SOURCES OF BUSINESS CYCLE FLUCTUATIONS: COMPARING CHINA AND INDIA

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Sources of Business Cycle Fluctuations: Comparing China and India

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Abstract

This paper investigates the sources of business cycle fluctuations in China and India since 1978/81. Under the framework of a standard neoclassical open economy model with time-varying frictions (wedges), we study the relative importance of efficiency, labor, investment and government consumption wedges on the business cycle phenomenon. This enables us to contrast and compare the two countries' experience in a way remarkably different from previous studies. The results for both China and India show that efficiency wedge is the main source of economic fluctuations, while the investment wedge and government consumption wedge played minor roles in generating business cycles.

Keywords: Business cycle fluctuations, Business cycle accounting, China, India

JEL Classification: E32, E37, O47, O53

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1. Introduction

There is an extensive body of literature addressing China's and India's economic growth experience of the past two to three decades. Both countries have seen accelerated growth as trade liberalization and market-oriented structural reforms have deepened. India's economy has grown at a real average rate of 3.4 percent per annum over the 1981 – 2006 period, and GDP per capita has more than doubled. China with its unprecedented development experienced a real average rate of growth of 9.8 percent over the 1978-2006 period, while its GDP per capita increased more than 7-fold. These developments have not only made China and India increasingly integrated into world trade and financial systems, but due to frequent policy distortions and constraints that affect the quality and sustainability of the economy, they have also become increasingly vulnerable to uncertainties. Thus, a major challenge for these countries is how to prepare for, and manage various shocks while maintaining a balanced economic growth.

This paper provides guidance on the issue by examining the sources of business, i.e., economic, cycle fluctuations in China and India. Theoretically, identification of the sources underlying business cycle fluctuation contribute to our understanding of the economic mechanisms of the two countries respectively and, thus the major differences or similarities of the two. Practically, with the knowledge of what sources lies behind economic fluctuations, the governments' of both China and India can adopt appropriate policies to smooth business cycles and thus increase the welfare of its citizens.

Unlike the case for India[1], an extensive body of literature addresses China's business cycle although most of them stay at the level of descriptive study and summary statistics calculations. Qian (2004), Lu and Qi (2006), Liu (2006) are some

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[1] The authors cannot find any study of Business Cycle Accounting for India.

[2] A technical appendix of this paper for details on the estimation procedure is available from the authors by request.

[3] Lin *et al*., 2006 provide a good overview of China's reform experience, and Kochhar *et al*., 2006 provide a good overview of India's pattern of development.

[4] Ideally, we should inspect quarterly series to summarize the stylized facts. However, there is no quarterly data available for GDP by expenditure for China and India, which makes it impossible for us to have quarterly data for private consumption, government consumption etc. We use government consumption plus net exports as a single variable in our analysis because it has an exact counterpart in the benchmark model specified in section 2.

[5] Xu (2007) split the sample period for China into two sub-samples (1978-1991 and 1992-2006). In the current

representative studies among others. Unlike them, Zhang and Wan (2005), and Xu (2007b) employed long-run restrictions proposed by Blanchard and Quah in a SVAR framework to decompose business cycle fluctuation sources into supply shocks and demand shocks, and found that most fluctuations in output can be explained by supply shocks.

In this paper, we analyze business cycle fluctuations with the method first proposed by Mulligan (2002) and Chari, Kehoe, and McGrattan (2007). This method named "business cycle accounting" (BCA) starts from a standard neoclassical growth model with time-varying wedges of efficiency, investment taxes, labor taxes, and government consumption. These four wedges are then measured so that the model replicates the data exactly. Hence, by inspecting the measured wedges one can learn about the relative importance of wedges in generating macro-variable fluctuations and identify possible business cycle sources. Chari et al., (2007) also show that a large class of quantitative business cycle models are equivalent to the prototype model used in BCA. Hence, measured wedges serve as useful guidelines in model building.

Despite debates about its validity (Christiano and Davis, 2006; Chari et al., (2007), the BCA method has been gradually accepted. It was employed by Chakraborty (2004), Kobayashi and Inaba (2006) to investigate Japan's recession; Lama (2005) used it to identify business cycle sources for Argentina, Brazil and Mexico; Cavalcanti (2004) employed it to account for business cycles in Portugal.

In this paper, we conduct the business cycle accounting exercise using data from 1978 – 2006 for China and 1981 – 2006 for India. To preview the answer, the overall results show that in both countries the efficiency wedge is the main source of economic fluctuations, while the investment wedge and government consumption wedge played only minor roles in generating business cycles.

The reminder of the paper is organized as follows. Section 2 describes the benchmark model used in our business cycle accounting exercise. Details of accounting procedures are introduced in section 3. In section 4, we summarize some business cycle stylized facts found in the macro-series of China and India. This section also presents the accounting results. Section 5 concludes.

2. The Benchmark Growth Model

Following Chari et al., (2007), we apply a stochastic growth model with time-varying shocks as benchmark. In each period, the economy experiences one of finitely many events s_t which are called shocks. The history of events up through and including period t is denoted by $s^t(s_0, \ldots, s_t)$. Initial state s^0 is given. In period 0, the probability of any particular history s^t is $\pi_t(s^t)$. In the model, there are four stochastic variables, all of which are functions of history S^t. They are: the efficiency wedge $A_t(s^t)$, the investment wedge $1/[1+\tau_{xt}(s^t)]$, the labor wedge $1-\tau_{lt}(s^t)$, and the government wedge $g_t(s^t)$.

