Open access • Journal Article • DOI:10.1515/BEJM-2012-0129

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Published on: 01 Jan 2013 - B E Journal of Macroeconomics (De Gruyter)

Topics: Business cycle accounting, BRIC and Business cycle

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30 August 2012

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Abstract

We apply the Business Cycle Accounting methodology developed by Chari, Kehoe and McGrattan (2007) to study the economic resurgence of Brazil, Russia, India and China (BRIC) over the last decade. We document that while efficiency wedges do contribute in a large part to growth, especially in Brazil and Russia, there is an increasing importance of investment wedges especially in the late 2000s, noted in China and India. The results are typically related to the stages of development with Brazil and Russia coming off a crisis to grow in the 2000s, while India and China were on a comparatively stable growth path. Relating wedge patterns to institutional and financial reforms, we find that financial market developments and effective governance in BRICs in the last decade are consistent with improvements in investment and efficiency wedges that led to growth.

Keywords: BRIC, business cycle accounting, efficiency, market frictions, trend shocks, investment adjustment costs

JEL Codes: E32, E66

At its simplest, a growth economy should be regarded as one that is likely to experience rising productivity, which, together with favorable demographics, points to economic growth that outpaces the global average.....So we opted for the following: any economy outside the so-called developed world that accounts for at least 1% of current global GDP should be defined as a growth economy. ————————Jim O' Neill (M.D. & Head of Global Economic Research at Goldman Sachs)

1 Introduction

Over the last decade, the average growth rate of Brazil, Russia, India and China, or BRICs, has outpaced the global average with their cumulative share in the world GDP growing from about 16% in 2000 to 26% in 2011. China and India stand $2nd$ and $3rd$ in world GDP ranking by PPP comparisons (the top spot still belongs to the United States), while Russia and Brazil ranks $6th$ and $7th$ (**Table 1**).

<Table 1 about here>

The broad facts of BRIC resurgence are generally well known (**Table 2**[1]). While Brazil and India started the $1960s$ closer to their US and OECD counterparts, China faltered[2]. During the $1970s$, China played catch-up and Brazil grew steadily, but India declined. The tables turn in the $1980s$ with Brazilian growth slowing as India made a come-back. $1990s$ were a period of economic and political turbulence for the BRICs though the negative impact was stronger in Brazil and Russia. Finally, during the last decade of $2000s$, all BRIC nations made a remarkable come-back surpassing their historical performance with China in the lead.

<Table 2 about here>

In this paper, we perform an exploratory analysis of the fluctuations in output of the BRIC economies over the last two decades - the relative stagnation of the $1990s$ followed by the economic recovery of the $2000s-$ using the Business Cycle Accounting (BCA) "wedge" methodology formulated by Cole and Ohanian (2004) and Chari, Kehoe and McGrattan (henceforth CKM, 2007) amongst others.

Taking a cue from Calvo (2000), BCA focuses not on identification of primary forces like policy changes or institutional reforms that affect the economy, rather on

[1]Tables 1 and 2 are from the IMF and Angus Maddison's online data resources. Details of the historial timeline are in the online appendix.

[2]Per capita GDP growth rate is low in Brazil compared to aggregate GDP growth due to an expanding population.

the channels through which these factors work. The technique uses an real business cycle (RBC) framework with four channels: time varying productivity ("efficiency wedges"), labor taxes ("labor wedges"), taxes on investment ("investment wedges") and government consumption[3] ("government consumption wedge"). The BCA methodology is implemented in two steps. In step one, the first order conditions of a standard RBC model along with macroeconomic data is used to estimate the wedges. In step two, the estimated wedges from step 1 are fed back into the model individually and in different combinations to ascertain their marginal contributions in generating the observed economic outcome[4].

Application of the BCA methodology to the BRICs identifies two major channels at work: *i*) Brazilian and Russian crisis of the 1990*s* is primarily the result of distortions in investment and labor markets (particularly in Brazil). The growth of the 2000*s* however is the handiwork of improvements in efficiency; *ii*) in contrast, in China and India, both relatively stable in the 1990s, efficiency wedges play an important role till mid-2000s, after which declining investment market distortions became increasingly important for the rapid recovery[5]. These findings suggest that institutional and policy reforms at the core of the BRIC resurgence worked primarily by increasing production efficiency and reducing investment market frictions to aid capital accumulation. Our primary findings are robust to three additional checks - (a) introduction of capital adjustment costs, known to alter benchmark BCA results (Christiano and Davis, 2006), (b) factor hoarding to address concerns about mismanagement of efficiency wedges and (c) small, open economy setting as in most BRICs with separation of transitory and trend shocks affecting productivity (Aguiar and Gopinath, 2007),

