China inflation dynamics: Persistence and policy regimes

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Abstract

Inflation in China has been remarkably stable during the last decade, a dramatic shift from the pattern seen in the prior two decades, and so questions arise as to whether inflation dynamics has also changed, and if so, what has caused the change and what are the policy implications? This paper explores these important questions and finds that the persistence of inflation dynamics in China experienced a significant reduction in the late 1990s. By using counterfactual simulations we show that systematic monetary policy change is the main contribution to the observed structural change. Our result implies that although inflation is less persistent and hence less responsive than it used to be to shocks, monetary authorities must be vigilant in monitoring potential inflation rise and to take preemptive action to anchor inflation expectations against any indication that they may rise in the coming periods.

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1. Introduction

Among the central issues in macroeconomic policy modeling is the nature of short-run inflation dynamics. The matter is particularly important for the monetary authorities who have an explicit mandate for the maintenance of stable prices as their overriding objective. In light of this mandate,
a challenging task for policy makers and policy analysts is the investigation of structural stability of econometric representations of inflation dynamics in countries with distinct changes over time in monetary policy regimes. As articulated in Lucas’ (1976) seminal work, the changes in policy regimes can induce significant structural breaks in inflation dynamics, and hence any policy analysis may have little use if such structural breaks were neglected.

In response to this challenge, there are an increasing number of studies devoted to analyzing the stability of inflation dynamics, with particular focus on the so-called persistence parameter. The persistence of inflation is defined as the tendency for inflation to stay away from its average level for a protracted period when perturbed; and is measured by the sum of the coefficients on the autoregressive dependent variables. To date, most of the existing literature concentrates specifically on industrial economies, notably Stock (2001), Cecchetti and Debelle (2006), Stock and Watson (2007), Zhang, Osborn, and Kim (2008), and Zhang and Clovis (2009) studying the issue for the US, O’Reilly and Whelan (2005) for Europe, and Benati (2008) for four developed economies. Little research, however, has been conducted on the structural change in the persistence of inflation dynamics in China, despite the increasingly important role of Chinese economy in the world economy.

The purpose of the present paper is to address this omission in the literature and attempt to characterize the nature of structural change in Chinese inflation dynamics. The paper also aims to provide quantitative evidence of policy implications of the structural change in inflation dynamics in China during 1981–2007, which, as Fig. 1 attests (see Section 2), was a period with remarkable variations in inflation and also saw profound changes in monetary policy regimes. More specifically, we investigate the respective quantitative contributions of monetary policy and structural shocks to the change in inflation persistence by counterfactual simulations in a vector autoregressive (VAR) framework which can reasonably capture the dynamic interactions among real economic activity, inflation, and monetary policy in China.

The empirical results suggest that economic propagation promoted by improved monetary policy accounts for about 90% of the decline in inflation persistence. It should be noted, however, although Chinese inflation has become less persistent and less responsive than it used to be to shocks, inflation expectations would become unhinged again and in turn high inflation may prevail again if the monetary authorities in China were less vigilant in maintaining a low rate of inflation. This result indicates that the expansionary policy to relaunch the economy by Chinese government since the outbreak of the global financial crisis in 2008 is likely to be a potential stimulus to future inflation in China.

The rest of the paper is organized as follows. Section 2 discusses stylized facts and structural change of Chinese inflation dynamics over the past three decades. Section 3 analyzes the quanti-
tative contributions of policy and shocks to the structural change in inflation dynamics. Section 4
discusses the policy implications of the main findings of the paper, followed by section 5 which
provides concluding remarks.

2. Stylized facts and structural change of Chinese inflation dynamics

2.1. Stylized facts

Since the beginning of the 1980s, the dynamic evolution of inflation in China has witnessed
remarkable cyclical behavior of booms and busts. Fig. 1 displays quarterly data of year-on-
year growth rate of Chinese consumer price index (CPI) over 1981Q1–2007Q1, which generally
confirms this impression. The plot of the time series data in Fig. 1 suggests that since the
commencement of economic reforms in the late 1970s, Chinese inflation witnessed the first
distinct increase in 1983–1984, followed by a second spike in 1985, and two most striking peaks
in the late 1980s and the middle 1990s. Since the late 1990s, however, inflation in China has been
relatively low and stable, with a number of periods of deflation (e.g. 1998–2000, 2001–2003).
Despite two local peaks of inflation occurred in 2004 and 2007 due to transitory demand shock (e.g.
shock to real estate market) and supply shock (e.g. shock to food and energy price), respectively,
the most recent decade can be characterized as a low inflation era.