The representative consumer chooses consumption $\tilde{c}_t(s^t)$ and labor supply $l_t(s^t)$ to maximize expected utility

$$\sum_{t=0}^{\infty} \sum_{s^t} \rho^t \pi_t(s^t) u\left(\tilde{c}_t(s^t), l_t(s^t)\right) N_t \tag{1}$$

Subject to the budget constraint

$$C_t(s^t) + [1+\tau_{xt}(s^t)]X_t(s^t) = [1-\tau_{lt}(s^t)]\omega(s^t)L_t(s^t) + r_t(s^t)K_t(s^{t-1}) + T_t(s^t) \tag{2}$$

and the motion of capital

$$K_{t-1}(s^t) = (1-\delta)K_t(s^{t-1})|X_t(s^t) \tag{3}$$

Where $C_t(s^t)$, $X_t(s^t)$, $T_t(s^t)$, and $K_t(s^{t-1})$ denote aggregate consumption, investment, lump-sum transfer and capital stock, respectively. $\tilde{c}_t(s^t)$ denote per capita consumption, $\omega(s^t)$ the wage rate, $r_t(s^t)$ the rental rate on capital, ρ the discount factor, δ the depreciation rate of capital, and N_t the population with growth rate equal to $1|g_n$.

The production function is $A_t(s^t)F\left(K_t(s^{t-1}), Z_t L_t(s^t)\right)$, where Z_t denotes the labor-augmenting technology level with an assumed constant growth rate equal to $1+g_z$. At the equilibrium, we have the following resource constraint relation

$$C_t(s^t) + X_t(s^t) + G_t(s^t) = Y_t(s^t) \tag{4}$$

Where $Y_t(s^t)$ denote the aggregate output. To facilitate the preceding analysis, we transform the model into stationary form by defining the following de-trended variables: $c_t = \frac{C_t}{(Z_t N_t)} = \tilde{c}_t / Z_t$, $x_t = X_t/(Z_t N_t)$, $k_t = K_t/(Z_t N_t)$, $t_t = T_t/(Z_t N_t)$, $g_t = G_t/(Z_t N_t)$, $y_t = Y_t/(Z_t N_t)$, $\omega_t = \omega_t / Z_t$. The representative consumer's problem can be written with de-trended variables as:

$$\frac{max}{c_t, l_t, x_t} \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi_t(s^t) U\left(c_t(s^t), l_t(s^t)\right) \tag{5}$$

subject to

$$c_t(s^t) + [1 + \tau_{xt}(s^t)]x_t(s^t) = [1 - \tau_{lt}(s^t)]w_t(s^t)l_t(s^t) + r_t(s^t)k_t(s^{t-1}) + t_t(s^t)$$

(6)

and

$$(1+\gamma)k_{t+1}(s^t) = (1-\delta)k_t(s^{t-1}) + x_t(s^t) \tag{7}$$

where $\beta = \rho(1+g_n)$, $1+\gamma = (1+g_n)(1+g_z)$ and $U(\cdot,\cdot)$ depends on the choice of utility $u(\cdot,\cdot)$.

Firms' problem can be written as

$$\frac{max}{\{k_t(s^t), l_t(s^t)\}} A_t(s^t)F\left(k_t(s^{t-1}), l_t(s^t)\right) - r_t(s^t)k_t(s^{t-1}) - w_t(s^t)l_t(s^t) \tag{8}$$

The equilibrium of the model is summarized by the following resource constraint of the economy

$$c_t(s^t) + x_t(s^t) + g_t(s^t) = y_t(s^t) \quad (9)$$

together with production technology

$$y_t(s^t) = A_t(s^t)F\left(k_t(s^{t-1}), l_t(s^t)\right) \quad (10)$$

The optimal substitution between consumption and leisure

$$-\frac{U_{lt}(s^t)}{U_{ct}(s^t)} = [1 - \tau_{lt}(s^t)]A_t(s^t)F_{lt}(s^t) \quad (11)$$

and the Euler equation

$$U_{ct}(s^t)(1+\gamma)[1+\tau_{xt}(s^t)] = \beta \sum_{s^{t+1}} \pi(s^{t+1}|s^t)U_{ct+1}\{A_{t+1}(s^{t+1})F_{kt+1}(s^{t+1}) + (1-\delta)[1+\tau_{xt+1}(s^{t+1})]\}$$

(12)

Where U_{ct}, U_{lt}, F_{kt}, and F_{lt} denote the derivatives of the utility function and the production function with respect to their arguments.

Chari et al., (2007) show that various frictions in quantitative business cycle models are equivalent to this benchmark model: Frictions, such as input-financing friction, that cause input to be used inefficiently are equivalent to a efficiency wedge; sticky-wage or powerful labor unions are equivalent to a labor wedge; financial friction of the type proposed by Carlstrom and Fuerst (1997) is equivalent to a investment wedge; and net exports are equivalent to a government wedge, in an associated benchmark model.

3. Accounting Procedures

The purpose of the accounting procedure is to conduct experiment that isolates the marginal effect of each wedge as well as combinations of wedges on aggregate variables. First, the four wedges in the benchmark growth model are estimated from the data using equilibrium conditions (9), (10), (11) and (12). Then, the values of measured wedges are fed back into the benchmark model, one at a time and in combinations, to assess their marginal effect on aggregate variables. By construction, all four wedges together account for all of the observed movements in aggregate variables.