Our application adds to the extensive literature on BCA (CKM, 2007; Kersting, 2008; Chakraborty, 2009; Kobayashi and Inaba, 2006; Cho and Doblas-Madrid 2012, Otsu 2010*a*; Lama 2011), with the exception that in contrast to the existing studies our objective is to study not just a crisis, but the eventual recovery. Secondly, while China and India, has garnered most attention amongst the BRICs (Song, Storesletten and Zilibotti 2011, Dekle and Vandenbroucke 2012, Jones and Sahu, 2009, Hseih and Klenow 2009), we bring all BRIC nations on the same analytical platform to perform a joint analysis over an extended time period (1990 to 2009). This turns out to be crucial for unearthing the role of investment market frictions, a channel mostly ignored in BCA literature with a few exceptions. Focusing separately on periods of crisis and recovery we find, similar to Cavalcanti, Elosegui, McCandless &

[3]In a closed economy set-up, net exports are added to government consumption.

[4]For example, if BCA exercise identifies efficiency wedges as a major player, the interpretation is that whatever primary factors are responsible for output growth, they work by improving the nation's efficiency (or productivity).

[5]The role of labor and government consumption wedges turn out to be somewhat sensitive to model specifications.

Blanco (2008), that worsening investment frictions can explain a significant portion of business cycle downturns. We further detect that declining investment frictions and capital accumulation can also help sustain growth. This contrasts with the earlier findings of Jones and Sahu (2008) for India and Lama (2011) for Latin America, where a sample till mid-2000s undermines the potential role of investment market fluctuations.

Finally, we attempt to tie the observed wedge patterns with some indices of institutional and policy changes in the BRICs. A growing literature in recent years have found micro-level evidence of influence of credit market movements on investment and economic growth (Bekaert, Harvey and Lundblad, 2011; Alfaro, Kalemli-Ozcan and Sayek, 2009). BRICs followed a consistent policy of easing credit with privatization, financial liberalization and opening up[6]. The impact of such policies is observed in improved credit-ratings and credit availability. Indices of institutional and political reforms published by the World Bank suggests improvement in government effectiveness in all BRICs and political stability (mostly in Russia) that are conducive to growth and recovery, but other areas of concern remain, with control of corruption being the Achilles' heel.

The remainder of the paper is organized as follows. In section 2, we describe the business cycle accounting model. In section 3, we explain the business cycle accounting procedure and present the results. In section 4, we provide sensitivity analysis results. In section 5, we discuss the underlying factors that can explain the evolution of wedges. Section 6 concludes the paper.

2 The Benchmark Model

BCA methodology uses a standard, closed economy neoclassical growth model with a representative household, firm and a government. The representative firm hires labor and capital from the household to produce output using a constant returns to scale technology, which is affected by time-varying production efficiency. The representative household decides on consumption, labor and investment each period. The household faces a budget constraint where its expenditure is limited by its labor and capital income. In addition, as the ultimate owner of the firm, the consumer receives the profits. The consumer pays distortionary taxes on labor and capital income to the government. In the BCA framework, these distortionary taxes represent broader economic distortions that affect the factor markets. The government uses its tax revenue to finance government consumption. Any remaining amount is transferred back to the households as lump sum transfers. Exogenous shocks to production efficiency,

[6] We explain the details in the online appendix.

government consumption and distortionary tax rates are revealed in the beginning of each period and affect economic incentives.

2.1 Firm

The representative firm borrows capital K_t and labor L_t from the household in order to produce output Y_t according to a Cobb-Douglas production function:

$$Y_t = K_t^{\theta}(A_t L_t)^{1-\theta},$$

where A_t denotes exogenous production efficiency. Labor is defined as total hours worked (product of employment and hours worked per worker). Productivity can be divided into a trend component Γ_t and a cyclical component z_t, i.e. $A_t = z_t\Gamma_t$, where we assume a constant growth rate γ in the trend component in the benchmark model. Labor grows over time due to constant growth in population N_t at the rate of n. Output and capital grows over time due to both population and productivity growth. All variables are detrended by the growth trends in order to define a stationary problem:

$$y_t = \frac{Y_t}{N_t\Gamma_t}, k_t = \frac{K_t}{N_t\Gamma_t}, l_t = \frac{L_t}{N_t}, z_t = \frac{A_t}{\Gamma_t}.$$

The detrended production function can be rewritten as

$$y_t = k_t^{\theta}(z_t l_t)^{1-\theta}. \tag{1}$$

The detrended profit maximization problem is

$$\max \pi_t = y_t - r_t k_t - w_t l_t \tag{2}$$

where r_t and w_t denote the real return on capital and the real wage respectively. For the benchmark model, we follow CKM (2007) and define the efficiency wedges as the detrended productivity:

$$\omega_{e,t} = z_t. \tag{3}$$

2.2 The Household and Government

The representative household gains utility from consumption c_t and leisure $1 - l_t$ where we assume a log-linear utility function[7]:

$$u(c_t, 1 - l_t) = \Psi \ln c_t + (1 - \Psi)\ln(1 - l_t).$$

[7] We also conduct an exercise with Cobb-Douglas preferences with higher elasticity of substitution presented in the appendix.