The dynamic variation in Chinese CPI inflation over the past three decades reflects correspond-
ing historical changes in the mechanism of Chinese price formation accompanied by changes in
policy regimes. To be specific, it is well known that the prices of most commodities in China were
administered by government agencies and changed infrequently prior to the end of the 1970s
(Narayan, Narayan, & Russell, 2009). Since the start of the economic reforms in 1978, however,
the government-set prices were gradually liberalized. In particular, the central government of
China officially initialized a so-called “adjustment and reform” policy in 1979, with the aim of
promoting fast developments in industrial and agricultural sectors. It was under this background
that the old administratively set pricing system was increasingly liberalized. Consequently, the
prices of both agricultural products and industrial products increased considerably in the early
1980s, which inevitably passed through the production chain and generated higher consumer price
inflation.

In conjunction with the growing prices, the growth rate of the real output in the early 1980s was
also increasing into double digits. Countercyclical macro policies (e.g. credit controls), however,
were not implemented in a sufficient and timely manner. As Fig. 2 shows (based on the raw data
from International Financial Statistics), despite of a transitory drop in 1982, the growth rates of
both M2 and domestic credit in China exhibited an upward trend in late 1982, with unprecedented
loosening to levels of 40% in 1985 and nearly 50% in 1986, respectively. As a result, there was
evidence of overheating with a peak in inflation during 1985–1986. The tightening credit controls
in 1986 dampened the inflation, but it was effective only for a very short period. Due to further
liberalization and deregulation of prices in 1987, inflation rebounded to as high as 25% in 1988. In
response to the extraordinary inflation peak, the central government tightened money and credit
supply and reduced fixed investment substantively. The tighter policy conditions towards the end
of the 1980s curbed inflation.

1 The data is from the National Bureau of Statistics of China.
Although the tightening macro policy in the late 1980s took effect in cooling down inflation and economic growth, it proved to be over tightening. Due to the strict credit control in 1988 and 1989, the industrial sector witnessed substantive reduction and its output in the ensuing 3 years, which consequently caused serious problems of liquidity position and scarcity among a large number of enterprises in China. As a result, both economic growth and inflation were reduced to a relative low level (below 5%) over 1990–1992.

In the spring of 1992, the landmark speech of “promoting Chinese economic development with all efforts” by the Chinese leader Deng Xiaoping (known as “South China Tour Speech”) marked a new round of fast economic development in China. To encourage investments, the central government loosed credit control aggressively and the growth rate of money supply reached above 50% in 1994 (see Fig. 2). The proactive policy stance led Chinese inflation to increase in 1992 and peak in 1994. Following a number of tightening policy measures in 1994, inflation started to decelerate in 1995 and further decreased in the late 1990s. Since the end of the 1990s, China has experienced two periods of mild deflation in 1998–2000 and 2001–2003, with relatively low and stable inflation in the other periods over the new century.

The foregoing description indicates that the evolution of Chinese inflation moved synchronously with policy regime shifts in China over the same time period. Therefore, the recent marked decline in Chinese inflation may be attributed primarily to macroeconomic policy (Guerineau & Guillamont, 2005). More importantly, since China has witnessed profound changes in its monetary policy regimes over the past three decades, it is intriguing to examine the stability of inflation dynamics in China and the associated policy implications. We will investigate these questions in the following sections.

2.2. Structural change

As mentioned at the beginning of the paper, inflation persistence relates to the time taken for inflation to return to its baseline after a shock, and it is commonly measured by the sum of the coefficients on the lags of dependent variable in a dynamic model. In this paper, we follow the customary definition in the literature (e.g. Zhang & Clovis, 2009), and define inflation persistence to be estimated as parameter $\alpha_\pi$ in univariate regression of the form:

$$\pi_t = c + \alpha_\pi \pi_{t-1} + \sum_{i=1}^{p-1} \alpha_i \Delta \pi_{t-i} + \varepsilon_t,$$

(1)
Table 1
Andrews–Ploberger structural break tests for AR model.

<table>
<thead>
<tr>
<th>Coef.</th>
<th>( p )-sup</th>
<th>( p )-exp</th>
<th>( p )-ave</th>
<th>Break date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
<td>1996Q4</td>
</tr>
<tr>
<td>( c )</td>
<td>0.035</td>
<td>0.024</td>
<td>0.046</td>
<td>1994Q3</td>
</tr>
<tr>
<td>( \alpha_\pi )</td>
<td>0.065</td>
<td>0.062</td>
<td>0.069</td>
<td>1996Q4</td>
</tr>
<tr>
<td>( \alpha_\Delta )</td>
<td>0.042</td>
<td>0.027</td>
<td>0.044</td>
<td>1999Q2</td>
</tr>
</tbody>
</table>

where \( c \) denotes a constant, \( \pi_t \) is the rate of inflation, \( \Delta \pi_{t-i} = \pi_{t-i+1} - \pi_{t-i} \), \( p \) is the optimal lag order specified for the AR model based on Akaike Information Criterion (AIC) with a maximum of 8 lags, and \( \epsilon_t \) is a serially uncorrelated error term.