3.1 Calibration

To apply the accounting procedure, the following standard functional forms and parameter values in the business cycle literature are employed: Preference of the representative consumer are assumed to take the form of $U(c,l) = \log c + \omega \log(1-l)$. Production function is assumed to the Cobb-Douglas form of $F(k,l) = k^{\propto} l^{1-a}$.

We use Bayesian techniques in the empirical exercise to estimate wedges from the data. Although it is possible to estimate all model parameters from data simultaneously, we choose to fix those parameters, which have commonly accepted calibration values, in the estimation.

Following Chari et al., (2007), the following parameters are first calibrated in our empirical exercise. For China, we choose the capital share $\propto = 0.65$, the discount factor $\beta = 0.95$, the depreciation rate $\delta = 0.05$, time allocation parameter, $\omega = 2.24$which are commonly used in the quantitative research on Chinese economy. The value of growth rate of effective labor $\gamma = 0.098$ can retrieved directly from real output series. For India, capital share $\propto$ is set to 0.35 and γ is set to 0.035 with the other parameters set the same as for China.

3.2 Estimation of Wedges

To estimate the four wedges, the benchmark model is first log-linearized around its steady state and then solved with method proposed by Blanchard and Kahn (1980).

We define the vector

$$s_t = [\hat{a}_t \ \hat{\tau}_{xt} \ \hat{\tau}_{lt} \ \hat{g}_t]' \qquad (13)$$

where $\hat{a}_t$ and $\hat{g}_t$ are log deviations from trend, $\hat{\tau}_{xt}$ and $\hat{\tau}_{lt}$ are linear deviations from trend. Clearly, vector s_t can be viewed as the event experienced by the economy. Following Chari et al., (2007), we assume s_t takes the following vector AR(1) process

$$s_{t+1} = Hs_t + \varepsilon_{t+1} \qquad (14)$$

where the shock ε_{t+1} is i.i.d. over time and distributed normally with mean zero and covariance matrix V . To ensure our estimate of V is positive semi-definite, we estimate the lower triangular matrix Q where $V = QQ'$.

Because the four wedges are represented as deviations, their steady state values are needed for us to fully characterize the stochastic process for the state. The steady state value of government wedge g can be retrieved directly from the real data. For the efficiency wedge, its steady state value is normalized to 1. Hence, there are 28 parameters (16 in matrix H, 10 in matrix Q and 2 steady state values for investment wedge, τ_x, and labor wedge, τ_l) need to be estimated.

We then use a standard maximum likelihood procedure combined with prior from long-run relationships among different GDP components to estimate those 28 parameters. The realizations of those four wedges are estimated with the Kalman smoothing method.[2]

Because there are 4 shocks in our benchmark model, we can use up to 4 observation series to estimate the model with maximum likelihood method. If the number of observation series exceeds 4, measurement errors should be introduced into the model to overcome the problem of singularity encountered in the estimation. However, the existence of measurement errors will make our empirical exercise no

[2] A technical appendix of this paper for details on the estimation procedure is available from the authors by request.

longer an accounting procedure. We choose the four series of real output, real private consumption, real government consumption (plus net export) and real investment as the observation series. Filtered series of those four variables are used as raw data in our estimation.

3.3 Counterfactual Experiments

The final step of our accounting procedure is to conduct counterfactual experiments to isolate the marginal effects of wedges. In these experiments, a subset of the wedges is allowed to fluctuate as they do in the data while the others are set to their steady state values.

In the solution of the model, decision rules for output $y(s_t, k_t)$, consumption $c(s_t, k_t)$, investment $x(s_t, k_t)$ etc can be found. Suppose we want to evaluate the effects of the efficiency wedge, we set $\hat{a}_t(s_t) = \hat{a}_t$, $\hat{\tau}_{xt}(s_t) = \tau_{xt}$, $\hat{\tau}_{lt}(s_t) = \tau_l$,. $g_t(s_t) = g$. These assumed wedges, in addition with the decision rules and capital accumulation law, give us the realized sequences of output, consumption and investment, which are called the efficiency wedge components of output, consumption and investment. Components of other wedges or wedge combinations are retrieved using similar procedures.

4. Comparing China and India

4.1 Stylized Business Cycle Facts

Before proceeding to our business cycle accounting procedures, we outline some regularity in the macroeconomic data for China and India since the reform began in 1978 and 1981s, respectively[3]. China and India had comparable development strategies at the onset of reforms with both of them focusing on step-wise

[3] Lin *et al.*, 2006 provide a good overview of China's reform experience, and Kochhar *et al.*, 2006 provide a good overview of India's pattern of development.

market-oriented reforms and opening-up to the world economy. China began reforming its centrally planned economy in 1978 following a traditional pattern of specialization in labor-intensive industries commensurate with the country's income level. This strategy has later been complimented by a move to specialization in high-technology and skill-intensive industries and services.

India always had a large private sector and functioning markets, but which were subject to rigid state controls until the hesitant and piecemeal reforms of the early 1980s. As demonstrated in Kochhar et al., (2006) these became systematic and broader after India experienced a severe macroeconomic crisis in 1991. India clearly made an effort to take a big leap forward and intensified its efforts in high-technology and skill-intensive industries and services, rather than utilizing its comparative advantage in labor-intensive manufacturing. While the disadvantages and advantages of these development strategies is by itself a heatedly debated topic, there exist some notable differences in the macro-performance of the two economies.

