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China's Business Cycles

Perspectives from an AD–AS Model

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Abstract

This paper represents a first attempt to study China's business cycles using a formal analytical framework, namely, a structural VAR model. It is found that: (a) demand shocks were the dominant source of macroeconomic fluctuations, but supply shocks had gained more importance over time; (b) the driving forces of demand shocks were consumption and fixed investment in the first cycle of 1985–90, but shifted to fixed investment and world demand in the second cycle of 1991–96 and the post-1997 deflation period; and (c) macroeconomic policies did not play an important part either in initiating or counteracting cyclical fluctuations.

Keywords: business cycle, structural VAR, demand shocks, supply shocks, China

JEL classification: E32, O53, P24

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1 Introduction

China's economic performance in the past two decades is outstanding in two aspects: not only has it been growing faster than most developing and transition economies, it has also steered clear of severe macroeconomic instability. Studies on the growth aspect are abundant. See, for example, Sachs and Woo (2000), Zhang and Zou (1998), Hu and Khan (1996), Borensztein and Ostry (1996) and Chow (1993). By contrast, little has been published on the other aspect, namely China's macroeconomic fluctuations or business cycles which, according to Schumpeter (1939: 5), are inherent in the growth process.

This paper represents a first attempt to identify China's business cycles and to explore the characteristics and sources of the cycles. More specifically, this study examines the fluctuations in output and inflation within the aggregate-demand–aggregate-supply (AD–AS) framework. Following Blanchard and Quah (1989), the sources of these fluctuations are attributed to two generic shocks: supply shocks that affect real output permanently and demand shocks whose effects on real output eventually die out. This grouping of shocks helps fulfil several objectives. First, an important purpose of business cycle research is to provide advice for the formulation of counter-cyclical demand management policies. Real output growth and inflation are often regarded as the most comprehensive indicators of the general state of the macroeconomy, and as such, frequently constitute the principal concerns of policymakers. It is thus desirable to examine what drives the movements in real output and inflation. Second, various macroeconomic paradigms differ, sometimes widely, in their views about how exogenous shocks are transmitted throughout the economy. Even less common ground has been reached regarding the inner workings of developing and transition economies. The characterisation of the two shocks in this paper fits in with the AD–AS framework with a vertical long-run AS curve, which is arguably a best alternative to a consensus model for analysing aggregate fluctuations (Blanchard, 1997; Blinder, 1997). This reduces the chances of obtaining biased results due to erroneous a priori assumptions. Third, China stands out among transition economies in terms of macroeconomic stability. Fischer and Sahay (2000) argue that economic performance in transition economies depends importantly on both structural reforms and stabilisation policies, though initial conditions also matter. Dibooglu and Kutan (2001) show that real exchange rate movements in Poland and Hungary were driven by different shocks, owing to different macroeconomic policies pursued by the two countries. The question then arises whether China's relative stability shall be associated more with its gradualist approach to transition or with its conduct of macroeconomic policy. Since structural reforms typically involve the supply side of the economy while stabilisation measures largely land on the demand side, the results from our model will shed light on this question.

The remainder of the paper is organised as follows. The next section introduces our modelling approach along with the data and issues related to model estimation. Section 3 presents empirical results. Further discussions of the findings are offered in Section 4 and Section 5 concludes.

2 A structural VAR of output growth and inflation

2.1 Methodology

The theoretical framework of our analysis is the textbook AD–AS model (e.g., Mankiw, 2000), where the short-run equilibrium output y (expressed in logarithm) in period t can be represented by

$$y_t = y_t^* + y_t^d \tag{1}$$

where y^* is the log level of long-run equilibrium output and y^d is the deviation of y from its long-run value in the short-run. Assume that the long-run level of output follows an $I(1)$ process:

$$y_t^* = y_{t-1}^* + \alpha_1(L)\varepsilon_t^s \tag{2}$$

where ε^s represents supply shocks and is a white noise, the lag polynomial $\alpha_1(L)$ has absolutely summable coefficients, and all the roots of the characteristic equation of $\alpha_1(L)$ lie within the unit circle.[1] The short-run deviation y^d is induced by demand shocks ε^d:

$$y_t^d = \beta_1(L)\varepsilon_t^d\,, \tag{3}$$

where $\beta_1(L)$ is a lag polynomial, similar to $\alpha_1(L)$. Combining equations (1)–(3) yields

$$\Delta y_t = y_t - y_{t-1} = \alpha_1(L)\varepsilon_t^s + (1-L)\beta_1(L)\varepsilon_t^d\,. \tag{4}$$

Equation (4) indicates that supply shocks ε^s can cause permanent shifts in the output level y unless $\alpha_1(1) = 0$, whereas demand shocks ε^d merely have transitory effects.

Provided that the short-run AS curve is not horizontal, equation (1) implies a short-run Phillips curve trading off inflation and output. A common specification of the Phillips curve augmented with supply shocks and inflation inertia is the 'triangle model' as per Gordon (1998):

$$\Delta p_t = \gamma(L)\Delta p_{t-1} + \theta(L)(y_t - y_t^*) + \phi(L)\varepsilon_t^s\,, \tag{5}$$

where p is the general level of prices, and $\gamma(L)$, $\theta(L)$, and $\phi(L)$ are again lag polynomials. The first term on the right-hand side of equation (5) embodies inflation inertia, introduced through overlapping wage and price contracts and expectation formation. The second term is the output gap component of standard Phillips curve models. It measures the effect of excess demand on inflation. The addition of the third term, supply shocks, conveys the idea that part of short-run fluctuations are attributable

[1] All lag polynomials in this paper possess these properties unless otherwise specified. That is, the lag polynomials describe stationary processes and are invertible.

to transitory adjustments from one long-run equilibrium to another. Substituting equations (1) and (3) into equation (5) gives

$$\Delta p_t = \alpha_2(L)\varepsilon_t^s + \beta_2(L)\varepsilon_t^d \,, \qquad (6)$$

where $\alpha_2(L) = [1-\gamma(L)L]^{-1}\phi(L)$ and $\beta_2(L) = [1-\gamma(L)L]^{-1}\theta(L)\beta_1(L)$. Equation (6) shows that neither of the two shocks have permanent effect on the level of inflation. Thus, the rate of inflation is assumed to be stationary, thought the price level could be nonstationary.

