Chapter 10

OIL PRICE SHOCKS, INFLATION EXPECTATIONS AND MONETARY POLICY: EVIDENCE FROM CHINESE TAIPEI

By
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1. Introduction

For most central banks, maintaining an environment of stable inflation is their key mission. In the formation of inflation, inflation expectations play an essential role. In theory, inflation expectations can influence firms’ wage-price settings and consumers’ spending and saving decisions. In the new Keynesian models, for example, firms adjust prices in response to expected inflation. In reduced form, the new Keynesian Phillips Curve implies that inflation responds approximately one-for-one to shocks to inflation expectations. Therefore, for a central bank to control inflation, the ability to anchor inflation expectations is important, and many studies used this measure to assess the effectiveness of a country’s monetary policy.

Since headline inflation is an aggregate of multiple sectoral prices, it is subject to many temporary shocks (noises). For a central bank, the ultimate goal is to keep underlying inflation, which is trend inflation, at a desired level. Overreactions in monetary policy to temporary shocks to inflation may result in unwarranted fluctuations in economy. Following Bryan and Cecchetti (1994), trend inflation can be thought of as a long-term level that headline inflation will converge to when temporary shocks die out. In this regard, to control trend inflation, anchoring long-term inflation expectations is more relevant than short-term inflation expectations. Yellen (2015) suggested that the stability of trend inflation appeared linked to a change in the behaviour of long-term inflation expectations. Better anchored long-term inflation expectations may reflect an improvement in the conduct of monetary policy.

Many studies examined the anchoring ability of long-term inflation expectations to measure the effectiveness of monetary policy. Bomdirm and Rudebusch (2000); Beechey and Wright (2009); Gurkaynak et al. (2010a); Beechey et al. (2011); and Buono and Formai (2018) assessed the degree of anchoring in developed countries by examining how long-term inflation expectations respond to actual inflation, short-term inflation expectations, and macroeconomic news. For emerging countries, Mehrotra and Yetman (2014) examined long-term inflation expectations of ten Asian countries from 1995 to 2012, among which four of them adopted inflation targeting around the year 2000. They found that while countries experienced a decline in long-term inflation expectations after adopting inflation targeting, long-term inflation expectations in the non-inflation targetters had also fallen and became more tightly anchored since 2000. They also found the degree of anchoring of long-term inflation expectations appeared to be similar for both inflation and non-inflation targeting countries. Filardo and Genberg (2010) examined the dynamics of inflation rates

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and inflation expectations of 12 countries in Asia and the Pacific from 1990 to 2009 and found a common trend of lower and more stable inflation. They also suggested that formal inflation targeting was not the only monetary policy framework capable of delivering price stability. The IMF (2018) found inflation in emerging and developing countries since the mid-2000s has, on average, been low and stable. It suggested changes in longer-term inflation expectations were the main determinant of inflation and it also found that the bulk of improvements in anchoring long-term inflation expectations took place in the 2000s. Based on the findings in the aforementioned studies, inflation targeting should not be the only way to stabilise inflation. Monetary policy that emphasises the importance of inflation stability and communicates with the public with clear and credible procedures should also be able to anchor inflation expectations and lead to a low inflation environment. While the Central Bank of Chinese Taipei (CBCT) does not adopt inflation targeting, stabilising domestic inflation is within its mandates. Hence, it is interesting to examine the degree of long-term inflation expectations anchoring by using data from Chinese Taipei. Particularly, the author would like to investigate whether there is any change in the behaviour of long-term inflation expectations given the common trend of improved inflation performance since the 2000s in Asia found in other studies.

As suggested in the literature, one way to measure the degree of anchoring of long-term inflation expectations is to see how sensitive the expectations are to macroeconomic news (shocks). If the public is clear about the (explicit or implicit) inflation goal of the central bank and believes the central bank would commit to its goal, long-term inflation expectations should not be sensitive to temporary shocks which impact the economy, while short-term inflation expectations may be revised to its persistent nature. Among macroeconomic shocks, global oil prices played a salient role in the literature. A large number of studies suggested that inflation expectations were sensitive to oil price shocks (Harris et al., 2009; Coibon and Gorodnichenko, 2015). Conceptually, to analyse the effects of oil price shocks on actual inflation, most studies divide the impacts into two parts. One is first-round effects, occurring largely through increased energy cost feeding directly into higher input costs. The other is second-round effects, where oil price shocks feed into inflation indirectly through inflation expectations (Blinder and Rudd, 2012). Choi et al. (2017) examined the impacts of global oil prices in 72 advanced and developing countries from 1970 to 2015. They found that factors, such as the inflation targeting regime and the central bank governance index, influenced the degree of oil price pass-through into domestic inflation most significantly. They suggested that the improved conduct of monetary policy over time can result in the reduced impact of oil price shocks. As Choi et al. (2017) mentioned in their study, one important channel through which that monetary policy influences inflation is anchoring inflation expectations. By increasing the credibility of monetary policy, temporary shocks, such as oil price socks, will not lead to a significant change in inflation expectations. However, as they did not explicitly examine the behaviour of inflation expectations, it is still unclear through which channels monetary policy reduced the impacts of oil price shocks.

2. Walsh (2009) suggested a similar point.
3. For example, Mehrotra and Yetman (2014) and IMF (2018) Figure 3.3.
This paper is aimed to fill this gap. First, is to test whether there is any structural change in the behaviour of long-run inflation expectations in Chinese Taipei as what was found in many other countries. Then the sensitivity of inflation expectations to various shocks is examined, and the resulting difference between the sensitivity before and after the structural change is observed. Most importantly, this study examines how the change in the behaviour of long-term inflation expectations influences the pass-through of oil price shocks and whether it implies any change in the conduct of monetary policy.

To analyse the degree of anchoring of long-term inflation expectations and its role in transmitting oil price shocks, a structural vector autoregressive (SVAR) model is used to explore dynamic relationships among inflation expectations, other relevant macroeconomic variables, and global oil prices. The benefit of using SVAR is that a counter-factual analysis can be carried out by shutting down the response of long-term inflation expectation to oil price shocks. By comparing the counter-factual and actual impulse responses, the role of long-term inflation expectations in propagating oil price shocks into inflation can be assessed. As pointed out in Wong (2015), an observation that inflation expectations and inflation co-moving in the same direction after oil price shocks could not support a mechanism through which inflation expectations transmits the oil price shocks into inflation. Using a counter-factual analysis is suitable to disentangle this transmission mechanism.