In international comparisons, China's achievements have been unprecedented, but India has also grown at a rate that matches well the other industrializing economies of East Asia. Figure 1 shows the real GDP growth rate since 1978 and 1981 for China and India respectively.

FIGURE 1 ABOUT HERE

The real GDP growth of China averaged 9.8 percent over the 1978 – 2006 period, while real average growth in India stood at 3.4 percent over the 1981 - 2006 period, that is, approximately the same time span as that of China. During these periods, China's per capita GDP increased more than 7-fold while that of India more than doubled. Noteworthy is that both economies experienced large swings in economic growth rates over the whole period, although fluctuation has been gradually reduced over time, particularly in China.

Figure 2 and Figure 3 show real series of output growth and GDP composition. We use real series of output, private consumption, government consumption plus net exports[4]. All series are first logged and then de-trended using the HP-filter.

FIGURE 2 ABOUT HERE

FIGURE 3 ABOUT HERE

In both countries, the downward trend in the share of private consumption and upward trend in the share of investment in GDP are easily spotted.

In China, private consumption has long accounted for the largest share of GDP but was surpassed by investment in 2003 and where the latter accounted for 43 percent of GDP in 2006. In India, private consumption accounts for a much larger share of GDP although it has fallen from around 80 percent in 1981 to 59 percent in 2006. Here too, investment is increasing its share of GDP and reached 32 percent in 2006. In 2006, government consumption plus net exports accounted for 21 percent of GDP in China, while the same share was only 9 percent in India.

Table 1, Figure 4 and Figure 5 show the standard deviation and correlations with output of the four macro-economic series. Our first observation gives that output (real GDP) fluctuation was 3.2 percentage points for China and 1.7 percentage points in India, meaning that China had larger fluctuations in real GDP than India. On the other hand, the first-order autocorrelation coefficient of China's real GDP fluctuation was 0.72, while the same coefficient for India was only 0.32, implying that China's GDP growth was more persistent than that in India.

TABLE 1 ABOUT HERE

In China, private consumption was more volatile than real GDP, contrasting the popular consumption smoothing theory and experiences of other countries, including

[4] Ideally, we should inspect quarterly series to summarize the stylized facts. However, there is no quarterly data available for GDP by expenditure for China and India, which makes it impossible for us to have quarterly data for private consumption, government consumption etc. We use government consumption plus net exports as a single variable in our analysis because it has an exact counterpart in the benchmark model specified in section 2.

India where private consumption was much less volatile. In China, private consumption lagged behind output for one year, which is different from the Indian experience where private consumption follows output more closely.

Although fluctuation of China's output was almost twice that of India, investment fluctuation had almost the same magnitude in both countries. Contrasting to the common wisdom that Chinese economy was led by investment, fluctuation of investment lagged behind output movements for one to two years. On the contrary, investment is more appropriately described as contemporary or even leading variable of output in India.

FIGURE 4 ABOUT HERE

Although the magnitude of fluctuation in government consumption fluctuation was large in both countries, its correlation with output was relatively small. In China, it was even a counter-cyclical variable. These facts rule out the possibility that the output fluctuation was caused by government consumption and net exports in either China or India.

FIGURE 5 ABOUT HERE

4.2 Properties of Estimated Output Components

In this section, we describe the results derived from applying the BCA procedure. First, in both China and India, efficiency wedge (Solow residual) is the main driving force of output fluctuations[5]**.** As given by Table 2, Figure 6 and 7; in both countries, output fluctuations due to efficiency wedge alone are much higher than the observed

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[5] Xu (2007) split the sample period for China into two sub-samples (1978-1991 and 1992-2006). In the current study, however, such division of sample-periods cannot be done using data for India. Robustness of BCA results with data for India is sensitive to the calibrated parameter values when the time-series are split into two parts. The reason can most likely be attributed to the short time-series accentuated with only small variation in the data. Hence, we don't have enough confidence in the results retrieved with data for India in this respect. As a result, we use the whole sample period for our BCA estimation. Note that the main result for China, i.e., the significant role played by the efficiency wedge is evident also when the sample is divided into two periods. In the second period, however, investment wedge increases in importance.

output fluctuations in both economies (1.66 times in China and 2.52 times in India).

TABLE 2 ABOUT HERE

First, this can be explained by either two reasons: (1) output fluctuations were mainly led by technology advances and infrastructure change, which result in different productivity of input; or (2) there are still factors left which cannot be explained by a standard Real Business Cycle (RBC) model. Because Solow residual is sometimes called “measure of ignorance”, factors which cannot be explained by the specified model are attributed to it.

Second, the damping effect of distortions in labor market (sticky-wages and powerful labor unions) in India is much greater than in China. In India, output fluctuations due to labor wedge alone is 2.2 times of the observed output fluctuations in real world data, while it is only 0.52 times in China. Distortions in labor markets of India are counter cyclical, while its first-order auto-correlation for China is very small.

FIGURE 6 ABOUT HERE

FIGURE 7 ABOUT HERE

Finally, investment wedge and government consumption wedge only played minor roles in generating output fluctuation in both countries.

Cross correlations of output components due to each wedge show that the efficiency wedge with output is pro-cyclical in both economies although more forcefully so in China than in India. Meanwhile, investment, labor, output components were counter-cyclical variables in both economies, although correlations stood at very low levels for labor in China. Government consumption was a-cyclical in China and pro-cyclical in India.