The representation in Eq. (1) summarizes the impact of past levels of inflation on current inflation through the single coefficient \( \alpha_\pi \). To test for structural break in model (1) with the focus on the persistence parameter, we employ the Supreme Wald test of Andrews (1993) and the Exponential- and Average-Wald tests of Andrews and Ploberger (1994) to test for unknown structural breaks in the underlying model. All three tests are designed to test for the same null hypothesis of no structural break in the underlying parameters of interest. The corresponding \( p \)-values of these underlying tests are computed using the method of Hansen (1997).

By construction, the Andrews’ (1993) Supreme Wald-statistic is the maximum Wald-statistic for testing a break through all possible break points over a specified searching range, say \( \tau \), which is given by

\[
Sup \ Wald = \sup W_T(\tau_i) \mid \tau_i \in [\tau_{\min}, \tau_{\max}]
\]

(2)

where \( W_T(\tau_i) \) denotes the sequential Wald-statistic testing for the null hypothesis of no structural break in the underlying parameter. We set a customary searching interval \( \tau_i \in [0.15, 0.85] \) of the full sample \( T \) to allow a minimum of 15% of effective observations contained in both pre- and post-break periods. The Andrews and Ploberger’s (1994) average- and exponential-statistics are then computed as \( AveWald = \int_{\tau_{\min}}^{\tau_{\max}} W_T(\tau)d\tau \) and \( Exp \ Wald = \ln \left\{ \int_{\tau_{\min}}^{\tau_{\max}} \exp \left[ 0.5 W_T(\tau) \right] d\tau \right\} \). In practice, the White (1980) Heteroskedasticity-consistent Covariance Matrix Estimator (HCCME) version of the statistics are computed throughout the tests based on the residuals under the null hypothesis of no structural break for computational convenience.

Based on the above design, the results of the structural break tests are summarized in Table 1, where too, the stability tests are reported for all the coefficients overall and the three individual coefficients. Table reports \( p \)-values of the Andrews–Ploberger family of statistics (denoted \( p \)-sup, \( p \)-exp, and \( p \)-ave) for the structural break tests over full sample of 1981Q1–2007Q1. The first statistic (overall) tests for stability of all the coefficients in model (1). The second statistic (\( c \)) tests for stability of the intercept term assuming that the remaining coefficients are constant. Likewise, the third statistic (\( \alpha_\pi \)) tests for constancy of the persistence parameter assuming the other coefficients are constant and finally, the last statistic (\( \alpha_\Delta \)), tests for joint stability of the dynamic coefficients (i.e. the coefficients on all first difference inflation terms in the model) assuming the intercept and persistence parameter are constant.

The structural break tests for the overall parameters in Table 1 indicate statistically significant evidence of instability in the CPI inflation series, with \( p \)-values of all the Andrews–Ploberger family of statistics smaller than 1%. Investigating the other three tests in the regression reveals that
Table 2
Sub-sample estimates of China inflation persistence in AR model.

<table>
<thead>
<tr>
<th>Sub-samples</th>
<th>Grid bootstrap</th>
<th>OLS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>MU 90% interval</td>
<td>$\hat{c}$</td>
</tr>
<tr>
<td>1981Q1–1996Q4</td>
<td>0.890 [0.813, 0.982]</td>
<td>1.290 (0.453)</td>
</tr>
<tr>
<td>1997Q1–2007Q1</td>
<td>0.814 [0.569, 1.067]</td>
<td>0.307 (0.144)</td>
</tr>
</tbody>
</table>

The instability consistent with the overall break date for the CPI inflation is primarily concentrated in the persistence parameter.\(^2\)

Overall, the Andrews–Ploberger statistics in Table 1 suggest that in general, the AR process of the CPI inflation is unstable over 1981–2007. In particular, we find a significant structural change in the persistence parameter of the CPI inflation around 1997. As a natural next step, we investigate the estimates of inflation persistence over the two different periods based on the identified structural break date. However, the estimation of the persistence parameter in the AR model may be complicated by a number of problems. First, it is well known (Fuller, 1996) that the Ordinary Least Squares (OLSs) estimate of $\alpha_\pi$ tends to be biased downwards towards zero particularly when the true value of the persistence parameter is close to unity. In addition, the conventional asymptotic confidence interval associated with the estimate is also imprecise. In practice, testing the null hypothesis of whether the persistence parameter of the CPI is one using the conventional unit root tests gives $p$-values of the $\tau$-statistics of 0.086 and 0.045, respectively, which suggests that the unit root hypothesis is marginally rejected at the conventional significance levels.