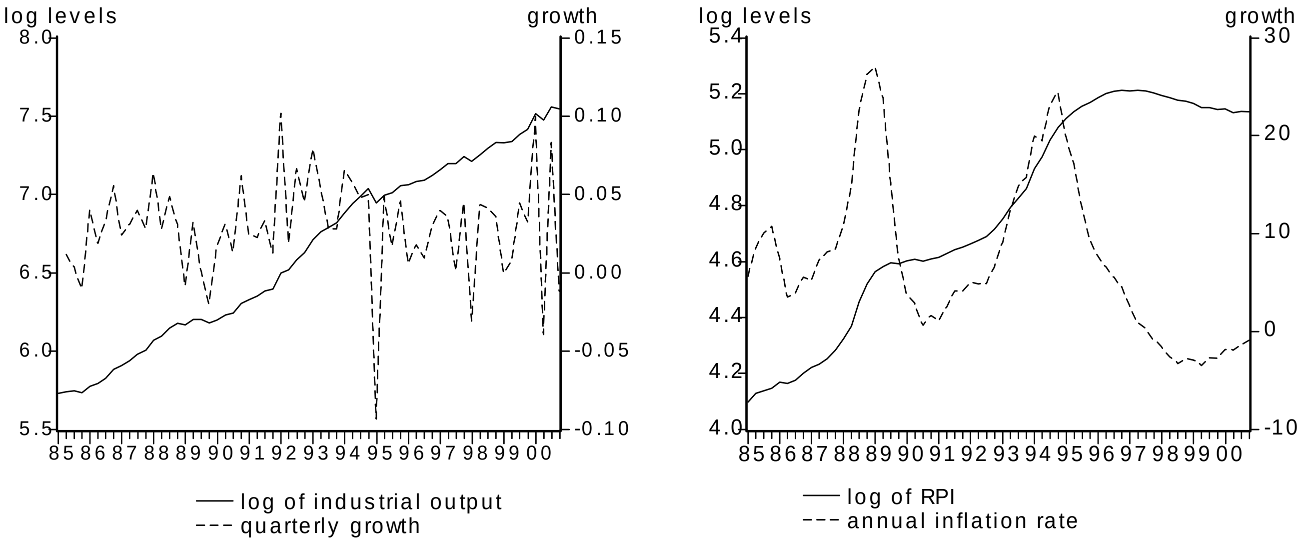
The structural model, as represented by equations (4) and (6), has numerous statistically equivalent representations, and thus cannot be estimated directly. To recover the structural parameters from their reduced-form counterparts, at least four independent restrictions on the structural model are needed. Following Blanchard and Quah (1989), restrictions are imposed on the variance-covariance matrix of the structural model. Equation (4) itself implies a restriction on the long-run property of the system—the long-run multiplier of ε^d on y is zero. This restriction, upon orthogonalisation and normalisation of the structural shocks, suffices to exactly identify the system.

2.2 Data and model estimation

Our analysis focuses on the period of 1985–2000. The level of real output is represented by real gross industrial output. Although real GDP might seem a more appropriate choice, its quarterly series is only available from 1994 onwards and is not long enough for the intended econometric analysis. Besides, there are grounds to argue that real industrial production can serve as a good indicator of aggregate economic activity, and that other broader measures may not be preferable. For one thing, agricultural production, as important as it is for the Chinese economy, has strong seasonal patterns and is still under the rule of natural forces. Including agricultural output will probably add too much noise to the data and cloud the overall picture. For another, the level of activity in the service sector, which now constitutes about a third of GDP, turns on that of the industrial sector. That the industrial sector plays a pivotal role in the course of macroeconomic fluctuations is true not just for countries like China where the service sector is small relative to the industrial sector. Even in more advanced economies such as the US, Japan, Germany, and so on, the output of the industrial sector, especially that of the manufacturing industries, finds its way into the coincident index compiled by government agencies and research institutions monitoring business cycles. The inflation rate is measured by changes in the retail price index (RPI). The alternative measure, the consumer price index (CPI), includes prices of such services as housing, transportation, health care, and so on. For much of the sample period, these prices were administered by the government and did not reflect market conditions.

Both real gross industrial output and RPI are obtained by converting the monthly data reported in *China Monthly Statistics* into seasonally adjusted quarterly observations. Figure 1 shows the log levels and growth rates of both series. The level of industrial production clearly exhibits an upward trend. Its first difference—the quarter-to-quarter growth rate, appears stationary and has a mean of 2.9 per cent. This suggests that industrial production can be characterized by either a random walk with drift or a trend

Figure 1 Log levels and growth rates of industrial production and RPI



stationary process. Moreover, in spite of the sharp dip in the first quarter of 1995, there seems to be little sign of structural breaks in its behaviour. The RPI series has two swells, a reflection of the 1988–89 and 1993–94 inflation episodes. The inflation rate displays some persistence, yet still looks mean-reverting with an average of 7.4 per cent over the sample period.

Whether the assumption of zero long-run multiplier of ε^d on y is capable of distinguishing supply shocks from demand shocks also depends on the statistical property of the data. It requires that real output be an $I(1)$ process and inflation an $I(0)$ process. To test the stationarity property of the two variables, three unit root tests are performed: the ADF, PP and KPSS tests. In addition, the so-called DJSR procedure of Doldado, Jenkinson and Sosvilla-Rivero (1990) is used to confirm the specifications of the deterministic components.

Table 1 summarizes the results. Industrial production is found to contain one stochastic trend. The identified nonstationarity in real output is disputable as breaks in the deterministic components of a time series can bias the results towards nonstationarity (Perron, 1989). To check if the industrial production data suffer from such a bias, the series is subject to a procedure proposed by Perron (1997), in which the date of structural break is endogenously determined. It turns out that the unit root hypothesis is accepted whatever form of the structural break is assumed.

The results on inflation are mixed. The ADF test suggests a stationary AR process whereas the PP and KPSS tests favour the unit root process. However, the PP test statistic is close to rejecting the null of nonstationarity at the 10 per cent significance level. Also, the KPSS test incorporates by default a drift term in the alternative hypothesis, which does not conform to the specification indicated by the DJSR procedure. In general, unit root tests cannot provide sharp discrimination between a true difference stationary process and one with roots that are large but less than one. Misspecification of the deterministic components can further blunt their discriminatory power. It is likely, therefore, that the inflation series is stationary but highly serially correlated.

Table 1 Univariate unit root tests

Series	Test statistics		
	ADF[a]	PP (l=3)[e]	KPSS (l=3)[f]
y	–2.0535 (l=2)[b]	–2.0937	*0.1613
Δy	*–9.6485 (l=0)[c]	*–9.6493	0.0893
Δp	*–2.2761 (l=1)[d]	–1.5142	**0.4163

Notes: The sample period is 1985:2–2000:4. * indicates that the null hypothesis is rejected at the 5% significance level, and ** at the 10% level.

[a] Augmented Dickey–Fuller test. Figures in the parentheses are the number of lags included in the regressions. The lag lengths are chosen by adding lags until the Ljung–Box *Q*-statistics of order eight fails to reject no serial correlation at the 5% significance level. For all three series, using lag lengths suggested by other criteria does not change the conclusions.

[b] The test incorporates a constant and a time trend.

[c] Only a constant is included in the regression.

[d] The regression does not include any deterministic components.

[e] Phillips-Perron test. The bandwidth of the Bartlett kernel is chosen according to Newey and West (1987).

[f] Tests for the null hypothesis of (trend) stationarity as in Kwiatowski *et al*. (1992).

