The Effects of Asset Purchases and Normalization of US Monetary Policy

Naoko Hara∗  Ryuzo Miyao†

Tatsuyoshi Okimoto‡

∗Bank of Japan
†University of Tokyo
‡Crawford School of Public Policy, Australian National University Research Institute of Economy, Trade and Industry (RIETI)

June 4, 2019 Seminar at Keio University
Motivation 1

1. Federal Reserve (Fed) lowered federal funds (FF) rate effectively to zero and introduced the Large Scale Asset Purchases (LSAPs) in Dec 2008

2. Previous studies provide mixed evidence for the effects of LSAPs
   i. Weale and Wieladek (2016) (WW): LSAPs led to a significant rise in real GDP and CPI
   ii. Hesse et al. (2018) (HHW): Early LSAPs had significant positive macroeconomic effects
   iii. Greenlaw et al. (2018): Effects of LSAPs tended not to persist

3. Instructive to examine whether the LSAPs have been effective to boost economy
Motivation 2

1. Impacts of LSAP might have been changed
2. LSAPs were modified several times
   i. LSAP1: Dec 5, 2008 to Mar 31, 2010
   ii. LSAP2: Nov 12, 2010 to Jun 30, 2011
   iii. OT: Oct 3, 2011 to Dec 30, 2012
3. WW: Including LSAP1 or not does not change the effectiveness of LSAPs
4. HHW: Effects of the late LSAPs were weaker
5. Interesting to consider a possible regime change
Motivation 3

1. Fed had started monetary policy (MP) normalization
   i. Dec 2012: First discussion at FOMC
   iii. May 2013: Bernanke shock (BS)
   iv. Jan 2014: Begin tapering the LSAP
   vi. Dec 2015: Begin raising the FF rate

2. Important to accommodate another possible regime change associated with normalization
Contribution and Results

1. Empirically assess the macroeconomic effects of LSAPs and normalization of US monetary policy
2. Detect possible regime changes using a Markov switching model and a shadow rate (SR) as a measure of USMP stance
3. Provide empirical evidence of changes in the impacts of USMP over the last decade
4. Clear evidence of a structural change around BS
5. LSAPs had significant and positive effects on real economy and inflation before BS
6. Another structural change is detected around the beginning of 2011
Contribution and Results

7. LSAP1 had a solid monetary policy effects on real economy and inflation
8. The late LSAP had smaller and less persistent impacts
9. USMP seems to be less influential after BS
10. SR suggests monetary policy stance after BS has been mostly contractionary
11. US monetary policy normalization had marginal effects on real economy and inflation
12. Two policy instruments have been used during the normalization regime
Contribution and Results

13. Examine in more details using two policy measures: Fed’s total asset to GDP and FF 12 month futures

14. Fed’s balance sheet shocks seem to have some impacts even after BS

15. Expectations of FF rate hike had few contractionary effects on real economy and inflation

16. Use components of GDP as alternative indicators of real economic activity to discuss possible factors that generate different policy effects

17. FF rate shocks have positive impacts on durables, offsetting negative impacts on non-durables and service
Weale and Wieladek (2016)

1. Examine the impacts of LSAP on real GDP and CPI in UK and US
2. SVAR model consisting of real GDP, CPI, asset purchase announcement, long-term government bond yields, real stock prices
3. Use four identifications to identify a MP shock
4. Asset purchase announcement of 1% of GDP leads to a statistically significant rise of 0.58% and 0.62% rise in real GDP and CPI for the US
For both countries the maximum values for the impact on both GDP and CPI are higher with identification schemes II, III and IV than they are with scheme I. This probably reflects the role that economic theory plays in identifying the effects with these schemes. Averaging across all four schemes, the maximum impact on GDP is 0.58 in the United States and 0.25 in the United Kingdom (Table A1, online Appendix A). The figures for the CPI are 0.62 and 0.32, respectively.

Baumeister and Benati (2013) and Kapetanios et al. (2012) use a conditional forecasting approach to quantify the impact of QE on real GDP and CPI in the US and the UK respectively. Online Appendix B contains the results of a similar exercise (Waggoner and Zha, 1999) which suggest that QE1 raised GDP in the US (UK) by about 2 (4) percentage points at its peak impact; QE2 (QE2/3) added about 6 (4) percentage points. The CPI in the US was increased by an amount similar to the increase in GDP in each case while in the UK both QE1 and QE2/3 raised the CPI by just under 6 percentage points. As discussed in detail below, scaling up the peak impacts derived from the impulse response analysis yields broadly similar numbers.

