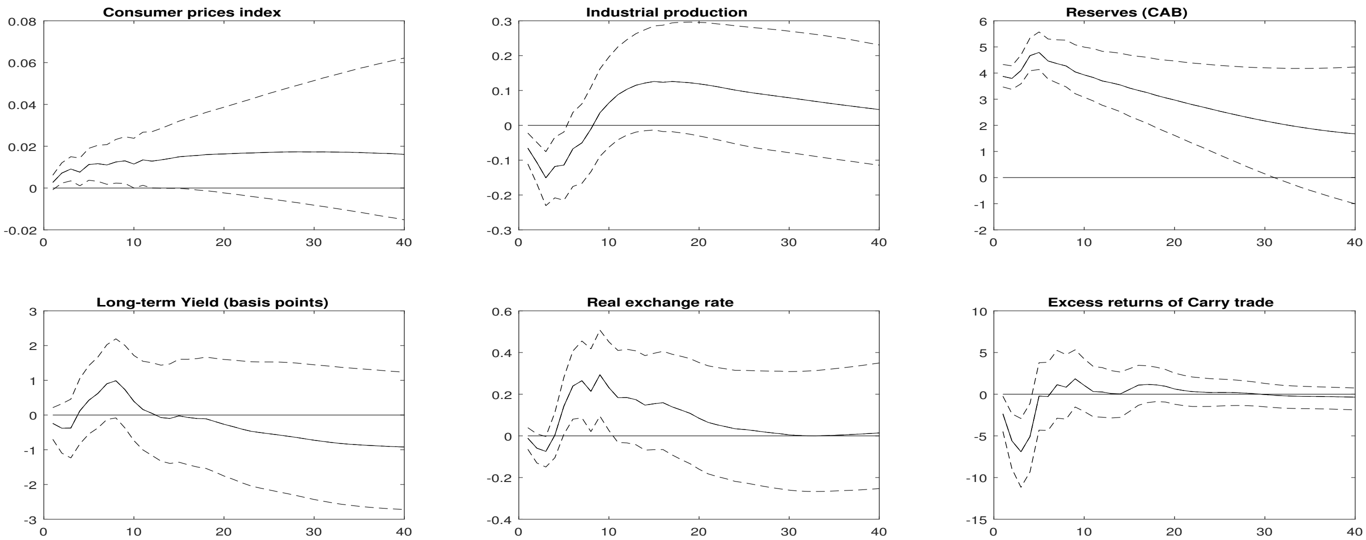

Figure 2: Impulse responses to an expansionary QE-Shock.
Note: Responses over a x-month horizon to a QE-shock as identified though non-Gaussian errors. Solid lines denote the median impulse responses from a BVAR (1000 draws), shaded areas indicate the 16% and 84% percentiles of the posterior distribution of the responses.

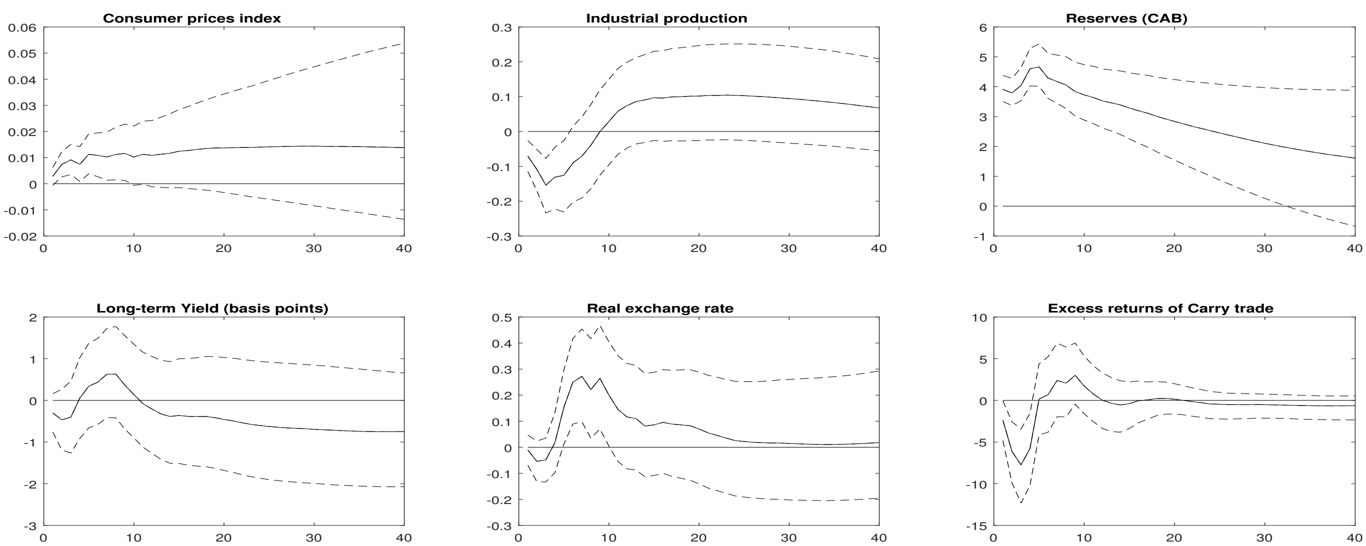

Figure 3: Impulse responses to an expansionary QE-Shock with the three main currency investments.
Note: See figure 2.