The rest of the paper is organised as follows. Section 2 discusses the relevant literature and how this study contributes to them. Section 3 presents the data and the SVAR model used in this study. Here, the diagrams of various measures of inflation and inflation expectations are also examined, and the possibility of a structural change in the behaviour of long-term inflation expectations is tested. Section 4 presents the relevant impulse responses and forecast error variance decompositions to examine the degree of anchoring of long-term inflation expectations. Section 5 provides a counter-factual analysis to assess the role of long-term inflation expectations in transmitting oil price shocks. In this section, whether the results of the two sub-samples in the counter-factual analysis imply any change in the conduct of monetary policy is also explored. Section 6 investigates the robustness of these results to alternative SVAR settings. Section 7 concludes the findings of the study.

2. Literature Review

This paper fits in the literature concerning the assessment of the degree of anchoring of inflation expectations and of how the monetary policy framework contributes to it. The literature proposing different approaches in analysing this topic can be separated into two groups in general. Many studies apply event-study or single regression type of analysis, where the left-hand side of the regression is the long-run inflation expectations and the right-hand side is macro-news. However, ignoring the dynamics of long-term inflation expectations and their interdependence with other macroeconomic variables may mislead the conclusion. Thus, a structural vector autoregressive (SVAR) model including inflation expectations and other relevant macroeconomic variables could be an alternative way to complement the above approach.
Davis (2014), Chang (2014) and Wong (2015) are the studies most relevant to this paper. Davis (2014) used survey data across 36 developed and developing countries from 1990 to 2011 in a SVAR setting to examine whether the adoption of inflation targeting had helped to anchor inflation expectations. He showed that there was a major change in the behaviour of short-term (12-month ahead) inflation expectations between the pre-2000 period and the post-2000 period for countries adopting inflation targeting around the year 2000, but there was no similar change for countries not adopting inflation targeting. He explained that by adopting inflation targeting, a central bank can enhance its transparency, credibility, and communication with the public and therefore can better anchor inflation expectations. However, the author did not include long-term inflation expectations in his analysis. As mentioned in the introduction, to assess the extent of inflation expectations anchoring, long-term inflation expectations which are closely related to the target of central banks, should be more relevant than short-term inflation expectations. His study did not discuss the role of inflation expectations in transmitting oil price shocks, either. Chang (2014) used data for Chinese Taipei from Consensus Forecasts to examine the dynamics of short-term (12-month ahead) inflation expectations with other macroeconomic variables in a SVAR setting. Unlike Davis (2014), the sample period covered in this study is from Jan. 2003 to May 2013. However, without covering the period before the early 2000s, it may be difficult to detect significant changes in the behaviour of inflation expectations, given that most studies found the changes in inflation expectations anchoring occurred around the year 2000. Moreover, this paper focuses on understanding the interactions among all the variables included in the model and does not emphasise the extent of inflation expectations anchoring. Wong (2015) only included three variables (i.e. oil prices, inflation expectation (long-run or short-run), and headline inflation) in his SVAR setting to analyse the behaviour of inflation expectations. As argued in Banbura, Giannone and Reichlin (2010), a large number of variables should be included in a VAR model because including too few variables risks omitting important variables and may lead to a problematic analysis. In addition to the differences in SVAR setting and the sample period covered, another contribution of this paper is the empirical investigation of the behaviour of monetary policy in affecting the role of inflation expectations in transmitting oil price shocks. Unlike Wong (2015) who was unable to provide evidences about monetary policy reactions explicitly from the model, the inclusion of policy rate (and other policy-related variables) in the SVAR setting provides more information about monetary policy.

3. Data and Model Specification

3.1 Inflation, Inflation Expectations and Global Oil Prices

Figure 1 provides an overview of the historical diagrams of various inflation rates, inflation expectations, and global oil prices (Brent oil) from Oct.1995 to Jul. 2018. The inflation expectations data used in this study are from the Consensus Forecasts since it is the only available source that provides long-term inflation expectations for Chinese Taipei. The upper panel presents the dynamics of headline inflation,\(^4\) core inflation (excluding fresh vegetables, fruit, and energy prices), and trend inflation.\(^5\) The middle panel shows the dynamics of long-term (10-year ahead) and short-term (1-

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\(^4\) Defined as year-on-year changes of non-seasonal adjusted monthly consumer price index (CPI).

\(^5\) Estimated by the method from Chan, Clark, and Koop (2018). Rather than just equaling the trend inflation with the long-term inflation expectations, their model allowed for the estimation of the link between trend inflation and the long-run forecast, which is helpful in fitting and forecasting inflation. The estimation model is provided in Appendix 1. Please see Chan, Clark, and Koop (2018) for details.
year ahead) inflation expectations. The lower panel shows historical Brent oil prices per barrel in US dollars. While headline inflation was very volatile as expected, core inflation also showed great fluctuations. Trend inflation was smoother and was about 2.3% in 1995, later declining to 1.5% around 2000 and then moving between 1% and 1.5% hereafter. In general, the long-term inflation expectation co-moved well with trend inflation, whereas the short-term inflation expectation deviations more.

**Figure 1**

**Inflation, Inflation Expectations, and Oil Prices**

![Graph showing inflation, inflation expectations, and oil prices over time.](image)
As stated in the introduction, many studies found the dynamics of inflation and long-term inflation expectation in the Asia-Pacific region to have declined, and this change was not subject to central banks adopting inflation targeting. In general, trend inflation in Chinese Taipei also showed a downward trend from 1995 to the early 2000s and stayed stable thereafter. It is therefore reasonable to suspect that the behaviour of long-run inflation expectations in Chinese Taipei had changed around the early 2000s. Unlike some studies which simply divided samples into two parts based on the periods before and after the year 2000, this study conducts a structural break test as a preliminary examination on long-term inflation expectations. The purpose of conducting a structural break test is to decide sub-samples for the following analysis, and it does not imply that a dramatic change is expected in the behaviour of long-term inflation expectations at certain points.6

To examine the possibility of a structural change in the long-term inflation expectation without specifying a possible structural change in certain statistical characteristic, a linear regression model is first estimated to explain the behaviour of long-term inflation expectation and an OLS-based CUSUM structural break test7 is applied on it. Based on Clark and Davig (2011) and Sousa and Yetman (2016), seven variables, including trend inflation, actual inflation (headline inflation), short-term inflation expectation, change in oil price, change in output8, change in nominal effective exchange rate (NEER), and one period lag of long-term inflation expectation, are chosen as regressors in the regression. Using OLS-based CUSUM structural break test, the null hypothesis of no structure break is rejected significantly and the estimated structural change point is Oct. 2003. Figure 2 shows the OLS-based CUSUM test with 0.05 confidence level. To better understand the possible source of this structure change, using the model from Chan, Clark, and Koop (2018)9 to estimate the dynamic properties of trend inflation, which is closely linked to the long-term inflation rate, may give us some hints. Based on the estimated trend inflation and the parameter, λn, which controls the value of stochastic volatility of trend inflation10 (Figure 3), it is obvious that both the

6. Unlike some economies in the Asia-Pacific region, which adopted inflation targeting around the year 2000, the Central Bank of Chinese Taipei does not change its official monetary policy framework. It is therefore unlikely to have a dramatic change in the behaviour of long-term inflation expectations. Meanwhile, as it is stated in Yallen (2015), even if central banks change their monetary policy frameworks or announce an inflation target, inflation expectations would be affected only after the central bank has had sufficient time to demonstrate its sustained commitment—a process that might take years, based on the U.S. experience.