To compensate for these problems, we follow Hansen’s (1999) grid bootstrap method to calculate the bootstrap distribution over a grid of values of the autoregressive parameter in AR models and then form the confidence interval by following a no-rejection principle. By construction, Hansen’s (1999) grid bootstrap approach provides a confidence interval with correct asymptotic coverage for both stationary and local-to-unity AR models. Therefore, in the following estimations, we focus on the grid bootstrap estimates for inflation persistence, while the OLS estimates are provided for comparison.

The estimation results for both inflation series are summarized in Table 2, from which it is evident that the statistical character of the persistence parameter for the CPI inflation before and after 1997 indeed differs markedly. For example, according to the grid bootstrap median unbiased estimates, the persistence of the CPI inflation is high (MU of $\hat{\alpha}_\pi = 0.890$) over 1981–1996, and comparatively low (MU of $\hat{\alpha}_\pi = 0.814$) over 1997–2007. The OLS estimates of the persistence parameter for the CPI inflation provide a more striking difference between the two regimes (0.868 versus 0.745). Another notable result is that the $R^2$ is above 0.90 in the regression before 1997 while it drops to 0.74 after 1997. This result may reflect the fact that the variation of the CPI inflation before the break point is much more evident than after the break point, as shown in Fig. 1. Thus the estimated standard deviation over the period of less variation (after 1997) will be lower.

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\(^2\) The break test statistics pertaining to the persistence parameter for the CPI are significant at the 10% level and the results of the unknown structural break tests indicate that both intercept and dynamic parameters may have also changed. There is also a potential complication if structural change in individual parameters occurs at different time. To pin down these complications, in practice we conduct a dummy test based on the timing of the overall break date and also perform dummy tests taking into account breaks at different times for the individual parameters. The results suggest that the persistence parameter for the CPI inflation manifests a significant break in 1996Q4 at the 5% level.
inevitably be small. This intuition can also explain why the 90% confidence intervals of the grid bootstrap after 1997 are wider than the corresponding ones before 1997.

In practice, we also investigate the robustness of our baseline finding by taking into account the impact of the real economic growth on inflation. To achieve this, we augment model (1) by adding a measure of real economic growth (e.g. the year-on-year growth rate of real GDP) and estimate the persistence parameter in a conventional Phillips curve specification as in Stock and Watson (1999). Based on this specification, we then perform the Andrews–Ploberger structural break tests for the model. The results (not reported here) indicate that although the dates of the breaks for the individual parameters are not exactly the same as those shown in Table 1, the break dates for the overall parameter stability of the Phillips curve model coincides with those associated with model (1). In addition, the persistence parameter for the CPI inflation in the Phillips curve specification manifests a significant structural change (the corresponding \( p \)-values of the structural break tests are smaller than 5%). Sub-sample estimation results of the Phillips curve specification, with both the grid bootstrap and the OLS estimators, indicate that the general pattern of the structural change in inflation persistence in the augmented specification does resemble that in the AR process studied in the previous section.

3. Monetary policy and the structural change: counterfactual simulations

The empirical results in the foregoing sections indicate that the persistence of the CPI inflation manifests a significant reduction around 1997, which is likely to be associated with policy regime shifts in China. In particular, the distinct structural change in the persistence parameter in 1997 coincides, and is consistent with, the strengthening role of the People’s Bank of China (PBOC) as the central bank of China in implementing monetary policy since the disinflation episode that began in the middle 1990s. In retrospect, the PBOC lost most of its functions as a central bank before 1978 due to the destructive Cultural Revolution (1966–1976). Although the PBOC assumed its responsibility as a central bank in 1983, its status as a central bank was not legally confirmed until 1995. Since then, there have been a number of improvements in monetary policy implementations. For example, in 1998, the PBOC replaced the quota management of credit with assets-to-liabilities ratio management. In January 1999, the central bank of China abolished its branches at provincial and municipal levels and instead set up nine regional branches to promote policy efficiency, to protect the PBOC from interferences of local governments, and to prevent potential hazards in the financial sector. In addition, since the end of the 1990s, the PBOC has adopted a composite measure of quantity-based (e.g. money supply) and price-based (e.g. interest rates) tools for implementing its policies, with the quantity-based tool being a predominant policy instrument. As such, the reforms over the last decade have been turning the PBOC into a more “traditional” central bank that relies on comprehensive tools to accomplish its ends in a more sufficient manner.