To relate our multipliers to those presented in previous work, we compare the effects of the US and the UK QE1 implied by the impulse responses in those studies, to the peak impact implied by the impulse responses in this paper. Baumeister and Benati (2013) for the US and Kapetanios et al. (2012) for the UK argue that the first round of asset purchases in the US and the UK led to a fall of about 100 basis points in the spread between the long-term and short-term interest rate. It is then easy to see that the estimates in those papers imply a rise of 1.08 (2.5)% and 0.9 (1.5)% in GDP and CPI in the US (UK), respectively. During QE1, the Federal Reserve and the Bank of England engaged in government bond purchases worth 2% and 14% of annualized 2009Q1 GDP, respectively. Based on the estimates in this paper, this would lead to a rise of 1.12 (3.08)% and 1.2 (4.2)% in US (UK) real GDP and CPI, respectively. When the effect of MBS purchases is included, the estimates for US real GDP and CPI become 1.4 and 1.5. For the UK, the impact on real GDP is slightly higher than previous work, but the...
Weale and Wieladek (2016)

4. Including LSAP1 or not does not change the effectiveness of LSAPs

5. MP shocks have more effects on term spreads than short-term interest rate futures

6. Portfolio rebalancing channel plays a more important role than signaling channel

7. LSAPs reduce the financial market and household uncertainty, possibly affecting on expectations

8. Response of corporate bond spreads is negative but insignificant for two identification schemes

9. Some evidence of risk-taking channel
Weale and Wieladek (2016)

For the UK, however, they suggest that the influence of asset purchases most likely affected GDP and CPI through channels other than the long rate. In online Appendix C we show that our results do not depend on the inclusion of the first round of asset purchases in the data set. Fig. C1 shows results estimated over the period 2010m3–2014m5. This omits the period when the financial crisis was at its most extreme. Our results are not greatly affected, suggesting that the impact of the second and third rounds of purchases in the UK and the US was not very different from the impact of the first round. This suggests that asset purchases did not become less effective over time. Fig. C2 looks at results estimated from 2007m1–2014m5. We now find that the effects on GDP are larger than in Fig. 2A and B. There is no significant effect on CPI in the UK with any of the identification schemes although the median impulse remains positive in all four cases. The inclusion of the UK data before asset purchases were introduced might therefore explain why previous work found a smaller effect on CPI inflation; indeed our estimates (Table C2) for this period imply an inflation/output trade-off of 0.37 rather than the value of 1.3 implied by our main results. This confirms our view that analysis over this extended period may be subject to the Lucas critique: in this case it seems to bias the UK inflation response to unconventional monetary policy to be substantially lower than we find it to be. For the US, Tables C1 and C2 show that the quantitative magnitudes are larger, but the relative impact on output and inflation remains the same as in the baseline case.

In summary, this suggests that the observed differences from previous work arise from both the inclusion of pre-asset purchase data and the difference in identification schemes in the latter. The resulting biases are substantially larger for the UK than the US.
Weale and Wieladek (2016)

Important transmission channels of monetary policy is the management of expectations about future economic outcomes while Boivin et al. (2012) argue that there is empirical support for this view. Expectations management is likely to reduce uncertainty, having effects on demand which do not need to be transmitted through financial markets, although it may reduce market risk premia.

We explore the impact on two measures of financial market uncertainty for that purpose: the implied volatility of the share price index (VIX) and interest rate futures (swaptions) in each country (MOVE). Two of the interpretations taken by previous work are that these measures reflect real economic uncertainty (Bloom, 2009) or investors’ risk appetite (Bruno and Shin, forthcoming).

To disentangle these two different interpretations, household survey measures of uncertainty and the BBB–AAA corporate bond spread into are included as a sixth variable in our VAR model to establish whether there is a significant response to asset purchase shocks. The results are shown in Fig. 5A and B and in Table A4 of online Appendix A.

Fig. 5A and B and Table A4 demonstrate that both the VIX and MOVE show significant movements in the UK, while only MOVE does so in the US. Bloom (2009) argues that the VIX is a reflection of uncertainty. On the other hand, Adrian and Shin (2010), Bruno and Shin (forthcoming) and Miranda-Aggripino and Rey (2013) argue that the VIX is a reflection of investors’ risk appetite. Interestingly, the reaction of household uncertainty over durable purchases suggests that the first interpretation is relevant for both countries. Similarly, the fact that corporate bond spreads react significantly in three of the four identification schemes for the UK only is stronger evidence that the risk-taking channel plays a role in the UK.