7. The CUSUM-type tests are used to assess the stability of coefficients (β) in a multiple linear regression model of the form y = Xβ+ε. Inference is based on cumulative sums, or cusums, of residual resulting from recursive regressions. Values of the sequence outside an expected range suggest structural change in the model over time.

8. Throughout this study, the author uses the detrended coincident indicator to represent output. Following Clark and Davig (2011) who use the Chicago Fed National Activity Index (CFNAI) because of its broad coverage, strong contemporaneous correlation to real output and reduced data revision issues, the author uses the detrended coincident indicator, which closely co-moves with the business cycle of Chinese Taipei to measure border coverage of output. The detrended coincident index is a weighted average indicator that is composed of seven time-series variables, including the industrial production index, electric power consumption, the index of producer’s shipment for manufacturing, sales of trade and food services, non-agricultural employment, customs-cleared exports, and imports of machineries and electrical equipments.


10 λn controls the magnitude of stochastic volatility of trend inflation. The bigger the λn, the larger the stochastic volatility of trend inflation.
level and the volatility of trend inflation were on a downtrend from 1995 to 2003 and stayed more stable hereafter. Thus, given the close link between long-term inflation expectations and trend inflation, it was likely that the mean and volatility of long-term inflation expectations moved to a lower and more stable regime after 2003 as well.

**Figure 2**

OLS-based CUSUM test

**Figure 3**

Trend Inflation
Then, the same set of variables is used and the discount rate as the policy rate is included to estimate an SVAR model to describe the dynamic relationships between inflation expectations and other macroeconomic variables. The whole sample observations are monthly data from Oct. 1995 to Jul. 2018, and the sample before and after Oct. 2003 is used to decide the sub-samples. The data sources and data handling are presented in Appendix Table A1. Unit root test for each variable is provided in Appendix Table A2 to ensure stationarity of the SVAR system. Figure 4 gives an overview of the dynamics of all the data.

Figure 4
Data in the SVAR Model
Given that global oil prices should be predetermined and the setting in Clark and Davig (2011)\(^\text{11}\) are followed, short-run recursive restrictions are used to identify structural shocks and order variables in the SVAR model with the constant suppressed as follows:

\[ A_0 y_t = \sum_{i=1}^{P} A_i y_{t-i} + \varepsilon_t, \text{Var}(\varepsilon_t) = I_7 \]  

(1)

where \( y_t = [P_t, \pi_{t,\text{L}}, \pi_{t,\text{S}}, \pi_t, a_t, EX_t, R_t]' \) consists of the difference in natural log of oil price \((P_t)\), long-term inflation expectations\(^\text{12}\) \((\pi_{t,\text{L}})\), short-term inflation expectations \((\pi_{t,\text{S}})\), the headline CPI inflation rate \((\pi_t)\), the difference in natural log of output\(^\text{13}\) \((a_t)\), the difference in natural log of NEER \((EX_t)\), and the discount rate \((R_t)\). Using BIC inflation criteria to choose the number of lag terms, the model is estimated with 2 lags for both sub-samples.

4. Impulse Responses

To examine the degree of anchoring of long-term inflation expectations, the estimates of a set of impulse responses of long-term inflation expectations to all the structural shocks in the model over the two sub-samples are presented. If the public is clear about the central bank’s goal (explicit or implicit), and believes the central bank intends to fulfill it, long-term inflation expectations should be well-anchored and should not be sensitive to temporary economic shocks. Further, the persistence of responses is also related to how clear or confident the public is concerning the central bank’s objectives. As suggested in Moreno and Villar (2010), if the public is clear about the goal of the central bank, they would find it easier to disentangle whether a given shock (for example, a surprise outcome of actual inflation) reflects a shift in the inflation target or just a transitory disturbance. Therefore, a transitory shock should not have persistent impacts on inflation expectations if the monetary policy framework is transparent and credible, and long-term inflation expectations are well-anchored. The impulse responses trace out the average effect of a hypothetical one-time structural shock. Here, the responses to 1% of various structural shocks for 60 periods with 90% confidence intervals are calculated. Figure 5 presents the results. The left panel is the impulse responses estimated with the first sub-sample (from Oct. 1995 to Oct. 2003), whereas the right panel is the responses estimated with the second sub-sample (from Nov. 2003 to Jul. 2018).

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\(^{11}\) As it was explained in Clark and Davig (2011), the official release of monthly inflation data is delayed for one month, which means survey respondents do not have current inflation data within the month they are submitting their forecasts. Long-term expectations are ordered before short-term expectations since a respondent usually will also revise his short-term forecast when revising his long-term forecast, but not vice versa. This argument is supported by the fact that long-term forecasts are less frequently revised compared to short-term forecasts in Consensus Forecasts. The discount rate is ordered last since the central bank is likely to adjust the rate in response to movements in observable data.

\(^{12}\) Throughout this study, 10-year ahead inflation expectation and 1-year ahead inflation expectation from Consensus Forecasts are used to represent long-term and short-term inflation expectations.