The stationarity property of the two series can also be tested jointly in a multivariate framework. For a bivariate system of $[y\ \Delta p]'$, the hypothesis that y is $I(1)$ and Δp is $I(0)$ amounts to postulating a cointegration vector of [0 1]. Hence, the null hypothesis can be constructed as: conditioned on the existence of one cointegration vector, y can be excluded from the cointegration space. The test statistics obtained from the Johansen procedure is 10.00. The same test applied to Δp produces a value of 1.6. As the test statistic is distributed as $\chi^2(1)$ with a critical value of 3.8 at the 5 per cent level, the hypothesis that y follows a difference stationary process and Δp is trend stationary is confirmed by the multivariate test. Therefore, the Blanchard–Quah decomposition can be applied to the bivariate VAR of Δy and Δp to differentiate between the permanent and transitory components of y.

Before proceeding to estimate the VAR system of Δy and Δp, the lag length of the system must be determined. An array of methods can serve the purpose, among which the information criteria AIC, BIC and HQ are most common. For the present model, the AIC selects a lag order of six. Both BIC and HQ choose a lag order of two. Considering the moderate size of our sample, a parsimonious model is preferable. Moreover, Paulsen (1984) demonstrates that in the presence of unit roots AIC is inconsistent and tends to overestimate the lag length while BIC and HQ retains consistency. However, the lag length of a VAR model should be sufficient to ensure that the residuals are free of autocorrelation. As Table 2 indicates, the model with only two lags still exhibits signs of residual autocorrelation. To render the residuals white noises, it is necessary to include at least four lags.

Table 2 Diagnostic statistics for different lag lengths (*p*-values in parentheses)

Lags	Equations	Q(12)	Portmanteau	JB	Normality	AIC	BIC	HQ
2	Δy	19.83		25.71				
		(0.03)	42.17	(0.00)	26.77	-6.08	-5.35	-5.57
	Δp	9.74	(0.38)	7.64	(0.00)			
		(0.46)		(0.02)				
3	Δy	16.91		21.00				
		(0.05)	36.08	(0.00)	31.73	-6.17	-5.15	-5.47
	Δp	7.99	(0.65)	12.51	(0.00)			
		(0.54)		(0.00)				
4	Δy	12.73		2.85				
		(0.12)	25.58	(0.24)	16.70	-6.39	-5.08	-5.48
	Δp	8.39	(0.96)	12.62	(0.00)			
		(0.39)		(0.00)				
5	Δy	8.53		2.54				
		(0.29)	19.26	(0.28)	23.74	-6.55	-4.95	-5.44
	Δp	8.11	(1.00)	17.29	(0.00)			
		(0.32)		(0.00)				
6	Δy	3.73		2.59				
		(0.71)	16.64	(0.27)	25.46	-6.75	-4.86	-5.44
	Δp	5.98	(1.00)	14.97	(0.00)			
		(0.42)		(0.00)				

Notes: Q(12): Ljung–Box test statistics for no autocorrelation of order 12, distributed as $\chi^2(8)$. Portmanteau: multivariate test for no autocorrelation, distributed as $\chi^2(40)$. JB: Jarque–Bera test for normality, distributed as $\chi^2(2)$. Normality: multivariate test for normality, distributed as $\chi^2(4)$. AIC: Akaike information criterion; BIC: Baynesian information criterion; HQ: Hannan–Qinn criterion.

The normality tests reject the null for all lag lengths listed in Table 2. The two inflation spurts in 1988–89 and 1993–94 and the sharp decline in industrial production in the first quarter of 1995 are largely responsible for the violation of normality. Although it is possible to alleviate the problem by incorporating dummy variables for these incidents, this option is not taken up here. The three occurrences are caused by unusually large demand and/or supply shocks, yet the nature of these shocks is no different from that of other shocks. Non-normality will not distort the point estimates of impulse responses and variance decomposition, though it does affect their interval estimates.

3 Estimation results

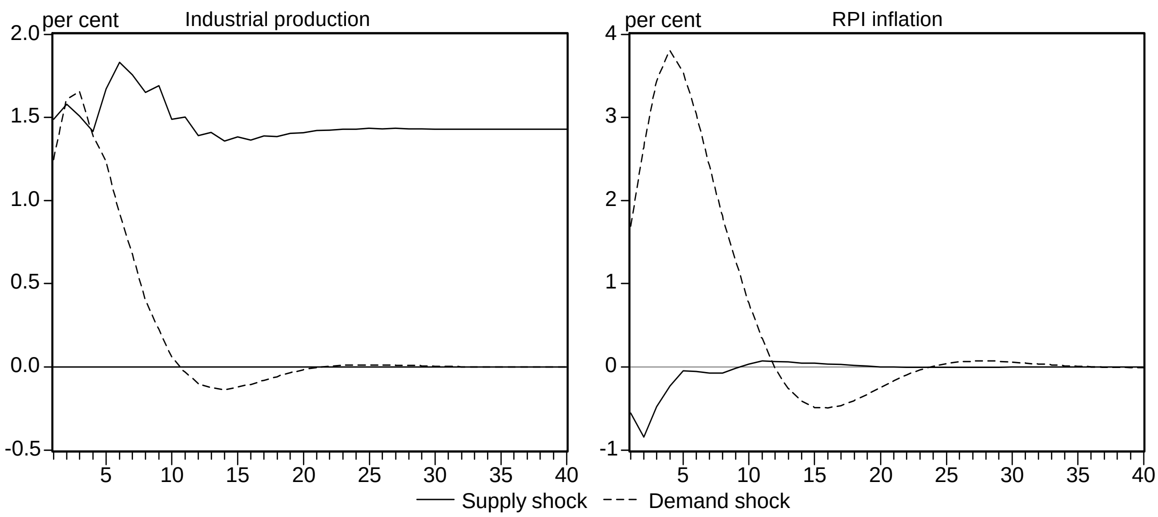
Based on the above discussions, a bivariate VAR(4) model of Δy and Δp is estimated. Parameter estimates of the reduced-form model are not reported as they are not economically interpretable. Attention is focused on innovation accounting of the structural model.

3.1 The dynamics of real output and inflation

Graphed in Figure 2 are the impulse response functions that trace out the impact on the levels of output and inflation of supply and demand shocks. The left panel displays the responses of output. It shows that one unit (i.e., one standard deviation) positive supply shock raises output by about 1.4 per cent in the long run. The adjustment is completed within three to four years. A typical demand shock has strong impact effects on output, increasing it by up to 1.6 per cent in the first three quarters. This demand-led expansion lasts about two and a half years, and output eventually returns to its original level after about five years.

The dynamics of the inflation rate is demonstrated in the right panel of Figure 2. As expected, a positive supply shock causes a slight dip in inflation, while a positive demand shock leads to a sharp increase in inflation. The inflationary effects of the demand shock persist for about two and a half years, followed by a period of over-adjustment (i.e., deflation). The whole process takes about five to six years to complete.