These important changes in monetary policy may have induced structural instability in the dynamic process of inflation, especially the persistence of inflation. That is, the change in the observed significant reduction in inflation persistence may reflect the fundamental shift in monetary policy whereby the PBOC now systematically acts to stabilize inflation around a potential long-run target and has gained credibility with the public that it will continue to do so into the future. The same interpretation for the change in inflation persistence is proposed by Taylor (2000) and Williams (2006) for the US economy. An alternative interpretation found in the analysis of Stock and Watson (2007), is that the economy has simply experienced a run of good luck and the decline of inflation persistence may only reflect the fact that the nature of “shocks” has changed.
These different interpretations have distinct implications for policy analysis. If the structural change in inflation dynamics is attributed to factors other than monetary policy, it implies that the PBOC could respond less to shocks and yet be confident that inflation would remain at a low level. However, if the change in inflation dynamics is attributed to improved monetary policy intervention by the PBOC, then the Stock and Watson’s policy conclusion is unwarranted (Mishkin, 2007). On the contrary, it implies that better policy has resulted in a better anchoring of inflation expectations through which inflation has become less persistent and is now less responsive to exogenous shocks. To explore these alternative possibilities, we conduct a counterfactual analysis based on a reduced form VAR model to establish a possible connection between systematic monetary policy changes (and shocks) and the observed change in the CPI inflation persistence.

We should also note that although the PBOC have recently promoted the development of market-based interest rates as policy instruments (e.g. Shanghai interbank offered rate was launched and started to operate by the PBOC in January 2007), quantity-based monetary instruments remain the main instruments of the PBOC, as explicitly stated in the Monetary Policy Report published quarterly by the PBOC and shown in Burdekin and Siklos (2008) and Geiger (2008). Therefore, our baseline VAR model incorporates quarterly data for the growth rate of the real GDP, inflation, and the growth rate of M2 to capture the dynamics in real economic output, inflation, and monetary policy. By construction, the equation with the growth rate of M2 as the dependent variable in the VAR system is used to capture the dynamic reactions of monetary policy to inflation and to real economic growth.

Prior to the counterfactual analysis, we assess the structural stability of the VAR system by focusing on the policy equation. In theory, a common break date may be estimated more precisely when the multivariate system is used. However, testing for stability of the overall parameters in the entire VAR system can nonetheless induce an overfitting problem (Stock & Watson, 2002). Since our interest is in any change in systematic monetary policy, we use the Andrews–Ploberger method to test for an unknown structural break in the lag dynamics of the monetary policy equation in the VAR model. The \( p \)-values associated with the tests (\( p \)-sup, \( p \)-exp, and \( p \)-ave) are 0.053, 0.033, and 0.026, respectively, with the break dated in 1997Q1. Imposing this break date and carrying out a Chow-type structural break test produces a \( p \)-value of the test statistic (\( F \)-statistic) of 0.024. Therefore, both of the structural break tests at unknown and known points indicate that the policy equation witnessed a significant structural break in 1997, which is consistent with the break date associated with the CPI inflation persistence reported in Table 1.

We impose 1997 as a break date and use the VARs estimated over 1981–1996 and 1997–2007 to simulate series for the CPI inflation for the respective sub-samples. Through this exercise, we attempt to assess whether changes in propagation of the system (the VAR parameters) or the impulse (the innovation covariance matrix) can account for the observed reduction in the CPI inflation persistence.

Specifically, each VAR has the form:

\[
Y_t = \Phi_i(L)Y_{t-1} + \epsilon_{it}, \quad \text{var} (\epsilon_{it}) = \Sigma_i
\]
Table 3
CPI Inflation persistence in the counterfactual analysis.

<table>
<thead>
<tr>
<th></th>
<th>( \alpha_{\pi}(\hat{\phi}_1, \hat{\Sigma}_1) )</th>
<th>( \alpha_{\pi}(\hat{\phi}_2, \hat{\Sigma}_2) )</th>
<th>( \alpha_{\pi}(\hat{\phi}_1, \hat{\Sigma}_2) )</th>
<th>( \alpha_{\pi}(\hat{\phi}_2, \hat{\Sigma}_1) )</th>
</tr>
</thead>
<tbody>
<tr>
<td>OLS</td>
<td>0.871</td>
<td>0.686</td>
<td>0.879</td>
<td>0.709</td>
</tr>
<tr>
<td>Grid bootstrap</td>
<td>0.897</td>
<td>0.754</td>
<td>0.906</td>
<td>0.773</td>
</tr>
</tbody>
</table>

Notes: the table reports point estimates for each permutation of the counterfactual analysis. Initial values are the actual observations; the first 100 obs. of the simulated series are discarded to avoid sensitivity; simulated sample sizes are consistent with the respective sub-samples.

where \( Y_t \) is a vector time series and the subscript \( i = 1, 2 \) denotes the first and second sub-sample (the intercept is squeezed in the equation for notational convenience but is included in the estimation); \( \Phi_i(L) \) denotes the polynomial of the lag operator with optimal lag order determined by the AIC. The estimates of the parameters and the innovation variance matrix in (3) are then used to generate inflation series over the different sample periods. Note that the simulation process assumes that the structural innovations (denoted \( e \)) implied by the reduced VAR model follow vector Gaussian white noise which links to the shocks in (3) through \( \Sigma_e = A_0^{-1} \Sigma_e (A_0^{-1})' \), where \( A_0 \) is the implicit contemporaneous parameters vector in the counterpart structural VAR model to (3) and are recovered by using the standard Cholesky decomposition method.