\(^{13}\) Based on the same argument as Note 4, the detrended Coincident indicator to represent output is used.
Figure 5
Impulse Responses of Long-term Inflation Expectations to Various Structural Shocks

The solid black lines represent the responses of long-term inflation expectations to 1% of various structural shocks for 60 periods with a 90% confidence interval (the dotted blue lines) constructed using bootstraps.
In the first sub-sample, the responses of long-term inflation expectations to short-term inflation expectations shocks are significant and very persistent compared to those in the second sub-sample. This means that variations in short-term inflation expectations can spill over to long-term inflation expectations and cause persistent changes in the long-term inflation expectations in the first sub-sample, which is an important source of de-anchoring (Jochmann et al., 2010). However, this spillover effect becomes smaller and insignificant in the second sub-sample. For oil price shocks and headline inflation shocks, the responses become smaller in magnitude in the second sub-sample, though being insignificant in both sub-samples. Long-term inflation expectations are also significantly sensitive to the output shocks. The impacts are very persistent. Since long-term inflation expectations can be interpreted as the perceived inflation target of the central bank (Yellen 2015), this result may indicate that the public thinks the central bank would like to partially accommodate any surprise from output and thus adjust its target. However, in the second sub-sample, impacts from output shocks become insignificant and less persistent, which can be another evidence of better anchored long-term inflation expectations. Other than short-term inflation expectations shocks and output shocks, long-term inflation expectations are also sensitive to their own shocks, which can be seen as to how the public adjusts their expectations about the central bank’s inflation target on the impacts of target shocks.

On the other hand, though short-term inflation expectations are intrinsically more sensitive to temporary economic disturbances, the persistence of their responses should also be related to how clear the public is about the objective of the central bank. Figure 6 presents the impulse responses of short-term inflation expectations, where the left panel is the estimates of the first sub-sample, and the right panel is the estimates of the second sub-sample. In the first sub-sample, the responses of short-term inflation expectations are only persistent to oil price shocks, output shocks, and shocks from short-term inflation expectations. Impacts from oil price shocks are not significant.

In the second sub-sample, the responses of short-term inflation expectations to all the shocks, except long-term inflation expectations shocks, become less persistent, but more significant at the initial stage. The impacts of long-term inflation expectations shocks may reflect that the public’s short-term inflation expectations are more likely to be affected by the news about central bank’s target but with a one-year delay. The above impulse response results show that long-term inflation expectations become less sensitive to macro-news and more sensitive to changes in perceived inflation targets. For short-term inflation expectations, though they are more sensitive to macro-news as expected, most of the impacts become less persistent in the second sub-sample. These results support a more credible monetary policy and better anchored long-term inflation expectations.
Figure 6
Impulse Responses of Short-term Inflation Expectations to Various Shocks

The black solid lines represent the responses of short-term inflation expectations to 1% of various structural shocks for 60 periods with a 90% confidence interval (the dotted blue lines) constructed using bootstraps.
4.1 Variance Decomposition

The forecast error variance decompositions that measure the extent of seven structural shocks explaining the variability of long-term inflation expectations on average are also examined. Table 1 presents the results, where the upper panel shows the results from the first sub-sample, and the lower panel displays the results from the second sub-sample.

Comparing the two sub-samples, the major differences are in the extent of long-term inflation expectation shocks, short-term inflation expectation shocks, and output shocks to explain the variation of long-term inflation expectations. In the first sub-sample, more than 60% of the variation in long-term inflation expectations is driven by their own shocks until the first year, but the share declined over time and is reduced to about 30% after three years. In contrast, short-term inflation expectation shocks explain 20% of the variation until one year and then the share increases to about 35% after three years. Output shocks explain 25% of total variation after three years. However, in the second sub-sample, more than 90% of the variation is driven by shocks from long-term inflation expectation shocks, and the influences are very stable over time. All the other structural shocks contribute to trivial portions of total variation. This result also shows that long-term inflation expectations are better anchored in the latter sub-sample period. The significant share made up by output shocks in the first sub-sample is consistent with the results from Figure 5, where output shocks have significant and persistent impacts on long-term inflation expectations. Davis (2014) provided a model with a similar idea to explain the high volatility of long-term inflation expectations in the U.S in the early 1980s, when the public was unsure about the central bank’s commitment to its target. The higher volatility territory in trend inflation of Chinese Taipei in the first sub-sample (Figure 3) is consistent with the argument made by Davis (2014).

Table 1
Variance Decomposition of Long-term Inflation Expectation (%)

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Oil Price</th>
<th>Long-term Inflation E</th>
<th>Short-term Inflation E</th>
<th>Headline Inflation</th>
<th>Output</th>
<th>NEER</th>
<th>Discount Rate</th>
</tr>
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<td>1.39</td>
<td>63.17</td>
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<td>0.94</td>
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<td>60</td>
<td>4.01</td>
<td>28.55</td>
<td>39.28</td>
<td>0.81</td>
<td>26.18</td>
<td>1.02</td>
<td>0.14</td>
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</table>

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Oil Price</th>
<th>Long-term Inflation E</th>
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<th>Output</th>
<th>NEER</th>
<th>Discount Rate</th>
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<td>2.8</td>
<td>0.42</td>
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</table>
5. Oil Price Shocks and Monetary Policy

5.1 Counter-factual Analysis of Oil Price Shocks

In Section 4, evidence from the impulse responses and forecast error variance decompositions supports the idea that the ability to anchor long-term inflation expectations has improved. As mentioned in the introduction, one channel through which oil price shocks pass through into inflation is influencing inflation expectations. Therefore, it will be interesting to investigate how changes in the behaviour of long-term inflation expectations affect the impacts of oil price shocks on headline inflation. To disentangle this mechanism, a counter-factual analysis is conducted by shutting down the response of long-term inflation expectations to 1% of oil price shocks and the consequent responses of short-term inflation expectations and headline inflation are examined. Following Wong (2015) and Kilian and Lewis (2011), to constrain the response of long-term inflation expectations, a sequence of long-term inflation expectation shocks just large enough to mute out the responses of long-term inflation expectations to oil price shocks is generated. The details describing the procedures of this counter-factual experiment are provided in Appendix 2.

Figure 7 represents the counter-factual results from SVAR models. The left panel is the counter-factual analysis for the first sub-sample, whereas the right panel is for the second sub-sample. The dashed red lines represent the counter-factual impulse responses caused by the shutdown of the responses of long-term inflation expectations to 1% of oil price shocks, whereas the solid black lines represent the actual impulse responses. The dotted blue lines are one standard error bands. In the first sub-sample, examining the degree of the passing-through of oil price shocks into headline inflation by shutting down the channel of long-term inflation expectations (i.e. the response of long-term inflation expectations to 1% of oil price shocks is zero), it is found that short-term inflation expectations fall from about -0.002% to about -0.003% three years after the oil price shocks. However, the decline in the responses of short-term inflation expectations is more related to the counter-factual responses of the discount rate and output, which increases mildly and decreases marginally, respectively, in response to the counter-factual response of long-term inflation expectations. Consequently, the responses of headline inflation change from -0.002% to -0.005%. It shows that a significant second-round effect of oil price shocks driven by short-term inflation expectations is mitigated indirectly by the shutdown of the responses of long-term inflation expectations.