Figure 2 Impulse responses of industrial production and RPI inflation



Several observations follow from the above description. First, the impulse responses of output and inflation are consistent with the predictions of the AD–AS model. A positive supply shock raises output and lowers inflation. In contrast, a positive demand shock induces increases in both output and inflation. Second, output responds strongly to both shocks while inflation does not seem to be sensitive to supply shocks. Third, the speed of adjusting to equilibrium differs slightly for the two shocks. In the case of supply shocks, the transition from the old equilibrium to the new one attains in four to five years. For demand shocks, it takes up to six years to restore the original equilibrium. On the basis of these results, the average business cycle will last between four to six years. Finally, the responses of both series to a demand shock indicate a positive correlation between output and inflation in the short run—one of the many versions of the Phillips curve.

Price liberalisation and the legacy of a monetary overhang made disinflation an indispensable part of macroeconomic stabilisation in transition economies, especially in the early stages of transition. Disinflation carries real cost. A widely-used measure of that cost is the 'sacrifice ratio', which is defined as the percentage decrease in industrial production required to reduce the inflation rate by one percentage point. This can be approximated by the ratio of the cumulative effects of a demand shock on output to those on inflation rate, calculated over the average length of the business cycle—24 quarters. The calculation results in a value of 0.61, which suggests that the cost of one percentage point reduction in inflation is about a 0.6 per cent decrease in output. Hence, the strong procyclical behaviour of the inflation rate is attributable to the sensitivity of inflation to demand shocks. The presence of supply shocks will attenuate the positive relation between inflation and output, especially if the contributions to aggregate fluctuations of supply shocks are more important than those of demand shocks. The relative importance of the two shocks is the question to which we now turn.

3.2 The relative importance of supply and demand shocks

To gauge the relative importance of supply and demand shocks for explaining the fluctuations in real output and inflation, two types of decompositions are conducted—forecast error variance decomposition (FEVD) and historical decomposition (HD).

The first calculates the share of the total forecast error variance of inflation or output that is due to a particular shock at various horizons. It provides an assessment of the average contributions by the two types of shock over the sample period. Table 3 tabulates the FEVD results. The first point to notice is that demand shocks account for over 90 per cent of the variability of the inflation rate at all forecast horizons. In the medium to long run, the share of demand shocks increases to 98 per cent. Such supremacy implies that, so far as the fluctuations of inflation are concerned, the role of supply shocks is minimal. Demand shocks are also important in driving cyclical fluctuations in real output. They explain about 40 per cent of output variations throughout the first year. Over the two- to five-year horizons, demand shocks account for 20 to 30 per cent of output variability. These results are in agreement with the findings from the impulse response analysis discussed earlier.

Table 3 Forecast error variance decomposition

Horizon (Quarters)	Industrial production			RPI inflation		
	Supply shock	Demand shock	s.e.	Supply shock	Demand shock	s.e.
1	55.5	44.5	41.5	9.7	90.3	25.2
2	57.3	42.7	33.3	9.4	90.6	14.0
3	53.8	46.2	15.5	5.5	94.5	9.9
4	61.4	38.6	10.2	3.5	96.5	1.2
8	73.2	26.8	12.0	1.9	98.1	4.3
12	77.9	22.1	11.5	1.9	98.1	4.4
16	80.7	19.3	10.4	1.9	98.1	4.8
20	82.9	17.1	9.8	1.9	98.1	4.9
40	89.4	10.6	7.4	1.9	98.1	4.8
60	92.4	7.6	5.9	1.9	98.1	4.8

Notes: Impulse responses are entered in percentage points. The standard errors (s.e.) are asymptotic values calculated as per Warne (1993).

The importance of demand shocks as suggested by the FEVD invites a further question—whether this is the case for every episode of the sample period. In other words, how representative is the average result of individual episodes, and have there been any changes in the characteristics of the underlying shocks? To answer these questions, it is instructive to distil the demand components of the two series, which represent the part of each series due to demand shocks from the third quarter of 1986 onwards. These are plotted in Figure 3 along with the cyclical components of the two series obtained by applying the Hodrick–Prescott (HP) filter to the original series.[2] The HP filter isolates from a time series those components within a preset range of frequencies, which in this case has been set to 2 to 32 quarters. Consequently, the extracted cyclical component encompasses short-run fluctuations caused by demand shocks as well as supply shocks. The differences between the demand component of a series and its HP cyclical component shall then reflect the fluctuations caused by supply shocks at business cycle frequencies.

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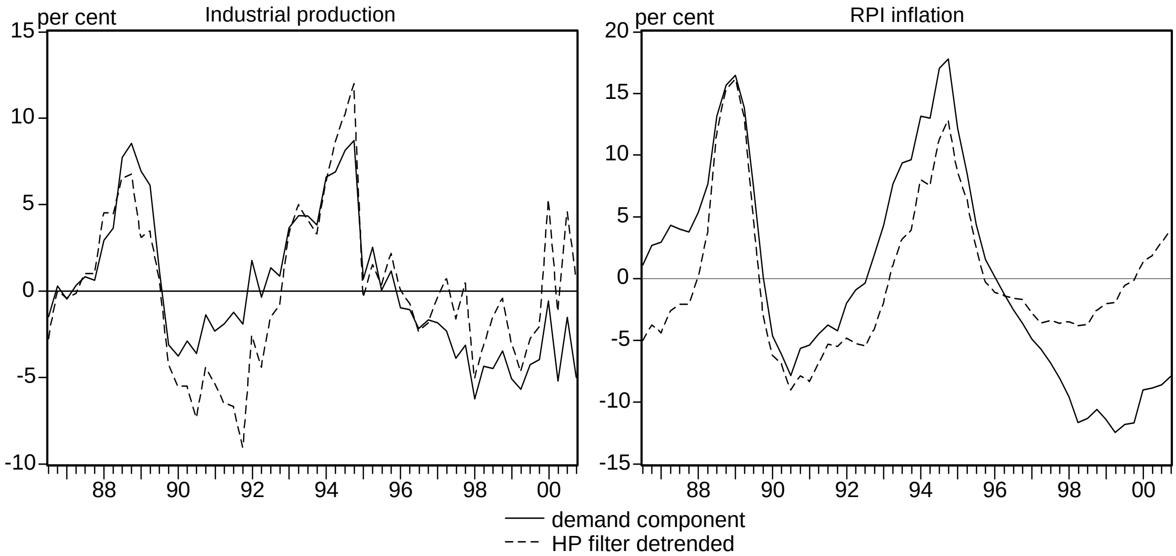
2 The smoothing parameter λ of the HP filter is set to 1600. Supposedly, other high frequency components—seasonal and irregular variation—have been removed by the X-11 procedure.