This suggests that the efficiency wedge may be the main driving force of output fluctuations. Table 2 also show that the relative importance of the efficiency wedge to output fluctuation is high for both China and India as the standard deviations is 1.66 and 2.52 respectively. It is thus evident that output fluctuation due to efficiency wedge was much larger than those caused by other wedges. Given the fact that efficiency wedge was highly correlated with output, it can be viewed as a good candidate for the sources of business cycle fluctuations.

4.3 Some Explanations

In the literature, the efficiency wedge in our model is usually referred to as "Solow residual", which captures factors others than inputs that have impact on final output. The Solow residual is also frequently called the "technology shock" or "institutional factor'. Our analysis points in the direction that technological advance and institutional changes are the main determinants of China's and India's business cycle. This is also in line with real-world observations from China and India. Both countries started out with backward technology but after decades of reform and opening-up, these economies have become more and more market-oriented, and the technology gap with advanced countries has narrowed significantly. In the mean-time, resource allocation from low-efficient sectors to sectors with higher efficiency has been significant thus leading to efficiency gains. Through reform, the institutional structure has been changed to liberate productive forces. Through the process of opening-up, China in particular, but also India has attracted significant amounts of foreign investment which most likely brings in advanced technology and management, thus leading to increasing competition. Our empirical results provide quantitative evidences to these observations.

5 Concluding Remarks

This paper investigate the sources of business cycle fluctuations in China and India since the late 1970s and early 1980s, using business cycle accounting (BCA) methodology developed by Chari et al., (2007). This enables us to contrast and compare the experiences from China and India in a way remarkably different from previous studies as the BCA exercise provides empirical documentation of macroeconomic fluctuations in both countries. Our work extends the BCA literature for China and India in a number of ways as it provides new estimates of business cycle fluctuations in the world's two most populous countries.

In particular, we document that in both countries the efficiency wedge (includes institutional change and technology advance), is the main driving force of output fluctuations and accounts for a lion share of the ups and downs in business cycles. Hence, insofar there is an explanation to tell within the BCA framework, for now we stick to one where output fluctuation are led by technology advances and changes in infrastructure both of which result in different productivity of input. We also document that the dampening effect of distortions in the labor market (sticky-wage and powerful labor unions) in India is much larger than in China. Finally, we document that the investment wedge (frictions in capital markets) and government consumption wedge only played minor roles in generating output fluctuations in the two countries, although the investment wedge is likely to increase in importance over time.

Our findings have directs implications for future comparative research between China and India. Because of the pre-dominant role played by the efficiency wedge in business cycles, models with frictions that cause inputs to be used inefficiently are good candidates to analyze China and India in a comparative framework. Secondly, because of the less significant role played by the investment wedge and government consumption wedge, models with emphasis on government consumption may not be appropriate for modelling neither of the two countries.

Finally, combining the experiences of China and India offer a valuable perspective on what cause business cycle fluctuations in the world's two most populous countries and, hence allow the governments of these countries to adopt policies that better smooth business cycles.

Appendix. Data

It is important to note that issues of data availability and quality are always of concern in business cycle accounting exercises. In addition, the data concerns we encounter in China and India are different. The construction of India's national accounts is centred on large periodic surveys of households, rather than relying on reports from major enterprises. China, in contrast, makes greater use of reports from large enterprises in the industrial sector.

For both countries we use annual GDP by expenditure data to carry out our business cycle accounting exercise. Annual data on GDP, private consumption, government consumption, gross capital formation and net exports (at current price) are available in "China Statistical Yearbook" (for China), and "India Statistical Survey" (for India). The data is checked against National accounts data compiled by the International Monetary Fund (IMF). Annual real GDP growth is also available there. Annual GDP deflator is calculated with current price GDP data and real GDP growth. We use the GDP deflator to deflate each current price series to get real series.

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Table 1. Comparison of China and India's Business Cycle Fluctuations 1/

A. China: 1978-2006

Variables	SD%	Cross Correlation of Output with variable at Lag k= -2	-1	0	1	2
Output	3.20	.17	.72	1.00	.72	.17
Private Consumption	4.13	-.09	.28	.65	.68	.43
Investment	8.02	-.48	-.17	.27	.65	.80
Government Consumption 2/	8.98	-.10	-.18	-.39	-.33	.13

B. India: 1980/81-2005/06

variables	SD%	Cross Correlation of Output with variable at Lag k= -2	-1	0	1	2
Output	1.70	.01	.32	1.00	.32	.01
Private Consumption	1.43	-.09	.02	.70	.20	.10
Investment	7.38	.12	.53	.64	.13	-.14
Government Consumption 2/	7.80	-.45	-.11	.00	.41	.09

1/ Series are first logged and detrended using the HP filter.
2/ Net export is included.

Table 2. Properties of Estimated Output Components 1/

A. China: 1978-2006

Output components	SD Relative to Output	Cross Correlation of Output with Component at Lag k= -2	-1	0	1	2
Efficiency	1.66	.12	.64	.90	.69	.28
Investment	0.57	.21	.03	-.21	-.39	-.45
Labor	0.52	-.28	-.53	-.39	-.02	.06
Government Consumption 2/	0.12	-.35	-.30	-.26	.00	.40

B. India: 1980/81-2005/06

Output components	SD Relative to Output	Cross Correlation of Output with Component at Lag k= -2	-1	0	1	2
Efficiency	2.52	-.38	.03	.49	.46	.04
Investment	0.49	.22	.11	-.43	-.26	-.09
Labor	2.20	.43	.08	-.04	-.40	-.04
Government Consumption 2/	0.33	-.46	-.13	-.06	.39	.07

1/ Series are first logged and detrended using the HP filter.
2/ Net export is included.