3.4. Robustness

We examine the robustness of our results from two perspectives. First, we investigate whether they may be subject to omitted variable bias and then explore whether they are materially affected by the way in which the announcements of asset purchases are defined.

Fig. 5.

(A) Results for the uncertainty channel–United States. This figure shows the response functions of the VIX, the MOVE, a measure of household uncertainty (HHUNC) and the spread between BBB and AAA corporate bonds to an asset purchase shock. Results are shown for the US for each of our four identification schemes. Five hundred simulations were used to generate the responses. The units of the vertical axes are shown for each column, while the horizontal axis indicates the number of monthly time periods since the announcement.

(B) Results for the uncertainty channel–United Kingdom. This figure shows the response functions of the VIX, the MOVE, a measure of household uncertainty (HHUNC) and the spread between BBB and AAA corporate bonds to an asset purchase shock. Results are shown for the UK for each of our four identification schemes. Five hundred simulations were used to generate the responses. The units of the vertical axes are shown for each column, while the horizontal axis indicates the number of monthly time periods since the announcement.
Hesse et al. (2018)

1. Investigate the macroeconomic impact of LSAPs and assess changes in its effectiveness
2. SVAR model with zero and sign restrictions to identify a MP shock
3. LSAP1-2 had significant positive macroeconomic effects, while those of the late ones were weaker
4. Only LSAP1-2 significantly lowered the VIX
5. Positive impact of LSAP on stock prices is significant and persistent throughout the entire programs
Impulse responses to an asset purchase announcement shock (split sample). Programmes median responses with 16th and 84th percentiles error bands. The asset purchase announcement shock is normalized to the size of 1% of annualized Q1 2009 GDP. The sample period for the early programmes runs from 11/2008 to 06/2011 for the United States and from 01/2009 to 06/2011 for the United Kingdom; the sample period for the subsequent programmes runs from 07/2011 to 10/2014 for the United States and to 11/2016 for the United Kingdom.
6. Reduced effectiveness seems to reflect in part better anticipation of LSAPs over time
Benchmark Model

1. Benchmark model is a VAR model based on WW and HHW

\[ Y_t = \alpha + \sum_{k=1}^{L} A_k Y_{t-k} + \varepsilon_t, \quad \varepsilon_t \sim iid \ N(0, \Sigma) \]

2. \( Y_t = (GDP_t, CPI_t, SR_t, R_t, P_t) \)
   
   i. \( GDP_t \): Real GDP
   
   ii. \( CPI_t \): CPI
   
   iii. \( SR_t \): Shadow Rates
   
   iv. \( R_t \): Long-term government bond yields
   
   v. \( P_t \): Real stock prices

3. WW and HHW use cumulative asset purchase announcements (CAPA) divided by a nominal GDP
Benchmark Model

4. CAPA has been constant after Jan 2013

5. Fed set FF rates effectively at zero until Dec 2015 and started raising to normalize MP

6. No single variable can capture USMP btw 2009-18
Benchmark Model

7. SR term structure model (SRTSM) has been developed to overcome the zero lower bound (Ichie and Ueno (2013); Krippner (2013); Bauer and Rudebusch (2016); Wu and Xia (2016))

8. SR can be a measure of the MP stance in zero lower bound environments (Bullard (2012); Krippner (2013); Wu and Xia (2016))

9. SR can capture MP expectation (Bauer and Rudebusch (2016))
10. Use the SR of Wu and Xia (2016) as a single measure of USMP
Markov Switching VAR (MSVAR) Model

1. Impacts of LSAPs may or may not have been changed
   i. WW: Including LSAP1 or not does not change the effectiveness of LSAPs
   ii. HHW: Effects of the late stage of LSAPs was weaker
2. Fed had started MP normalization over the last five years or so
3. Important to consider possible regime changes
4. Employ a Markov switching (MS) model with absorbing states to accommodate possible permanent regime changes
Markov Switching VAR (MSVAR) Model

5. Introduce Markov switching to the benchmark VAR model

\[ Y_t = \alpha(s_t) + \sum_{k=1}^{L} A_k(s_t) Y_{t-k} + \varepsilon_t, \quad \varepsilon_t \sim \text{iid } N(0, \Sigma(s_t)) \]

6. Variance of \( \varepsilon_t \) is also assumed to be regime dependent

7. \( s_t \) describes the regime, following Markov chain (MC)