Figure 3 Demand and cyclical components of industrial production and RPI inflation

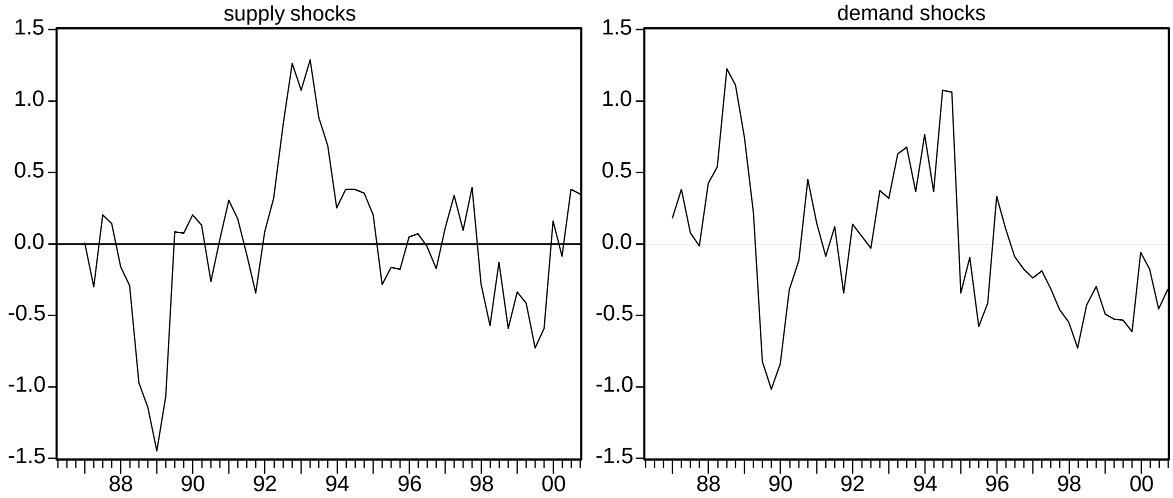


In both panels of Figure 3, the turning points of the demand components match closely the turning points of the HP cyclical components, attesting to the importance of demand shocks as a source of business cycle fluctuations. The relations between the demand components and their corresponding HP cycles have not been invariable. With respect to output, the demand component is slightly lower than the HP cycle before the first quarter of 1988. Starting from the second half of 1988, the HP cycle becomes lower than the demand component, and the discrepancy widened in 1990–91. However, the gap is closed up quickly by the sharp rises of the HP cycle from the third quarter of 1992 through 1993. From the end of 1996, the HP cycle is again above the demand component and the divergence grows wider in the last three years of the sample. For the inflation rate, the HP cycle increases faster than the demand component in 1988, eliminating the initial difference between the two. A dip of the HP cycle in the third quarter of 1992 sets apart the two time paths once more. After a period of convergence in 1995 and 1996, they start to depart from each other again, more notably so from 1998. These relative movements of the demand components and the cyclical components point to the presence of important supply shocks in 1988–89, 1992–93 and around 1998.

Figure 4 plots the four-term moving averages of the structural shocks recovered from the residuals of the estimated VAR model.[3] In the left panel, large negative supply shocks are found during 1988–89. Strong positive supply shocks appeared in 1992–93. According to the impulse responses in Figure 2, a positive supply shock reduces inflation, and brings about a permanent increase in the level of real output. A negative

3 It is not appropriate to use the derived structural shocks directly. The derived shocks are white noises by construction. However, quarterly data are themselves average observations on the underlying data generating processes which may be of higher frequencies. The true structural shocks sampled on a quarterly basis will thus be serially correlated. Applying four-term moving average to the derived shocks is a convenient, though not the only, way to render the shocks more interpretable.

Figure 4 Historical realisations of supply and demand shocks



supply shock does the opposite. It can be then deduced that the negative supply shocks occurring in 1988–89 should have reinforced the effect of positive demand shocks on inflation, but have partly offset the effect of demand shocks on industrial production. As the HP cycle does not discriminate between permanent shocks and transitory shocks, the HP cycle of output is lower than the corresponding demand component whereas the HP cycle of inflation rises faster the demand component.

The situation in 1992–93 can be explained analogously. Less amenable to this interpretation is the period of 1998–99. Figure 4 suggests that there could have appeared some minor negative supply shocks around this time. In Figure 3, the HP cycle of the inflation rate moves accordingly further above the demand component. However, the supply shocks do not seem to present themselves in the HP cycle of output, which continues to exceed the demand component by the same amount as it does before the shocks take place. Two tentative explanations can be offered for the behaviour of output. First, the problem may lie with the algorithm of the HP filter. The positive supply shocks in 1992–93 should have raised the long-run trend of output permanently. Because of the limited sample size, the increases in the long-run trend are not adequately reflected in the trend estimated by the HP filter. Also, the HP filter has been shown to have poor end-of-sample properties (Rennison, 2003). This means the estimated deviations from the trend will be greater than their true values. Second, it may take some time for the effects of the large positive supply shocks in 1992–93, coupled with the small ones in 1994 and late 1996 to early 1997, to reach their full potential. That is, the cyclical component of output is not only the result of contemporaneous shocks, but is also under the influence of shocks from previous periods.

The time plots of historical supply and demand shocks also provide an account of how the forces driving inflation and output have evolved. The years before 1995 are characterised by strong shocks, both from the demand side and from the supply side, and both positive and negative. Since 1995 the magnitudes of shocks have dampened substantially. The first half of the 1990s stands out as an episode of expansionary supply and demand shocks. In comparison, the late 1980s experienced expansionary demand shocks but contractionary supply shocks.

4 How does the model interpret China's business cycles?

The supply and demand shocks as conceptualized by equations (4) and (6) are each a composite of disturbances deriving from different sources. This section examines how the results can help explain China's business cycles in the sample period.

4.1 The chronology of China's business cycles

There exists, as at the time of writing, no official chronology of China's business cycles. Partly this is due to the lack of data for compiling such a chronology. The commonly-used rule of thumb—that a downturn consists of at least two consecutive quarters of negative GDP growth—apparently does not apply as post-reform China has not experienced negative GDP growth.

Previous studies on China's macroeconomic cycles either sidestepped this question or proposed a division of cycles based on the rates of annual inflation and/or GDP growth rates. Examples of the latter include:

i) Yu (1997): 1978–83, 1984–86, 1987–90, 1991–;

ii) Oppers (1997): 1979–81, 1982–early 86, mid 1986–90, 1991–;

iii) Liu (2000): 1977–81, 1981–86, 1987–90, 1991–.

The demand components of output and inflation in Figure 3 suggest a demarcation of the cycles as follows: 1985/86–90, 1991–96, and 1997–. This is largely consistent with Yu (1997), Oppers (1997) and Liu (2000). However, two major differences must be noted. First, the years 1985–86 are included in the cycle ending in 1990 and the years after 1997 are assigned to another cycle. Amalgamating 1985 and 1986 into the 1987–90 cycle is not merely out of consideration for convenience as our data set starts with 1985. It is also justified on the ground that the contraction from late 1985 to early 1986 was mild, short-lived and limited in scope. By the second quarter of 1986, the economy was well on its way to rebound. Indeed, Oppers (1997) observed that the years between 1984 and 1989 can be treated as one cycle. The demand components exhibit much diminished cyclicality after 1997, suggesting systematically different behaviour. The cited researches fail to explore this point perhaps because they employed data up to 1998. Our analysis based on more recent information indicates that 1997 marks the beginning not only of another cycle but also of a new phase of China's macroeconomic fluctuations. Moreover, the impulse response analysis shows that it takes four to six years for the effects of supply and demand shocks to dissipate. The average duration of a cycle found by examining the demand components—five to six years—corroborates the previous result. Note also that the ups and downs of the demand components accord well with the HP filter detrended series. Since the HP filter used here extracts time series components of periodicity less than or equal to eight years, the conformance further demonstrates the predominance of demand shocks as the sources of China's business cycles.