The simulated inflation series are then used to estimate the persistence parameters in the univariate model. By using different \( \Phi \) and \( \Sigma \), it is possible to compute the counterfactual persistence of inflation that would have arisen had either \( \Phi \) and \( \Sigma \) taken different values. For example, \( \alpha_{\pi}(\hat{\phi}_1, \hat{\Sigma}_1) \) is the estimated inflation persistence in period one, and \( \alpha_{\pi}(\hat{\phi}_2, \hat{\Sigma}_2) \) is the inflation persistence that would have occurred had the lag dynamics been those of the second period and the error variance matrix been that of the first-period. Other cases are defined analogously.

Table 3 summarizes the VAR-based estimates of inflation persistence for the four possible permutations of estimated VAR coefficients and variance matrices. The columns labeled \( \alpha_{\pi}(\hat{\phi}_1, \hat{\Sigma}_1) \) and \( \alpha_{\pi}(\hat{\phi}_2, \hat{\Sigma}_2) \), respectively contain the VAR-based estimate of the first and second period sample inflation persistence, which are quite close to the respective sample estimate shown in Table 3. The columns labeled \( \alpha_{\pi}(\hat{\phi}_1, \hat{\Sigma}_2) \) and \( \alpha_{\pi}(\hat{\phi}_2, \hat{\Sigma}_1) \) contain the counterfactual estimates. Taking the OLS estimates for example, the counterfactual combination of first-period dynamics and second period shocks (\( \alpha_{\pi}(\hat{\phi}_1, \hat{\Sigma}_2) \)) produces an estimated persistence of 0.879, essentially the same as the first-period persistence estimate. In contrast, the first-period lag dynamics and second period shocks produce an estimated inflation persistence of 0.709, which is close to the second period persistence estimate.

According to these estimates, had the lag dynamics of the post-1997 period occurred in the pre-1997 period, the CPI inflation would have been much less persistent. Our empirical results indicate that the changes in the parameters of the VAR system induced by monetary policy changes – the dynamic propagation of the system – can account for about 88% (i.e. \((0.871–0.709)/(0.871–0.686)\)) of the observed reduction in the inflation persistence.

The counterfactual analysis indicates that improved monetary policy is the main contribution to the reduced inflation persistence in China. According to Mishkin (2007), better monetary policy reduces inflation persistence by anchoring inflation expectations. In this aspect, monetary policy is the source of the change in the evolution of long-run inflation expectations per se. This explanation appears to be consistent with the stylized facts for China. As section 2 describes, during the 1980s and 1990s, the central government of China and its central bank maintained a policy stance that was inadvertently too easy (on average) and that allowed inflation expectations
to drift up markedly over many years. Since the late 1990s however, the PBOC has increased its commitment to price stability in both words and actions. The preemptive strikes against upswings and downswings in inflation by the PBOC since the late 1990s have not only kept inflation low and stable, but also anchored long-run inflation expectations, which effectively helps reduce inflation persistence.

4. Policy implications

The formal econometric tests in the preceding sections have confirmed that the persistence of inflation dynamics in China did experience a significant structural break in 1997. This change is mainly attributed to better monetary policy. These underlying findings have important policy implications in terms of the impulse responses of inflation to structural shocks and appropriate monetary policy responses to a projected change in the inflation rate in the periods ahead. This section discusses the policy implications of our empirical results from these two important policy perspectives.

4.1. Impulse response of inflation to structural shocks

As discussed in the start of the paper, inflation persistence is defined as how long the effects of a shock to inflation will last. Therefore, the first-order implication of the observed reduction in Chinese inflation persistence is that inflation over the post-1997 period tends to revert more quickly to its steady state level than inflation the pre-1997 era.

To confirm this impression, we compute impulse response functions (IRF) of inflation to the structural shocks embedded in the counterpart structural system of the reduced form VAR model (3) over the two sub-samples demarcated by the structural break point 1997. Note that the order of the three variables in the VAR system (i.e. the growth rate of the real GDP, the inflation rate, and the growth rate of M2) follows the standard literature (e.g. Stock & Watson, 2002), so the three structural shocks implicitly defined in association with model (3) are respectively, a demand shock, a supply shock, and a monetary policy shock. In computing the IRFs of inflation to the three structural shocks, one standard deviation change in the underlying shocks is used.