8. Assume the MC has absorbing states to capture permanent regime changes, given the evolution of USMP over the last decade
9. Example of a transition probability for 3 state MC

\[ P = \begin{bmatrix} p_{11} & 0 & 0 \\ 1 - p_{11} & p_{22} & 0 \\ 0 & 1 - p_{22} & 1 \end{bmatrix} \]

10. Regime can move from 1 to 2 and 2 to 3 with time

11. Can detect two structural changes within the sample period
Identification of MP shocks

1. Closely follow HHW to identify MP shocks
2. Use a combination of zero and sign restrictions
3. Assume that a MP shock has no immediate impact on output and prices
4. Classical assumption used by, for example, Christiano et al. (1999)
5. Contractionary MP shocks increase the SR and long-term bond yields, and reduce real stock prices
6. Similar identification is also used by one of WW’s identifications
7. Sign restrictions are imposed on periods 0 and 1
Data and Estimation

1. Sample period: from Jan 2009 to Sep 2018
2. Monthly GDP data are obtained from Macroeconomic Advisor
3. SR data are taken from Wu’s website
4. Other data are downloaded from FRED
5. $L$ is set to two, following WW and HHW
6. Assume one regime contains at least two years of data
7. All models are estimated by Bayesian Gibbs sampler with diffuse priors
Results of Two Regime Models

1. Smoothed probabilities of regime 2

2. Two regime model detects a regime change around July 2013 immediately after BS
3. Impulse responses to MP shocks in regime 1

- **GDP**
- **CPI**
- **Long Rate**
- **Stock Price**
Results of Two Regime Models

4. Impulse responses to MP shocks in regime 2
Results of Three Regime Models

1. Smoothed probabilities

2. Three regime model detects regime changes around the beginning of 2011 and Jul 2013
Results of Three Regime Models

3. Impulse responses to MP shocks in regime 1

- GDP
- CPI
- Long Rate
- Stock Price
Results of Three Regime Models

4. Impulse responses to MP shocks in regime 2
5. Impulse responses to MP shocks in regime 3
Additional Analysis

1. Analysis based on the SR suggests that there are at least two distinct regimes
   i. LSAP regime: Jan 2009 to Jun 2013
   ii. Normalization regime: July 2013 to Sep 2018

2. SR is used for a proxy of MP instruments for both regimes

3. Instructive to examine each regime using the more direct MP measures
   i. LSAP: AP
   ii. Normalization: AP and FF rates
Results of LSAP Regime

1. Estimate two regime MSVAR model with CAPA/GDP as a MP measure

2. Smoothed probabilities of regime 2

3. Two regime model detects a regime change around the beginning of 2011
Results of Two Regime Models

4. Impulse responses to MP shocks in regime 1
5. Impulse responses to MP shocks in regime 2

**GDP**

**CPI**

**Long Rate**

**Stock Price**
Results of Two Regime Models

6. Impulse responses of GDP components to MP shocks in regime 1
Results of LSAP Regime

7. Impulse responses of GDP components to MP shocks in regime 2
Results of Normalization Regime

1. Estimate 5-variate VAR model with FF rates or total asset to GDP ratio as a MP measure
2. Impulse responses to FF12 rate shocks
3. Impulse responses to AP shocks

- **GDP**
  - Negative responses from periods 3 to 18 with values ranging from -0.16 to 0.

- **CPI**
  - Negative responses from periods 1 to 12 with values ranging from -0.16 to 0.

- **Long Rate**
  - Negative responses from periods 1 to 9 with values ranging from -1.4 to 0.

- **Stock Price**
  - Positive responses from periods 9 to 24 with values ranging from 0.1 to 0.2.
Results of Normalization Regime

4. Impulse responses of GDP components to interest rate shocks
5. Impulse responses of GDP components to AP shocks

- Non-durable
- Service
- Durable
- Capital neworder
Conclusions

1. Empirically assess the macroeconomic effects of LSAPs and normalization of USMP
2. Detect possible regime changes using a Markov switching model and a shadow rate (SR) as a measure of USMP stance
3. Clear evidence of a structural change around BS
4. Another structural change is detected around the beginning of 2011
5. LSAP1 had a solid monetary policy effects on real economy and inflation
6. Late stage of LSAPs had weaker and less persistent impacts
Contribution and Results

7. USMP seems to be less influential after BS
8. USMP normalization had marginal effects on real economy and inflation
9. Fed’s balance sheet shocks had slightly weaker (stronger) effects than during the early (late) stage of the LSAPs
10. Expectations of FF rate hike had few contractionary effects on real economy and inflation
11. FF rate shocks have positive impacts on durables, offsetting negative impacts on non-durables and service