Figure 1

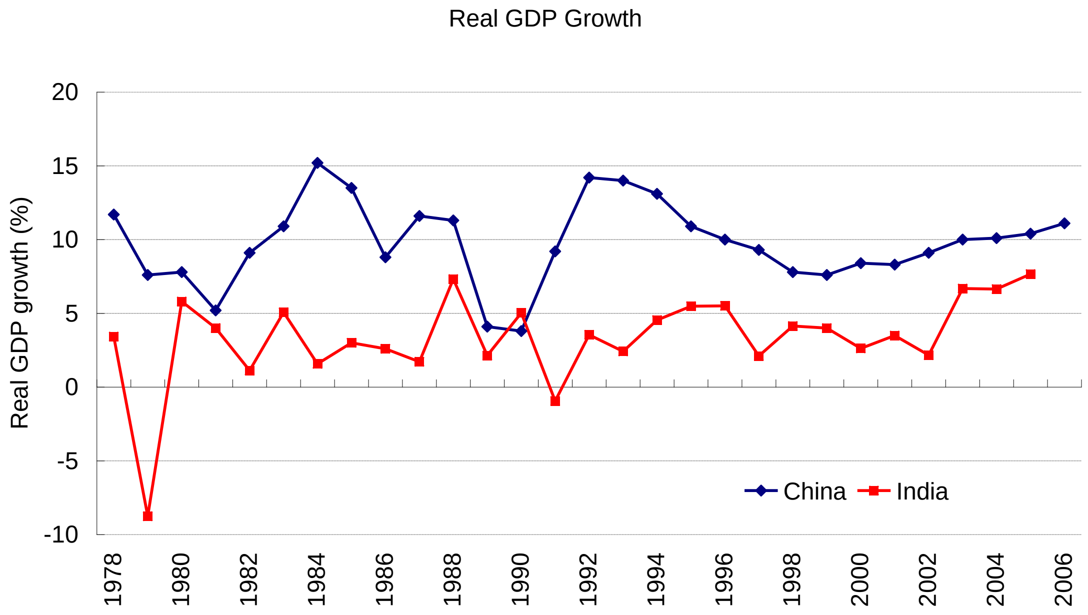


Figure 2

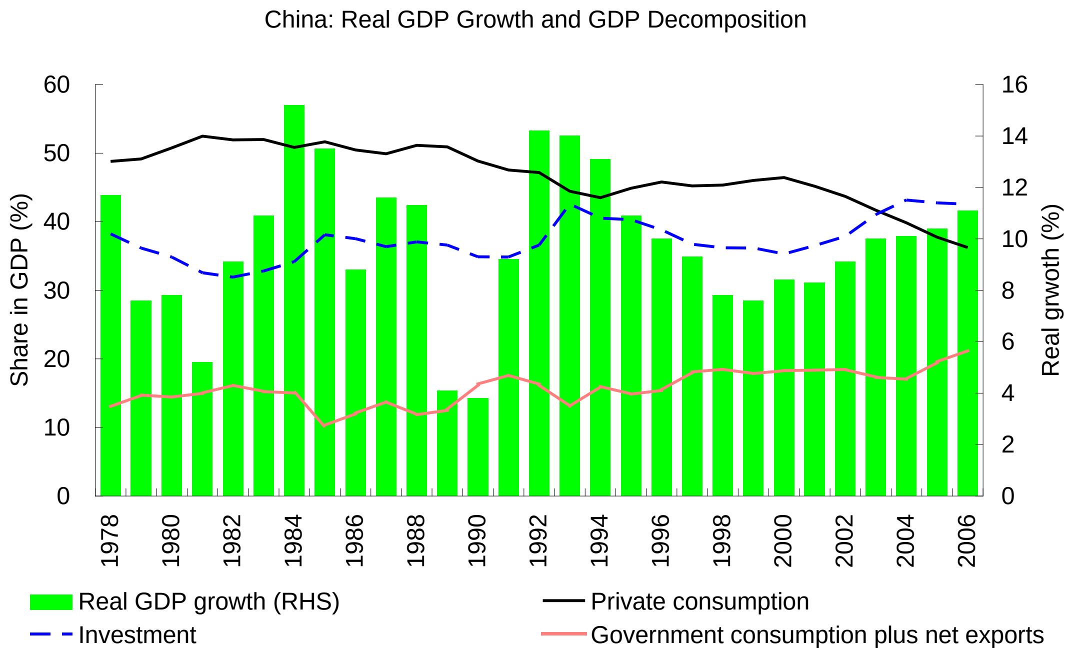


Figure 3

India: Real GDP growth and GDP decomposition

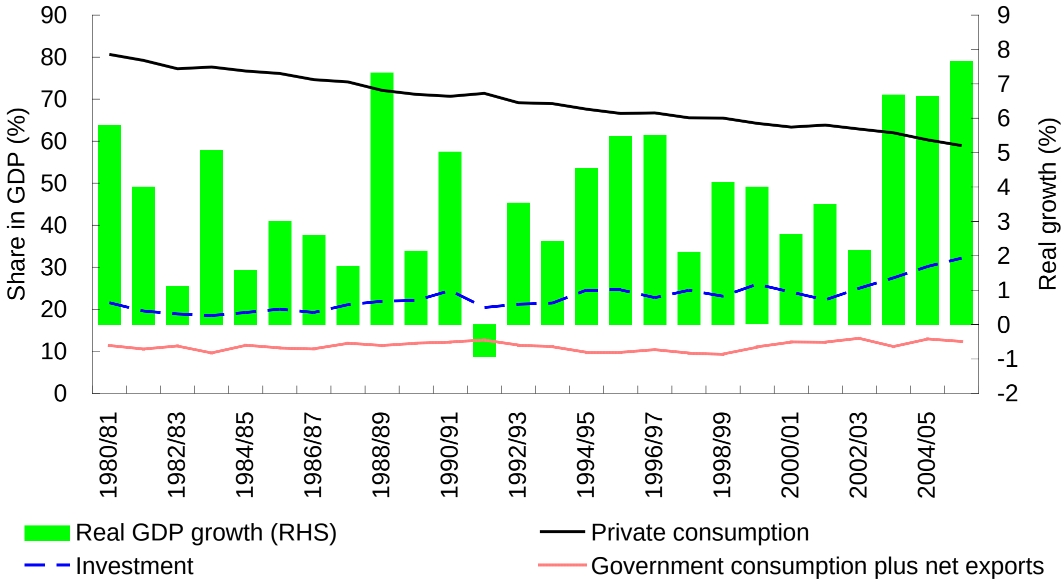


Figure 4

China: Business Cycle Fluctuations

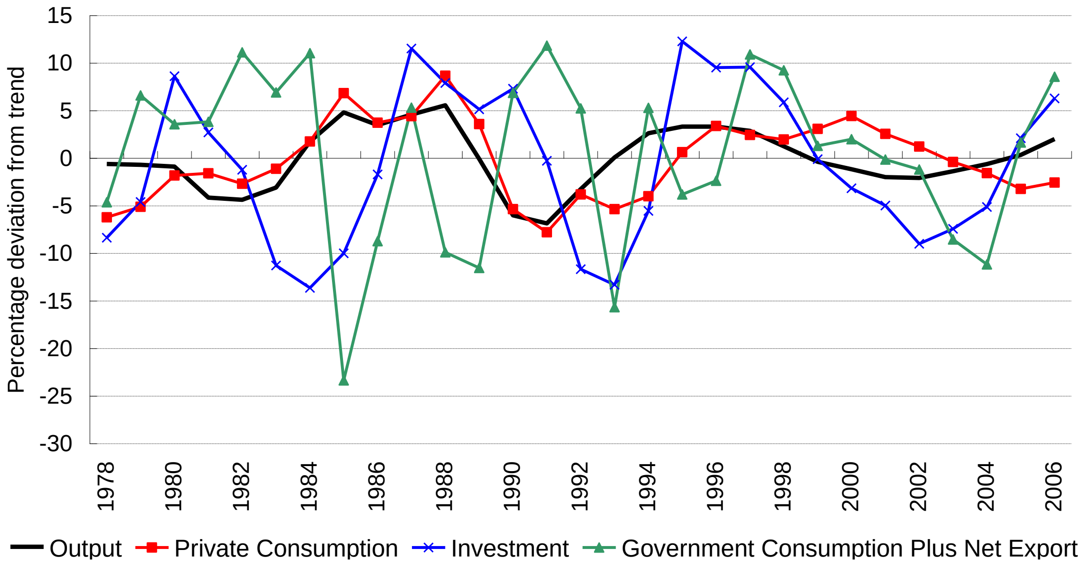