Turning to the second sub-sample, it is notable that under the actual impulse responses, compared to that in the first sub-sample, the response of long-term inflation expectations is smaller and not significant. Shutting down the response of long-term inflation expectations does not lead to any significant changes in the responses of other variables. Overall, there is no significant difference between the counter-factual and actual impulse responses both in short-term inflation expectations and in headline inflation. This result suggests a weaker role of long-term inflation expectations in affecting the responses of short-term inflation expectations and thus the responses of headline inflation to oil price shocks. After all, long-term inflation expectations are less sensitive to oil price shocks in the second sub-sample under the actual impulse responses.

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14. The more significant second-round effect with the short-term inflation expectation, but not with long-term inflation expectation, is consistent with the evidence that shorter term inflation expectations are more important in determining headline inflation (Fuher 2011; Fuher et. al. 2012; Chang 2014; Wong 2015).
Figure 7
Actual and Counter-factual Impulse Responses to 1% of Oil Price Shocks

The solid black lines represent the actual impulse responses to 1% of oil price shocks. The dotted blue lines are the one standard error band of the actual impulse responses. The dashed red lines are the counter-factual impulse responses.
5.2 The Stances of Monetary Policy

The breakdown of transmission from inflation expectations to headline inflation was also found in the post-1990 sample period in Wong (2015). He provided two possible explanations. One was through the price and wage setting channel. When the economy was in a very low and stable inflation environment, it was costly to change prices (Ball, Mankiw, and Romer, 1998; Akerlof, Dickens, and Perry, 2000), which might have caused the influence of inflation expectations on actual price inflation to become less pronounced. Figure 3 demonstrates that trend inflation in Chinese Taipei after 2003 became lower and more stable. This could represent a low inflation environment where the role of inflation expectations in transmitting shocks to actual prices became insignificant. Another possible interpretation provided by Wong (2015) was related to the role of monetary policy. As he suggested, if monetary policy placed more weight on targeting inflation, inflation expectations would be better anchored. In the related literatures, a number of papers showed that the effect of transitory oil price shocks had diminished over time and went on to argue that one of the reasons for this change was the improved monetary policy (e.g., Blanchard and Gali, 2007; Leduc, Sill and Stark, 2007; Mehra and Herrington, 2008; Blanchard and Riggi, 2009; Evans and Fisher, 2011).

To investigate the role of monetary policy in the impacts of oil price shocks, the impulse responses of the discount rate to oil price shocks are decomposed to understand the percentage contributions of seven structural shocks in the SAVR.\textsuperscript{15} Figure 8 illustrates the results, where the upper and lower panels present the results of the first and second sub-samples, respectively. To improve the readability, the contributions of seven structural shocks are divided into two charts (left and right charts). In each chart, the dashed black line represents total impulse responses of the discount rate.

\textbf{Figure 8}
Decomposition of the Response of the Discount Rate to 1\% of Oil Price Shocks

\textsuperscript{15} Detailed procedures are provided in Appendix 3.
In both sub-samples, the discount is raised substantially for the first 3 months in response to the oil price shocks, whereas it is lowered for the first 12 months in response to the declines in output triggered by oil price shocks. However, in the first sub-sample, the discount rate nearly only responds to output dynamics and the discount rate’s own lags. Its direct responses to oil prices almost vanished after the first 3 months, and it hardly reacts to headline inflation, long-term and short-term inflation expectations, and NEER at all horizons. In the second sub-sample, while most of the responses of the discount rate are on account of output dynamics and the discount rate’s own lags, its direct responses to oil prices last around 2 years with small magnitude. More importantly, unlike that in the first sub-sample, the discount rate responds more to the dynamics of short-term inflation expectations and headline inflation in the second sub-sample. A larger portion of the discount rate’s responses is accounted for by short-term inflation expectation dynamics with expected sign. This finding supports the idea that monetary policy becomes more aggressive in the battle against inflation and is also more forward-looking than before.

Regarding the role of short-term inflation expectations in monetary policy found above, an interesting question is how different it would be if monetary policy does not respond directly to short-term inflation expectation dynamics. To answer this question, another counter-factual analysis is conducted by shutting down the direct responses of the discount rate to short-term inflation expectation dynamics triggered by oil price shocks. Figure 9 presents the results, where the left and right panels represent the estimates in the first and the second sub-samples, respectively.

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16. The contribution of headline inflation is much smaller and less persistent than that of short-term inflation expectations in the decomposition of the discount rate’s responses, so it is not considered here.
Figure 9
Actual and Counter-factual Impulse Responses to 1% of Oil Price Shock

The solid black lines represent the actual impulse responses to 1% of oil price shocks. The dotted blue lines are the one standard error band of the actual impulse responses. The dashed red lines are the counter-factual impulse responses.
In the first sub-sample, within the first year after oil price shocks, even though short-term inflation expectations drop significantly, there is almost no difference between the actual and counter-factual responses of the discount rate. The responses of the discount rate start to decrease to a lesser extent after the first year, and the gap between the counter-factual and actual impulse responses expands gradually and becomes stable three years after the shocks. However, the change in the responses of the discount rate, though not significant, has nearly no impact on the responses of other variables. In the second sub-sample, given substantial increases in short-term inflation expectations in response to oil price shocks, under the counter-factual analysis, the response of the discount rate decreases significantly compared to the actual analysis within the first year. The decrease in the responses of the discount rate causes the responses of output to decline to a lesser extent (though probably not significant). For other variables, changes in their impulse responses are marginal. While the results from this counter-factual analysis do not show much difference in the responses of other variables under the alternative monetary policy, the more significant and timely changes (with expected sign) in the responses of the discount rate do support a more aggressive monetary policy stance in fighting inflation in the second sub-sample. This also supports the explanation that the improved conduct of monetary policy contributes to better anchored long-term inflation expectations in the second sub-sample found in Section 4.

Another way to examine the stance of monetary policy is to see, on average, what factors drive the dynamics of the discount rate. Table 2 presents the variance decomposition of the discount rate under the two sub-samples. In the first sub-sample, most of the variations of the discount rate are driven by output shocks and the discount rate’s own shocks. Inflation related variables contribute to trivial portions of total variation. On the other hand, in the second sub-sample, inflation related variables, especially long-term inflation expectations, explain a larger portion of the discount rate variations. The contribution of the discount rate’s own shocks decreases remarkably, which can also support the improvements of monetary policy. As suggested by Clark and Davig (2011), a monetary policy that responds more systematically to macroeconomic developments and is less reflective of idiosyncratic changes in the discount rate can better anchor long-term inflation rates since it can provide a better understood mapping between observable macroeconomic data and the discount rate, a factor that could help the public form long-term inflation expectations.