Hence, in a stretch of sixteen years between 1985 and 2000, China experienced two complete cycles and one that is currently underway. The cyclical behaviour of the economy appears to have undergone two distinct phases. The first phase, from 1985 to 1996, contained two cycles with intensifying inflation fluctuations and large oscillations in real activity. The second phase of 1997–2000 was characterised by flat growth and disconcerting deflation.

4.2 Sources of demand shocks

The importance of demand shocks indicated by the results in section 3 does not present much of a surprise. After all, some legacies of the centrally-planned system, such as widespread ‘soft-budget constraint’, cannot be eliminated overnight. As Kornai (1980) observes, the prevalence of soft-budget constraint can put the economy under constant pressure to over-expand. Meanwhile, economic reform has led to rapidly rising personal income, easier access to the world market and more (legal or illegal) profitable investment opportunities, which may also give rise to overheating. The question remains, however, as to what really underlay demand pressures in this period, or, in other words, how the demand components as shown in Figure 3 can be traced to movements in the prominent ingredients of aggregate demand.

A relatively straightforward way towards this end is to examine the correlations between the demand components and the prime suspects of demand pressures—excesses in fixed investment, consumption and export. This amounts to conducting simple regressions of the former on the deviations from the trend, or the cyclical components, of the latter across different periods. Derived through HP filtering, the cyclical components of fixed investment, retail sales (as a proxy for private consumption), and exports are plotted in Figure 5. The regression results are presented in Table 4.

Figure 5 HP-detrended cyclical components of fixed investment, retail sales and exports

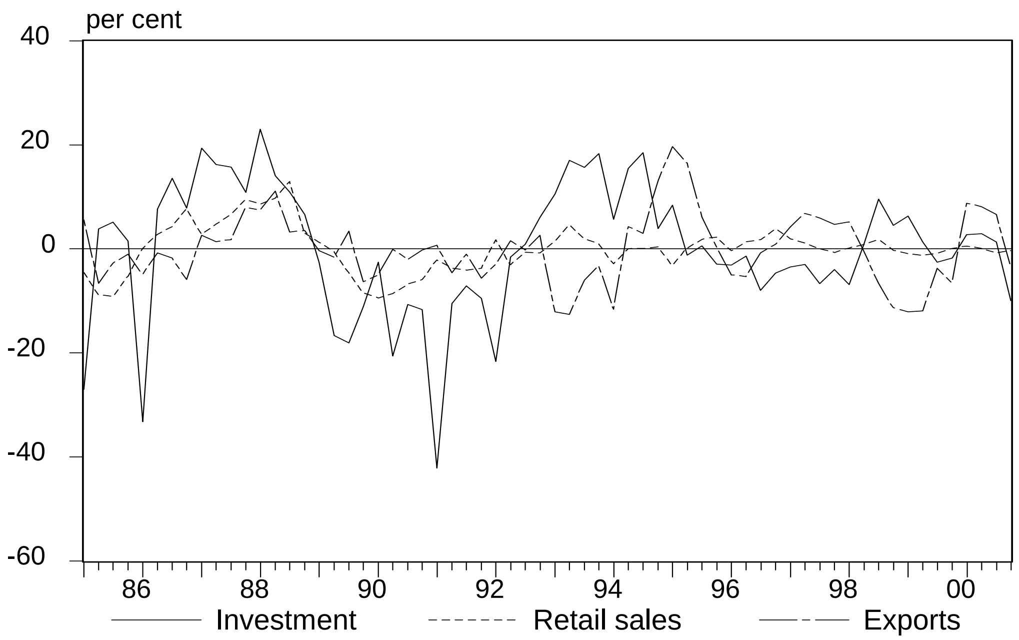


Table 4 The sources of demand shocks

	Industrial production											
	1986:3–2000:4			Cycle I: 1986:3–1990:4			Cycle II: 1991:1–1996:4			Deflation: 1997:1–2000:4		
Variable	Coefficient	s.e.	*p*-value	Coefficient	s.e.	*p*-value	Coefficient	s.e.	*p*-value	Coefficient	s.e.	*p*-value
Constant	-0.002	0.007	0.795	0.014	0.009	0.144	0.023	0.007	0.004	-0.056	0.005	0.000
Investment	0.121	0.067	0.076	-0.236	0.109	0.047	0.215	0.056	0.001	0.067	0.100	0.516
Retail sales	0.142	0.190	0.458	0.662	0.236	0.014	0.177	0.320	0.587	0.424	0.536	0.445
Exports	0.127	0.097	0.196	0.088	0.240	0.720	0.086	0.093	0.366	0.152	0.072	0.057
R^2		0.165			0.448			0.474			0.384	
Adj. R^2		0.119			0.329			0.396			0.230	

	RPI inflation											
	1986:3–2000:4			1986:3–1990:4			1991:1–1996:4			1997:1–2000:4		
Variable	Coefficient	s.e.	*p*-value	Coefficient	s.e.	*p*-value	Coefficient	s.e.	*p*-value	Coefficient	s.e.	*p*-value
Constant	0.000	0.010	0.986	0.033	0.015	0.047	0.037	0.010	0.001	-0.095	0.004	0.000
Investment	0.236	0.106	0.030	-0.303	0.180	0.115	0.389	0.074	0.000	-0.156	0.088	0.102
Retail sales	0.153	0.299	0.612	1.031	0.390	0.019	-0.031	0.423	0.942	0.718	0.469	0.151
Exports	0.298	0.153	0.057	0.051	0.397	0.899	0.295	0.122	0.026	0.144	0.063	0.042
R^2		0.215			0.424			0.637			0.626	
Adj. R^2		0.172			0.301			0.582			0.533	

Note: Dependent variable = demand component of industrial production or RPI inflation; independent variables = cyclical components (derived through HP filtering) of fix investment, retail sales and exports.

With regard to industrial production, the regressions show that fixed investment is significant in equations for the second cycle and the whole sample, but not for the deflation period. It also appears important in the equation for the first cycle, albeit with a puzzling negative sign. Retail sales play a significant role in the first cycle while the influence of exports dominates in the deflation period of 1997–2000. Quite similar results occur with the inflation equations, except that the export series is significant in the regressions for the entire period and for the last two sub-periods. Another point to note is that, with the exception of the first cycle, the R^2s of the inflation equations are higher than those of the industrial production equations. This signifies that the demand component of inflation has a stronger correlation with the excesses and slumps in fixed investment, retail sales and exports. To the extent that causality runs from the three variables to inflation, this piece of evidence confirms, once again, that demand shocks are the foremost force behind the movements of inflation.