Based on these constructions, Fig. 3 summarizes the IRFs of inflation to the demand shock, the supply shock, and the monetary policy shock over the pre- and post-1997 periods, respectively. The figure shows clearly that the IRFs of inflation to the alternative shocks over the post-break period diminish more quickly than for the previous period. Interestingly, the moderate responsiveness of

![Fig. 3. Impulse responses of CPI inflation to alternative shocks.](image-url)
inflation to the supply shock and monetary shock seems more striking than that of inflation to the aggregate demand shock. On average, it takes about 1 year (i.e. 4 lags) for inflation to revert to its equilibrium level when it is perturbed by the supply or monetary shock in the post-1997 period, in comparison to around 2 years in the pre-1997 era. The time taken for inflation to revert to its steady state level following a disturbance of the aggregate demand reduces from 4 years in the pre-1997 period to less than 3 years post-1997.

Overall, the structural change (reduction) in Chinese inflation persistence implies that inflation in China has become less responsive to alternative structural shocks, albeit the magnitude of the change in the responsiveness to different shocks varies. The changed pattern of impulse responses of inflation to alternative shocks over the two different samples also seems to indicate that the underlying shocks are less likely to generate economic instability today than they would have done a decade ago, as long as the present monetary policy remains vigilant to inflation pressures ahead. We note, however, that this result does not suggest that the central bank in China could respond less to shocks and yet be confident that inflation could remain at a low level. At issue, among other things, is that the observed structural change in the Chinese inflation dynamics originated from the improved monetary policy and not other factors, as attested in Section 3. The following sub-section discusses some further implication of our results on inflation expectations and inflation control in China.

4.2. Inflation expectations and inflation control in China

The finding of a structural change in inflation dynamics has important implications for inflation expectations and hence inflation control policy. As recent studies of Williams (2006), Mishkin (2007), and Kiley (2008) all correctly pointed out, better monetary policy produces better anchors of inflation expectations which in turn lead to less persistent inflation. To see this, consider that if economic agents set prices and wages with reference to the rate of inflation they expect (which is highly plausible) and if inflation expectations respond less than previously to variations in the past inflation due to improved monetary policy and this results in better anchored inflation expectations, then current inflation will become relatively more insensitive to the past inflation, that is, the persistence of inflation will be reduced. Similar logic explains the finding that inflation is less responsive than previously to the demand, supply, and policy shocks (as can be seen in Fig. 3).

Our finding that Chinese inflation persistence was high during the period of high and volatile inflation in the 1980s and 1990s and has since declined to a lower level is consistent with this logic. As we discussed in Section 3, monetary policy in China before the late 1990s was inefficient and unsuccessful in controlling inflation. As a result, inflation expectations were poorly anchored. This is particularly true for the period of the 1980s and the early 1990s when the Chinese expectations of high inflation in the future were extremely strong due to the aggressive price liberalization. With the improved monetary policy since the late 1990s, however, inflation expectations in China have become much better anchored.

It is natural therefore to seek, and indeed we have found evidence of better anchored inflation expectations in China. Consider the measure of expected inflation for the coming quarter reported by the PBOC. Fig. 4 plots the survey of inflation expectations in China based on the raw data of survey index of future price expectations managed and published by the PBOC. The figure shows...
that inflation expectations lead the actual inflation by several periods and expected inflation is generally lower than the actual inflation. On average, inflation expectations over the past decade in China are close to zero (except for a transitory jump in 2004) which confirms the conjecture of better anchored inflation expectations coming from the improved monetary policy since the late 1990s.

This discussion reaffirms the fact that the structural change in Chinese inflation dynamics is mainly attributed to better monetary policy and a resultant better anchoring of inflation expectations. Given this fact, the reason that inflation has become less persistent is that the monetary authorities in China have been vigilant in maintaining a low rate of inflation since 1997.

However, our findings could lead to inappropriate policy advice, especially in the background to the recent global financial crisis outburst in 2008. In particular, the reduction in inflation persistence seems to be suggesting that inflation dynamics in China has entered a more “benign” era where inflation process has changed in a way that would help entrench low inflation permanently. Under this misinterpretation, it seems that the PBOC could be confident that inflation in China would remain at a low level even if it is less sensitive to shocks and the bank keeps extraordinarily accommodative policies dominant for a protracted period.

This interpretation is inappropriate and misleading because the observed structural change in Chinese inflation dynamics is due to better monetary policy but not other factors. If the PBOC were to become complacent and think that they could get away with not reacting to shocks that, in their mistaken view, no longer have the potential to induce inflation to rise persistently, then inflation expectations would become unfettered again. Therefore, complacency that may arise from the recent lower inflation persistence could return China to an era like the high and volatile inflation in the 1980s and 1990s. This is exactly the concern expressed in Mishkin (2007), in which he worries that a misunderstanding of the inflation process might induce another era like the Great Inflation in the 1970s in the United States. Likewise, for China, a misunderstanding of the nature of its inflation dynamics may again lead China to a high inflation equilibrium.