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17. In the actual analysis, short-term inflation expectations decrease in response to oil price shocks. Shutting down their direct impacts on the discount rate causes the discount rate to decrease to a lesser degree in the counter-factual analysis.

18. Given the counter-factual analysis in Figure 5, the increase in short-term inflation expectations is directly triggered by oil price shocks and has not much to do with long-term inflation expectations.

19. If the public anticipates the central bank to respond aggressively to inflationary shocks, they may assume the effects of these shocks will dissipate sooner and set prices accordingly. As a result, inflation expectations will be less responsive to transitory shocks (Davig and Doh, 2014).

20. As explained by Clark and Davig (2011), a more systematic monetary policy could provide a better understood mapping between observable macroeconomic data and the discount rate, a factor that could help the public form long-term inflation expectations.
Table 2
Variance Decomposition of the Discount Rate (%)

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Oil Price</th>
<th>Long-term Inflation E</th>
<th>Short-term Inflation E</th>
<th>Headline Inflation</th>
<th>Output</th>
<th>NEER</th>
<th>Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>3.07</td>
<td>2.26</td>
<td>1.96</td>
<td>0.7</td>
<td>30.19</td>
<td>0.27</td>
<td>61.55</td>
</tr>
<tr>
<td>24</td>
<td>2.4</td>
<td>1.21</td>
<td>4.86</td>
<td>0.54</td>
<td>42.93</td>
<td>0.41</td>
<td>47.66</td>
</tr>
<tr>
<td>36</td>
<td>2.21</td>
<td>0.93</td>
<td>10.89</td>
<td>0.38</td>
<td>45.21</td>
<td>0.28</td>
<td>40.1</td>
</tr>
<tr>
<td>60</td>
<td>2.58</td>
<td>0.73</td>
<td>20.1</td>
<td>0.24</td>
<td>47.05</td>
<td>0.2</td>
<td>29.1</td>
</tr>
</tbody>
</table>

The Second Sub-sample

<table>
<thead>
<tr>
<th>Horizon</th>
<th>Oil Price</th>
<th>Long-term Inflation E</th>
<th>Short-term Inflation E</th>
<th>Headline Inflation</th>
<th>Output</th>
<th>NEER</th>
<th>Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>9.63</td>
<td>16.23</td>
<td>4.03</td>
<td>1.29</td>
<td>38.9</td>
<td>1.8</td>
<td>28.12</td>
</tr>
<tr>
<td>24</td>
<td>4.18</td>
<td>54.73</td>
<td>1.84</td>
<td>0.73</td>
<td>20.31</td>
<td>1.48</td>
<td>16.74</td>
</tr>
<tr>
<td>36</td>
<td>3.31</td>
<td>63.39</td>
<td>1.49</td>
<td>0.71</td>
<td>16.9</td>
<td>1.31</td>
<td>12.89</td>
</tr>
<tr>
<td>60</td>
<td>3.11</td>
<td>66.26</td>
<td>1.39</td>
<td>0.8</td>
<td>15.36</td>
<td>1.27</td>
<td>11.81</td>
</tr>
</tbody>
</table>

6. Robustness Test

To investigate the robustness of these results, the sensitivity of these results to two alternative short-term recursive identification schemes is first tested. One is interchanging the order between inflation expectations and headline inflation, which means instead of ordering inflation expectations before headline inflation, the headline inflation is ordered before inflation expectations. The other ordering scheme is that since most studies considered the currency market as the most efficient market, any changes in economy should be reflected in the currency market immediately. In this regard, alternatively the NEER is ordered as the last variable in the SVAR ordering. The fourth and fifth SVAR settings examined are related to the variable representing the CBCT’s monetary policy instrument. In fact, the official monetary policy intermediate target is M2 growth; however, Chen and Wu (2010) argued that it was more likely that the CBCT had switched to use the discount rate as the policy rate to achieve its final targets since 1998. Similarly, many studies focused on estimating an interest rate reaction function of monetary policy in Chinese Taipei by using (interbank) overnight rate as the policy rate. Therefore, the M2 growth rate and the overnight rate are used, respectively, to replace the discount rate as the policy rate of CBC. Table 3 explains the differences among alternative SVAR settings, whereas the resulting figures and tables for alternative

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21. The order between long-term inflation expectation and short-term inflation expectation should not be altered.
22. The final goals (mandates) of the CBCT are maintaining price stability, promoting financial system soundness, and fostering economic growth.
SVAR settings are presented in the appendix. Overall, the results under four alternative SVAR settings are very similar, which proves the robustness of the current results.

### Table 3
Alternatives SVAR Settings

<table>
<thead>
<tr>
<th>Model</th>
<th>Differences in SVAR setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>SVAR 1</td>
<td>The main SVAR setting of current study</td>
</tr>
<tr>
<td>SVAR 2</td>
<td>Interchange the order of inflation expectations and headline inflation</td>
</tr>
<tr>
<td>SVAR 3</td>
<td>Order the NEER as the last variable in the SVAR</td>
</tr>
<tr>
<td>SVAR 4</td>
<td>Replace the policy rate (the discount rate in SVAR 1) with the M2 growth rate²⁴</td>
</tr>
<tr>
<td>SVAR 5</td>
<td>Replace the policy rate (the discount rate in SVAR 1) with the overnight rate</td>
</tr>
</tbody>
</table>

7. Conclusion

Though the monetary policy framework of the CBCT is not inflation targeting, long-term inflation expectations of Chinese Taipei have also been within the downtrend commonly seen across emerging and developing economies, especially in Asia, since the late 1990s. By examining the sensitivity of long-term inflation expectations to various macro-news in an SVAR framework, it is found that the degree of anchoring of long-term inflation expectations has improved since the early 2000s. Particularly, for global oil price shocks, while there are significant second-round effects indirectly affected by long-term inflation expectations before the early 2000s, the counter-factual analysis shows that better-anchored long-term inflation expectations, found after the early 2000s, have little to do with the actual inflation outcome in the latter sub-sample. This phenomenon is consistent with Wong’s (2015) explanation of a lower inflation and improved monetary policy environment, which is supported by the finding of this study through exploring the role of monetary policy.