The above findings are in line with the indications of Figure 5. The upswing of the first cycle (1986–90) was brought about by excessive expansion in both investment and retail sales. During this period, state-owned enterprise (SOE) reforms, fiscal decentralisation and easy bank credit fuelled high wage growth and rapid expansion in fixed investment. Price reform raised expected inflation rates. When the government attempted to cool off the economy by tightening credit quotas and imposing administrative controls, both investment and retail sales plummeted.

This pattern of double-expansion and double-dip in investment and consumption changed substantially in 1991–2000. Retail sales in Figure 5 displayed stability throughout the period, reflecting a subdued role of consumption in generating cyclical fluctuations. The expansion phase of the second cycle was driven by the investment boom of 1992–93. Fixed investment also managed a mild turnaround between 1998 and 1999, thanks to large government outlays on infrastructure investment. Exports assumed a higher profile in this period. Strong exports growth occurred in 1994, which may have prolonged the upswing of the second cycle and undermined the government's effort to contain excess demand pressure. Negative shocks to exports in 1998, in contrast, might have contributed to deflation.

To sum up, demand shocks in the first cycle are largely attributable to consumption and fixed investment, whilst in the later years they are more closely associated with fixed investment and exports. A number of factors could have contributed to these variations from the first cycle to the later two periods. First of all, household expectations about inflation and uncertainty of future income and expenditure have changed, partly due to past experience and partly in response to reforms in employment, education and health care systems. On the one hand, the inflation episodes in 1985–86 and 1988–89 helped households eventually break away from the psychology moulded in the central planning era when price stability and shortage were the norm. Certainly, expectations of future inflation would still raise current consumption, but blind stockpiling had become a fading bygone. On the other hand, a growing number of SOE employees were laid off or became *de facto* unemployed especially in the latter half of the 1990s, amidst acceleration in dismantling the old welfare system in the urban areas. Increased uncertainty about the future propels risk-averse households to build up a buffer stock of savings (Carroll, 1992; Zhang and Wan, 2002). Added to this uncertainty is the enlarging income disparity between the coastal and the inland regions, between cities and the countryside, and among different professions and social groups. All these factors combined make consumption growth fall behind output growth. As such, the reduced volatility of consumption in the later periods not only indicates consumption smoothing, but also signals weaker consumption demand.

The second cycle coincides with yet another reform cycle. The renewed momentum of reform, following Deng Xiaoping's tour of south China, touched off an investment boom in 1992–93. This was further facilitated by rapidly accumulating household savings, devolution to local governments of the power to ratify investment projects, and a proliferation of financing conduits other than bank lending. An upswing driven by fixed investment, albeit eventually bringing in its train rises in consumption demand and hikes in consumer goods prices, entails a downturn different from one ensuing on a consumption-led expansion. Because investment projects take time to complete and bring forth new capacity, the downturn will be more protracted than the time required for simply liquidating excess inventories.

Macroeconomic management in the second cycle leaned more towards market-oriented levers, too. To avert the undue hardship caused by indiscriminate administrative restraints, measures like interest rates adjustment and treasury bonds were actively utilized. The focus of administrative controls was placed on maintaining order in financial markets by cracking down on 'illegal' fund raising schemes, bank lending to non-bank financial institutions, and so on. Traditional tools of tightening credit quotas, reducing ratified investment projects and price surveillance were also involved, yet in a more selective and flexible manner. As can be expected of these changes, the trough of industrial growth became shallower whereas the petering out of inflation spouts grew more drawn out.

The foreign sector assumed a high profile in the second and third cycles, due to the surge of inward foreign direct investment (FDI) and the success of export promotion. In 1992–96, FDI increased by leaps and bounds. The annual inflows reached US$41.73 billion in 1996, nearly ten folds of the US$4.37 billion in 1991 (*SYC*, 1999). The share of FDI in total domestic fixed investment rose from 4 per cent or so in 1991 to over 17 per cent in 1993 and 1994. The ratio declined a little in the following years, but still remained above 13 per cent.[4] A large proportion of these investments went into export-oriented manufacturing industries. In the meantime, a series of foreign exchange reforms[5] and fiscal incentives (tax rebates) were implemented to stimulate export growth. As a result, exports not only multiplied in terms of absolute volume, but also increased its share in GDP. Particularly noteworthy is the 1994 exchange rate reform that unified the official exchange rate with the swap market rate, and led to a more flexibly managed exchange rate regime. In the same year, China's exports expanded by 32 per cent, followed by another 23 per cent increase in 1995 (*SYC*, 2000). Although it is debatable as to how much of this rapid export expansion can be ascribed to the devaluation of the official exchange rate, the increase in itself proved to be not well timed. It came at a time when the annual inflation rate (as measured by percentage

4 These ratios are calculated using FDI data from *SYC* (1999) and fixed investment data from *WDI* (2000).

5 The Chinese currency Renminbin (RMB) underwent substantial devaluation between 1990 and 1994, from 4.78 yuan to the US dollar to 8.62 yuan. Convertibility on current account was established in 1996.

growth of CPI) hit a record high of 24.1 per cent (*SYC*, 2000), thus complicated the task of containing excess demand pressure.

The Asian financial crisis constituted a major negative external shock. Although the contagion of exchange rate collapse and large-scale capital flight did not spread across China's borders, exports dived sharply in 1998 and in the first half of 1999. Meanwhile, FDI inflows stalled in 1998 and then declined in 1999. After monetary easing failed to fend off the deflation that set in 1998, fiscal policy, largely dormant for years, was brought back into action. However, pump-priming via public investment in infrastructure did not instigate an instant and strong upturn in non-state investment. Private consumption remained stable, yet flat. It seems therefore that the external sector held sway in the deflation period.

4.3 Potential output and supply shocks

The Blanchard–Quah decomposition employed in this study derives from the notion of a vertical long-run Phillips curve. The historical decomposition of output can thereby be used to construct a measure of potential output.

Theoretically, potential output corresponds to the level of output that obtains when all adjustments arising from nominal rigidities and misperception have completed. Within the context of the structural VAR model of equations (4) and (6), this definition of potential output can be identified with the permanent component of industrial production. It is the time path of industrial production in the absence of demand shocks. The computed potential level of industrial production is shown in Figure 6, along with its observed values. The differences between the two series represent the output gaps—percentage deviations of actual output from its potential value. During the two inflation episodes (1988–89 and 1993–94), positive output gaps (excess of actual output over potential output) reached as high as 10 per cent (in the fourth quarter of 1988) and 12 per cent (in the fourth quarter of 1994) respectively. This demonstrates that short-run supply is rather elastic, perhaps a reflection of widespread underemployment of labour in the SOEs and a very fluid population of rural migrant workers.

At first glance, actual output in Figure 6 seems to track potential output well despite deviations occurring from time to time. This does not necessarily constitute evidence that supply shocks explain the bulk of output fluctuations. A high correlation between the levels of two $I(1)$ series may come about in the presence of a dominant drift term, even if the two series are not genuinely related in any way. The forecast error variance decomposition of section 3 suggests that demand shocks are very important in accounting for the business cycle frequency movements of industrial production. That result, however, is based on the assumption that supply and demand shocks are of fixed sizes. As is evident in Figure 4, the magnitudes of both types of shocks have varied substantially over time. To reveal the role of supply shocks in different historical periods, simple regressions have been conducted to regress the first differences of actual output on the first differences of potential output. Table 5 reports the results for the entire sample and the three sub-periods.