November every year and it is based on 20,000 survey samplings of the public as to future price change in one quarter ahead.
Therefore, the monetary authorities in China now should not take the low inflation as given. On the contrary, inflation in China should be viewed more as a threat than a problem given the recent stimulus measure of relaunching the economy since the outbreak of the 2008 financial crisis. Indeed, the Chinese government has implemented expansionary monetary policy in conjunction with proactive fiscal policy since late 2008. At the time of our writing, this loose policy stance has remained for more than a year, which is likely to unwind inflation expectations and hence trigger the rise of inflation in China in the period ahead as the Chinese economy recovers from the global financial crisis. The PBOC however, has signaled no swift change in its loose policy stance, and the continued stimulus may well risk a higher inflation outlook in China.

To highlight the potential risk of rising inflation in the near future in China, we extend our CPI inflation data set from 1981Q1 to 2009Q2 and then estimate CPI inflation forecasts for the upcoming periods (up to 2011) based on simple AR models. For comparison purpose, our inflation projections are based on both a naïve AR process and an AR model with the identified structural break in 1997Q1. Fig. 5 summarizes the estimated point forecasts of future inflation and the associated 90% confidence interval. As expected, the AR model with the 1997 break produces more accurate forecasts for inflation. That is, the confidence interval of the forecasts in the model with the 1997 break is considerably narrower than that in the model without the consideration of the break. The general pattern of future inflation dynamics produced by the two different regressions, however, is rather similar. There is an obvious upward trend in inflation for the coming periods (1–2 years) with deflation ending by the late 2009, which indicates that inflation in China is likely to rise in a few periods ahead. In addition, the forecasting confidence interval shows that there is a possibility for Chinese inflation to rise close to 15% (as shown by the upper band of the confidence interval) by the middle of 2010 if the current loose policy continues.

The forecasting result is also backed up by the recent rise in inflation expectations in China. A close look at Fig. 4, for example, reveals that the survey of the public’s expectations on future inflation manifests a distinct upward reversal in the first two quarters in 2009. This evidence suggests that it is highly likely that inflation in China will rise in several periods ahead. Therefore, the Chinese monetary authorities should make specific preemptive strikes to control potential future inflation before it actually arrives. One such measure is to manage inflation expectations in an efficient and timely manner. To this end, the extent to which the current expansionary policy

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6 In the first half year of 2009, China has issued new loans totaling 7.4 trillion yuan (around $1 trillion).
expands need to be moderated. Policy makers should consider paring the scale and size of domestic credit loans and money supply via the central bank’s open market operations. In the near term, it is necessary for the PBOC to raise banks’ reserve requirements, and this should be achieved no later than the first quarter 2010. This measure may also be implemented in conjunction with window guidance (i.e. the hierarchical moral suasion) and market interest rates adjustments. In essence, the Chinese monetary authorities now need to consider the balance between economic growth and inflationary expectations before actual inflation strikes back.

5. Conclusion

Inflation in China has been remarkably stable during the past 10 years, a dramatic shift from the pattern seen in the two decades previous. Associated with such a change in the behavior of Chinese inflation, the persistence of inflation also experienced a significant structural break which was mainly induced by monetary policy regime shifts and is confirmed by the formal econometric tests in the present paper. These results imply that inflation in China now is less persistent and less responsive to random shocks. However, since the structural change in inflation dynamics is attributed mainly to better monetary policy and the associated better inflation expectations, it is also possible for high inflation to strike back China in the absence of a determined effort by the monetary authorities in managing inflation expectations. Therefore, the policy makers in China must be vigilant in controlling the potential rise of inflation in the periods ahead, especially given the overwhelming stimulus measure implemented in China since the onset of the recent global financial crisis.

It should be noted that our search for the causes of the significant structural break in Chinese inflation dynamics is not intended to be exhaustive, nor indeed is it the only new evidence in the literature, that is, other factors may also influence inflation, and some of these may provide other possible explanations for the recent change in Chinese inflation dynamics. For example, increased globalization and other sources of increased competition may have lowered the sensitivity of domestic inflation to alternative shocks, albeit the evidence on this point is limited and inconclusive (Mishkin, 2007). Moreover, the present study has not formally linked the empirical findings to more fundamental changes in China’s economy while it focuses on the profound changes in monetary policy regimes. It could be profitable to adopt a more structural framework incorporating, when tractability allows, all the relevant models pertaining to inflation dynamics in China. In the case where the system is possible while analytical results are not attainable, one could consider the possibility of turning to numerical simulation analysis using algorithms as in for example, Fair and Taylor (1983) and Anderson and Moore (1985); or use the methods introduced in McCallum (1998) and Söderlind (1999). That said, a more rigorous study of the relevant issues would entail a structural system of equations incorporating, for instance, an IS equation, a monetary policy reaction function, and the New Keynesian Phillips curve and then working through to the final equations. Estrella and Fuhrer (2003) and Rudebusch (2005) provide important contributions in this direction for the US economy and so much further similar research, focusing on exclusively on the Chinese economy is clearly warranted.

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