In line with the theory and the empirical literature, the more aggressive policy stance of the CBCT in fighting inflation and the more systematic responses of its monetary policy to macroeconomic developments can contribute to better-anchored long-term inflation expectations. As implied from the theory and suggested by the IMF (2018), well-anchored inflation expectations can significantly improve economic resilience to external shocks, such as global oil price shocks or currency depreciation shocks, which are particularly challenging for emerging economies. Therefore, improving the extent of inflation expectations anchoring by increasing the credibility and transparency of monetary policy is helpful for central banks not only to stabilise inflation, but also to focus on smoothing output. Given that Chinese Taipei is a small open economy and relying on imported oil and commodities, improving the extent of inflation expectations anchoring is essential for the CBCT.

²³ Figures A1.1.1-2, A1.2.1-2, A1.3.1-2, and A1.4.1-2 provide the impulse responses of long-term inflation expectations and short-term inflation expectations under SVAR 2, SVAR 3, SVAR 4, and SVAR 5 settings, respectively. Figures A2.1, A2.2, A2.3, and A2.4 present the counter-factual impulse responses to 1% of oil price shocks by the shutdown of the response of long-term inflation expectations under SVAR 2, SVAR 3, SVAR 4, and SVAR 5 setting, respectively.

²⁴ Since M2 growth can only possible be the CBCT’s policy rate till late 1990s, the author only estimated SVAR 4 in the first sub-sample and compared it to that of SVAR 1 in the first sub-sample.
References


Appendix 1

Chan, Clark, and Koop (2018) developed a bivariate model of inflation and a survey-based long-run forecast of inflation that allows for the estimation of the link between trend inflation and the long-run forecast. The following is the baseline model (M1) presented in their paper:

\[
\begin{align*}
\pi_t - \pi^*_t &= b_t(\pi_{t-1} - \pi^*_{t-1}) + v_t, \\
zt &= d_0t + d_1t\pi^*_t + \varepsilon_{zt,t} + \varphi\varepsilon_{zt-1}, \quad \varepsilon_{zt,t} \sim N(0, \sigma^2_z) \\
\pi^*_t &= \pi^*_{t-1} + n_t, \\
b_t &= b_{t-1} + \varepsilon_{b,t}, \\
d_{it} - \mu_{di} &= \rho_{di}(d_{i,t-1} - \mu_{di}) + \varepsilon_{di,t}, \varepsilon_{di,t} \sim N(0, \sigma^2_{di}), i = 0,1, \\
v_t &= \lambda^{0.5}_{vt}v_{vt,t}, \varepsilon_{vt,t} \sim N(0,1), \\
n_t &= \lambda^{0.5}_{nt}n_{nt,t}, \varepsilon_{nt,t} \sim N(0,1), \\
\log(\lambda_{i,t}) &= \log(\lambda_{i,t-1}) + v_{i,t}, v_{i,t} \sim N(0, \varphi_i), i = v, n,
\end{align*}
\]

where \(\pi_t\) is the headline inflation rate, \(\pi^*_t\) is trend inflation, and \(z_t\) is survey-based long-run inflation expectations. The stochastic volatility is controlled by the Equations (A6) and (A7) for inflation gap and trend inflation, respectively.
Appendix 2

Following Wong (2015), to construct a counter-factual analysis by shutting down the responses of long-term inflation expectations, Equation (1) is first defined in companion form,

\[ A_0 y_t = \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t, \]

\[ y_t = \sum_{i=1}^{p} A_0^{-1} A_i y_{t-i} + A_0^{-1} \varepsilon_t, \]

\[ X_t = \Lambda X_{t-1} + \nu_t, \]

where,

\[ X_t = \begin{pmatrix} y_t \\ y_{t-1} \\ \vdots \\ y_{t-p+1} \end{pmatrix}, \Lambda = \begin{pmatrix} A_0^{-1} A_1 & \cdots & A_0^{-1} A_p \\ \vdots & \ddots & \vdots \\ 0 & \cdots & 0 \end{pmatrix}, \nu_t = \begin{pmatrix} A_0^{-1} \varepsilon_t \\ 0 \\ \vdots \\ 0 \end{pmatrix} \quad \text{(A9)} \]

Let \( EE(\nu_t|\nu_t) = \Omega \). I define \( A_0^{-1} = chol(\Omega) \) and \( e_j \) as a selector row vector with 1 as the \( j \)th element and 0 elsewhere. The impulse response function of variable \( j \) to 1% of oil price shocks at horizon \( k \), \( \Psi_f^k \), is:

\[ \Psi_f^k = e_j \Lambda^k \zeta, \]

where,

\[ \zeta = A_0^{-1} e'_2 = A_0^{-1} e_2'. \quad \text{(A10)} \]

To construct a sequence of long-term inflation expectation structural shocks, \( \hat{\varepsilon}_f^n \), to offset the responses of long-term inflation expectations to 1% of oil price shocks for \( k \) periods means to solve a sequence of shocks so that \( \Psi_f^k = 0, k \in N \). It requires:

\[ e_2 \zeta + e_2 A_0^{-1} e_2' \hat{\varepsilon}_f^n = 0. \]

It means \( \hat{\varepsilon}_f^n = -\frac{e_2 \zeta}{e_2 A_0^{-1} e_2'} \). The rest of the sequence can be calculated recursively through:

\[ \hat{\varepsilon}_f^n = \frac{-\Psi_f^k - \sum_{n=0}^{k-1} e_2 A_0^{-1} e_2' \hat{\varepsilon}_f^n}{e_2 A_0^{-1} e_2'}, k \in N. \]

The counter-factual impulse response function for all variables to 1% of oil price shocks with long-term inflation expectations held fixed, \( \tilde{\Psi}_f^k \), can be computed as:

\[ \tilde{\Psi}_f^k = \Psi_f^k + \sum_{n=0}^{k-1} e_j \Lambda^n A_0^{-1} e_2' \hat{\varepsilon}_f^n, j = \{1,2,...,7\}. \]
To decompose the impulse responses of the discount rate to the dynamics triggered by oil price shocks, Equation (1) is first rearranged in the following form,

\[ A_0 y_t = \sum_{i=1}^{p} A_i y_{t-i} + \varepsilon_t, \]

\[ y_t = Cy_t + A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t, \]

where \( C \) is a \( F \times F \) dimensional lower triangular matrix with zeros on the diagonal, and \( F \) denotes the number of structure variables in the system. Define

\[ B = \begin{bmatrix} C & A_1 & \ldots & A_p \end{bmatrix}. \]