Figure 6 Actual and potential levels of industrial production

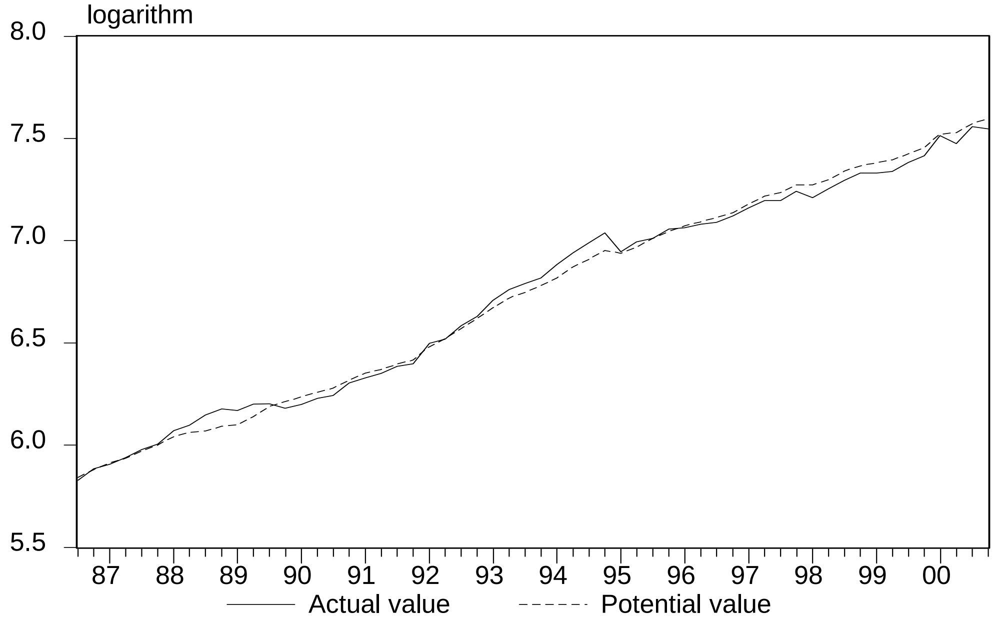


Table 5 Potential output, actual output and the demand component

	Period			
	1986:4–2000:4	1986:4–1990:4	1991:1–1996:4	1997:1–2000:4
Adjusted R^2	0.634	0.033	0.768	0.827
Coefficient on the growth of potential output[a]	1.741 (0.176)	0.607 (0.488)	1.982 (0.226)	2.064 (0.242)
Correlation between potential output and the demand component[b]	0.104	-0.461	0.252	0.779

Notes: [a] The regressions are run in the first differences of industrial production and its potential values. Entries in parentheses are the standard errors of the coefficient estimates.

[b] This is computed as the correlation between the first differences of potential output and the demand component.

As can be seen from Table 5, supply shocks explain about 63 per cent of the variability of industrial production on average. However, their explanatory power has increased significantly over time, from virtually negligible in the first cycle to over 82 per cent in the last sub-period. Hence, supply shocks acquired increasing importance in driving the fluctuations in industrial production in the sample period. This is understandable since, presumably, years of economic reform has reduced institutional rigidities hampering the adjustment of the economy to exogenous shocks. A market with enhanced capability of functioning more efficiently entails a greater role of supply shocks in determining the course of the macroeconomy.

What then are the possible sources of supply shocks? First, China has accumulated a massive pool of migrant rural labourers in the reform period. The process of rural-to-urban, agriculture-to-non-agriculture labour transfers accelerated in later years, but was never smooth. From time to time, there were eruptions of regional protectionism and crackdowns on ‘illegal’ migrant workers. The disturbances, both positive and negative, to the supply of industrial labour force are not well reflected in the official employment statistics, but can nevertheless be of a significant magnitude. Second, increases in the volumes and volatility of international trade and FDI inflows can result in supply shocks via their impact on domestic investment, resource allocation and technological progress. Third, the government, by tightening or easing credit controls, can shift the allocation of resources between the state and non-state sectors, which in turn affects the economy-wide level of productivity as the non-state sector is generally more efficient (Brandt and Zhu, 2000, 2001).

The derived potential output also casts some light on the effectiveness of demand management policy. The last row of Table 5 presents the correlations between the permanent and transitory components of real output over different periods. As discussed above, movements in potential output are caused by supply shocks while the transitory component represents the cumulated effects of demand shocks. If macroeconomic policy is the prime mover of demand shocks, the degree of co-variation between the two components of output can be regarded as signifying how accommodating macroeconomic policy was in the specified period. Should this be true, the figures in Table 5 would suggest that policy was counteractive to supply shocks in the first cycle, but has grown much more accommodating in the later years. More specifically, it can be inferred from the description that when faced with negative supply shocks in 1988–89 and 1998–99, the government pursued expansionary policies in the first case, yet implemented restrictive policies in the second occasion. These scenarios are clearly at odds with the officially announced policy intentions. Neither are they the likely outcomes of implemented policies, albeit unexpected side-effects and events could have dislodged the original policy objectives. Therefore, we choose to interpret the correlations in Table 5 as testimony that demand management policies did not, at least not always, wield material influence on aggregate demand.

5 Conclusion

Based on a structural VAR model of real output and inflation, this paper analyses two types of exogenous shocks driving business cycles in China: demand shocks and supply shocks. The dynamic effects, relative importance and possible origins of these shocks are explored in relation to their historical evolution.

Three interesting findings emerge. First of all, both impulse response analysis and forecast error variance decomposition show that demand shocks exerted stronger influence on output and inflation than do supply shocks. However, there were variations from one period to another. These variations manifested themselves in a number of ways. The amplitudes of both shocks exhibited a tendency to moderate through time. Further, supply shocks have acquired more importance in the later years of the sample. Meanwhile, the major sources of demand shocks have been shifting.

Second, the Chinese economy is found to be experiencing another cycle started in 1997 after completing two cycles: 1985–90 and 1991–96. The first cycle was dominated by consumption and fixed investment shocks. In the second cycle and the post-1997 deflation period, shocks from fixed investment and world demand occupied the central stage. Overexpansion of investment led to slumps in private investment thereafter, leaving exports the chief engine of growth in 1997–2000.

An examination of the derived potential output gives rise to the third finding—demand management policies do not seem to have been a particularly important source of aggregate demand shocks, neither have they demonstrated effectiveness in restraining excess demand. Thus, stabilisation policy is not the major source of macroeconomic fluctuations, despite the close association between demand shocks and business cycles. In comparison with the evidence for other transition economies presented in Fischer and Sahay (2000) and Dibooglu and Kutan (2001), greater macroeconomic stability in China is attributable both to its transition strategy, which moderated the impact of structural reforms, and to non-restrictive macroeconomic policy.

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