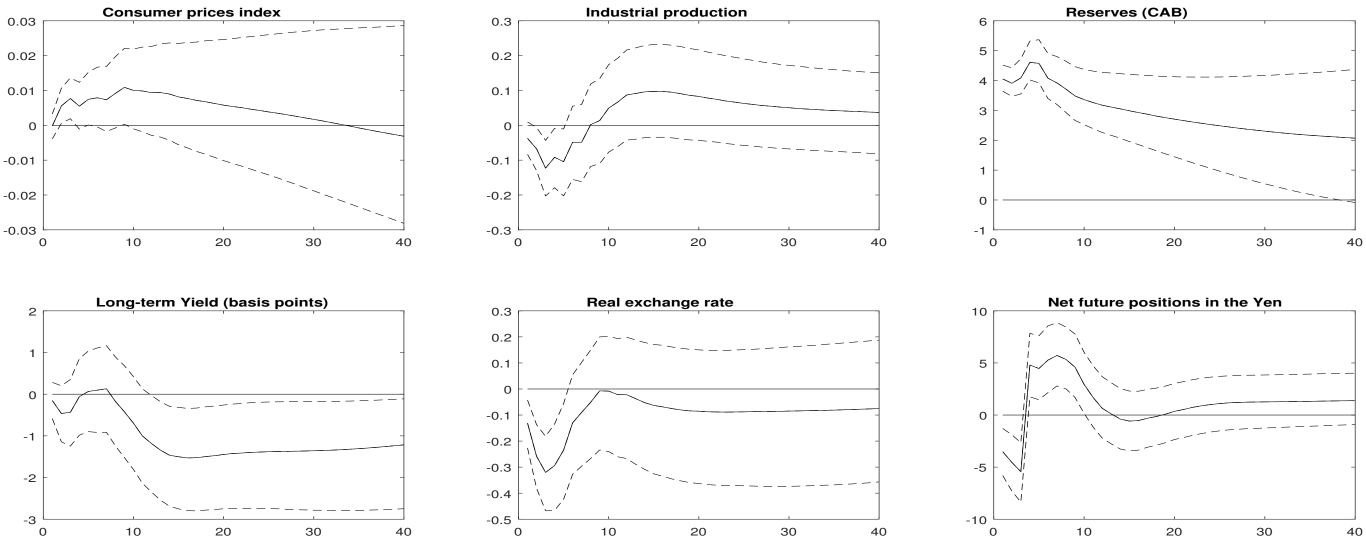

Figure 4: Impulse responses to an expansionary QE-Shock with net positions as a proxy of capital outflows.
Note: See figure 2.

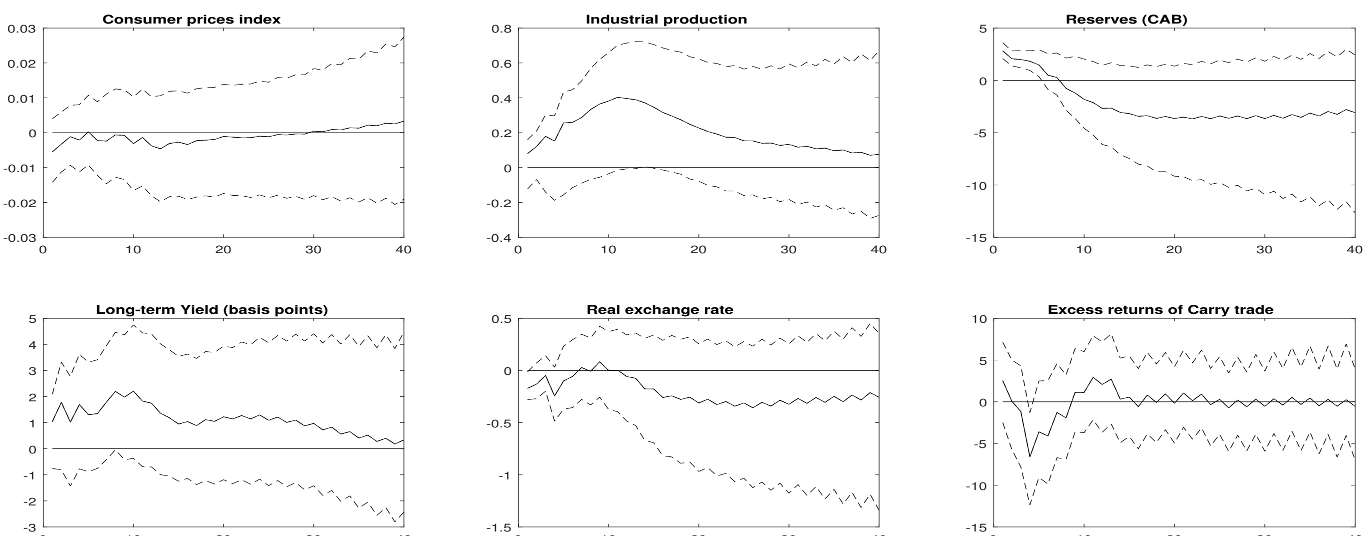

Figure 5: Impulse responses to an expansionary QE-Shock with a shorter sample size.
Note: See figure 2.

	CPI	IP	RES	LTY	REER	CT
Estimation of the scales and degrees of freedom						
σ	0.00	0.00	0.01	0.13	0.00	0.33
λ	3.42	2.41	2.21	3.97	8.18	5.14
Posterior probabilities						
h = (0,. . . 6)	0.09	0.00	**0.39**	0.02	0.02	0.01
h = (0,. . . ,12)	0.10	0.00	**0.44**	0.01	0.02	0.01

Table 1 Scales and degrees of freedom of SVAR model estimation and posterior probabilities to satisfy the QE-shock at different horizons
Note: σ represents the scale of the error terms and λ the degree of freedom of the Student distribution. The posterior probabilities represents the probabilities to satisfy the sign restrictions that the reserves be positive and consumer prices be non-negative.