Figure 5

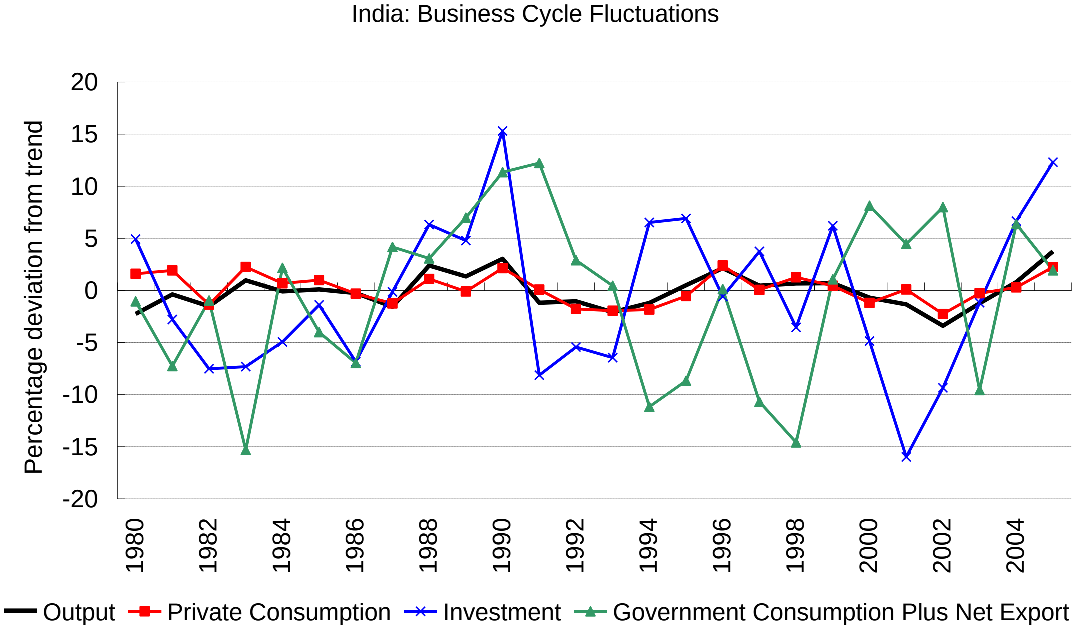


Figure 6

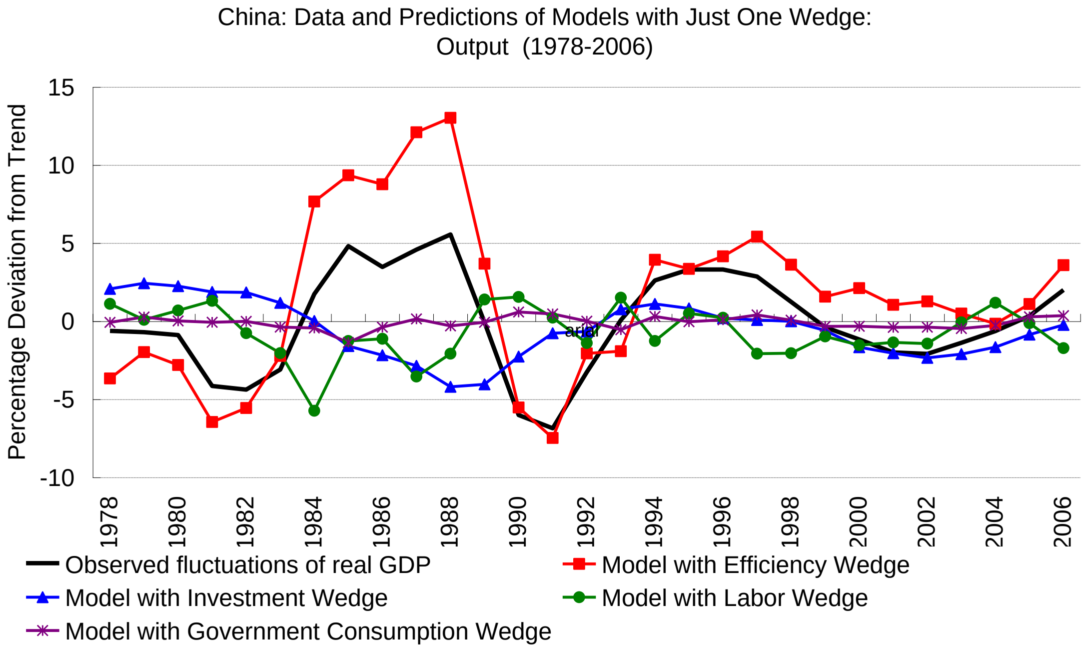
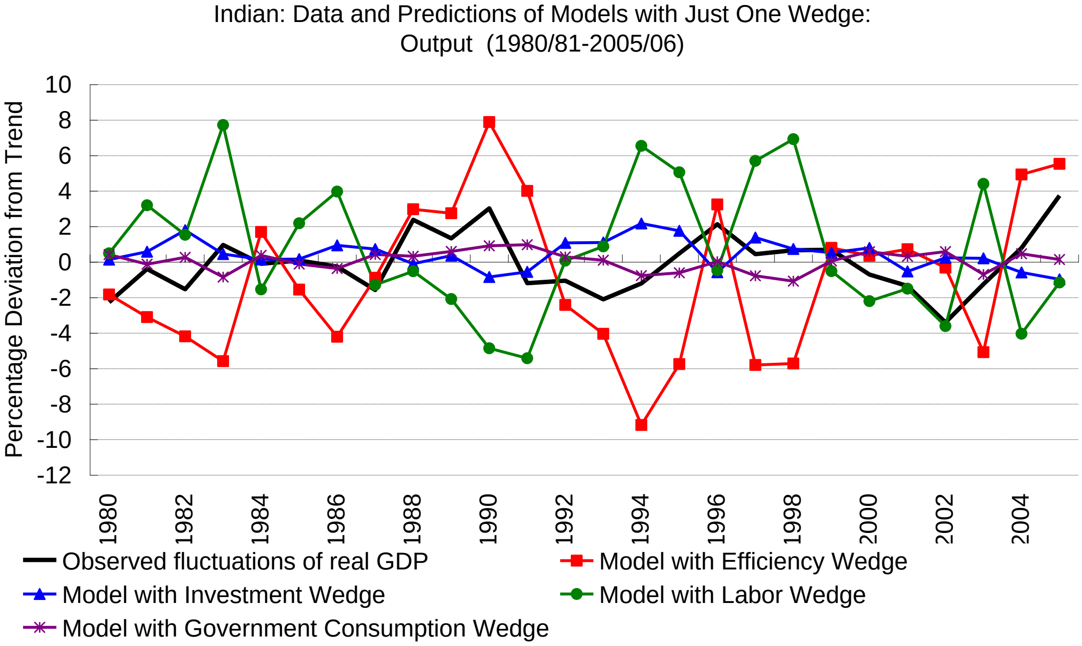


Figure 7


Indian: Data and Predictions of Models with Just One Wedge:
Output (1980/81-2005/06)
Percentage Deviation from Trend
10
8
6
4
2
0
-2
-4
-6
-8
-10
-12
1980
1982
1984
1986
1988
1990
1992
1994
1996
1998
2000
2002
2004
Observed fluctuations of real GDP
Model with Efficiency Wedge
Model with Investment Wedge
Model with Labor Wedge
Model with Government Consumption Wedge