The contribution of variable \( i \) to the response of the discount rate at horizon \( k \) to 1% of oil price shocks is given by:

\[ d_{\text{discount rate},i,k} = \sum_{m=0}^{\min(p,k)} B_{7,mF+i} \theta_{i,1,k-m}, \quad k = 0,1,\ldots; i = 1,\ldots,F, \]

where \( \theta_{i,1,k-m} \) refers to the (i,2) element of the \( F \times F \) impulse response coefficient matrix at horizon \( k-m \), denoted by \( \Theta_{k-m} \), as defined by Lutkepohl (2005).
Table A1
Data Source and Data Handling

<table>
<thead>
<tr>
<th>Name</th>
<th>Explanation</th>
<th>Source</th>
<th>Data Handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil prices</td>
<td>Brent oil price in US$</td>
<td>Datastream</td>
<td>1</td>
</tr>
<tr>
<td>Long-term inflation E</td>
<td>average of 10-year ahead expectations of consumer price index (CPI) inflation rate survey</td>
<td>Datastream (provided by Consensus Forecasts)</td>
<td>3</td>
</tr>
<tr>
<td>Short-term inflation E</td>
<td>mean of the 1-year ahead expectation of CPI inflation rate survey</td>
<td>Datastream (provided by Consensus Forecasts)</td>
<td>2</td>
</tr>
<tr>
<td>Headline inflation</td>
<td>year-on-year monthly CPI inflation rate</td>
<td>DGBAS, Executive Yuan</td>
<td>0</td>
</tr>
<tr>
<td>Core inflation</td>
<td>year-on-year monthly core inflation index rate (excluding fresh vegetable, fruit, and energy prices)</td>
<td>DGBAS, Executive Yuan</td>
<td>0</td>
</tr>
<tr>
<td>Output</td>
<td>detrended Coincident indicator</td>
<td>DGBAS, Executive Yuan</td>
<td>1</td>
</tr>
<tr>
<td>NEER</td>
<td>nominal effective exchange rate (broad index, year 2010=100)</td>
<td>BIS</td>
<td>1</td>
</tr>
<tr>
<td>Discount rate</td>
<td>key policy rate</td>
<td>CBC</td>
<td>0</td>
</tr>
<tr>
<td>M2</td>
<td>monetary aggregate (operating target)</td>
<td>CBC</td>
<td>1</td>
</tr>
<tr>
<td>Overnight rate</td>
<td>interbank overnight rate</td>
<td>CBC</td>
<td>0</td>
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</tbody>
</table>

To be continued...
<table>
<thead>
<tr>
<th>Data Handling Index</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No change</td>
</tr>
<tr>
<td>1</td>
<td>First difference of natural log</td>
</tr>
<tr>
<td>2</td>
<td>Following Davis (2014), a simple weighted extrapolation to combine the inflation expectations over two calendar years into one measure of 1-year ahead inflation expectations is used.</td>
</tr>
<tr>
<td>3</td>
<td>$\pi_{t+1}^e = \frac{1}{10} \sum_{i=1}^{10} \pi_{t+i}^e$, where $\pi_{t+i}^e$ is the expectation of year $t+i$ inflation rate</td>
</tr>
<tr>
<td></td>
<td>The data is available in semi-annual frequency before 2014 and becomes quarterly frequency hereafter. Linear extrapolation is used to transfer the data as monthly frequency.</td>
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Table A2
Unit Root Test

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF Test Statistics</th>
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<tbody>
<tr>
<td>Oil price</td>
<td>-16.87***</td>
</tr>
<tr>
<td>Long-term inflation E</td>
<td>-2.79***</td>
</tr>
<tr>
<td>Short-term inflation E</td>
<td>-2.21**</td>
</tr>
<tr>
<td>Headline inflation</td>
<td>-4.4***</td>
</tr>
<tr>
<td>Output</td>
<td>-3.02***</td>
</tr>
<tr>
<td>NEER</td>
<td>-13.47***</td>
</tr>
<tr>
<td>Discount rate</td>
<td>-3.84***</td>
</tr>
<tr>
<td>M2</td>
<td>-8***</td>
</tr>
<tr>
<td>Overnight rate</td>
<td>-2.53**</td>
</tr>
</tbody>
</table>

“*”, “**”, and “***” denote p-value<0.1, p-value<0.05, and p-value<0.01, respectively.

Figure A1.1.1
Impulse Responses of Long-term Inflation Expectations to Various Structure Shocks under SVAR 2 Setting

The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A1.1.2
Impulse Responses of Short-term Inflation Expectations to Various Structural Shocks under SVAR 2 Setting

The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A1.2.1
Impulse Responses of Long-term Inflation Expectations to Various Structural Shocks under SVAR 3 Setting

The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A1.2.2
Impulse Responses of Short-term Inflation Expectations to Various Structural Shocks under SVAR 3 Setting

The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A1.3.1
Impulse Responses of Long-term Inflation Expectations to Various Structural Shocks in the First Sub-sample under SVAR 4 and SVAR 1 Settings

The left and right panels represent the results for the SVAR 4 and SVAR 1 settings, respectively.
Figure A1.3.2
Impulse Responses of Short-term Inflation Expectations to Various Structural Shocks in the First Sub-sample under SVAR 4 and SVAR 1 Settings

The left and right panels represent the results for the SVAR 4 and SVAR 1 settings, respectively.
Figure A1.4.1
Impulse Responses of Long-term Inflation Expectations to Various Structural Shocks under SVAR 5 Setting

The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A1.2.1
Impulse Responses of Short-term Inflation Expectations to Various Structural Shocks under SVAR 5 Setting

The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A2.1
The Counter-factual Impulse Responses to 1% of Oil Price Shocks under SVAR 2 Setting

The counter-factual impulse responses are conducted by the shutdown of the responses of long-term inflation expectations. The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A2.2
The Counter-factual Impulse Responses to 1% of Oil Price Shocks under SVAR 3 Setting

The counter-factual impulse responses are conducted by the shutdown of the responses of long-term inflation expectations. The left and right panels represent the results for the first and the second sub-samples, respectively.
Figure A2.3
The Counter-factual Impulse Responses to 1% of Oil Price Shock in the First Sub-sample under SVAR 4 and SVAR 1 Settings

The counter-factual impulse responses are conducted by the shutdown of the responses of long-term inflation expectations. The left and right panels represent the results for the SVAR 4 and SVAR 1 settings, respectively.
Figure A2.4
The Counter-factual Impulse Responses to 1% Oil Price Shocks in the First Sub-sample under SVAR 5 Settings

The counter-factual impulse responses are conducted by the shutdown of the responses of long-term inflation expectations. The left and right panels represent the results for the first and the second sub-samples, respectively.