Total hours available is normalized to one. The household maximizes its expected lifetime utility:

$$\max E_t \sum_t \beta^t \left[u(c_t, 1 - l_t) \right],$$

where β is the subjective discount factor. The household budget constraint is

$$(1 - \tau_{l,t}) w_t l_t + (1 - \tau_{k,t}) r_t k_t + \pi_t + \tau_t = c_t + x_t, \tag{4}$$

where τ_{lt} and τ_{kt} are distortionary labor and capital income taxes while τ_t is the lump-sum government transfers. Investment x_t is defined by the capital law of motion:

$$n\gamma k_{t+1} = x_t + (1 - \delta) k_t. \tag{5}$$

The government collects distortionary taxes from the household in order to finance consumption and the balance is transferred to the household in a lump-sum fashion. Therefore, the government budget constraint is:[8]

$$g_t + \tau_t = \tau_{lt} w_t l_t + \tau_{kt} r_t k_t. \tag{6}$$

Combining the government budget constraint (6) and the household budget constraint (4) making use of the definition of profits (2), we obtain the resource constraint

$$y_t = c_t + x_t + g_t. \tag{7}$$

Since government consumption reduces the available resources for the private sector in the economy, we define this as the government consumption wedge following CKM (2007):

$$\omega_{g,t} = g_t. \tag{8}$$

Labor and investment wedges $\{\omega_{l,t}, \omega_{k,t}\}$ are defined as:

$$\omega_{l,t} = 1 - \tau_{lt},$$

$$\omega_{k,t} = 1 - \tau_{kt}.$$

Technically speaking, τ_{lt} drives a wedge between the consumption-leisure marginal rate of substitution and the marginal product of labor while τ_{kt} drives a wedge between the intertemporal marginal rate of substitution and the marginal return on investment. If there are no market distortions, τ_{lt} and τ_{kt} would be zero implying $\omega_{l,t} = \omega_{k,t} = 1$. This would yield the first best outcome (as can be seen from the first order conditions outlined in section 2.4).

[8] Note that under the traditional BCA architecture (CKM, 2007), the labor and capital wedges are modeled as taxes on labor income and capital income respectively, yielding the usual government budget constraint.

2.3 Wedges

We define the efficiency, government consumption, investment and labor wedges $\omega_t = (\omega_{e,t}, \omega_{g,t}, \omega_{k,t}, \omega_{l,t})'$ such that an increase in each wedge should lead to an increase in output. Increases in efficiency wedge directly increases production and stimulates factor demand by increasing the marginal product of inputs. On the other hand, increases in labor $(1 - \tau_{lt})$ and investment wedges $(1 - \tau_{kt})$, which by construction imply a decline in labor market friction τ_{lt} or investment market friction τ_{kt} respectively, stimulate output by encouraging the household to increase supply of factor inputs through an increase in the marginal income associated with them. An increase in government consumption wedge increases output by increasing aggregate demand[9]. Following CKM (2007), we assume that the wedges are exogenous and follow a stochastic process. Defining a vector of log-linearized wedges, $\widetilde{\omega}_t = (\widetilde{\omega_{e,t}}, \widetilde{\omega_{g,t}}, \widetilde{\omega_{k,t}}, \widetilde{\omega_{l,t}})'$ where $\widetilde{\omega}_t = \ln \omega_t - \ln \omega$, we assume that the wedges follow a first order VAR process:

$$\begin{aligned} \widetilde{\omega}_t &= P\widetilde{\omega_{t-1}} + \varepsilon_t \\ &\quad \varepsilon_t \sim N(0, V) \end{aligned} \tag{9}$$

where $\varepsilon_t = (\varepsilon_{e,t}, \varepsilon_{g,t}, \varepsilon_{k,t}, \varepsilon_{l,t})'$ are innovations to the wedges. Following CKM (2007) we allow spill-over of wedges through P and contemporaneous correlations of innovations in V.

2.4 Equilibrium

The competitive equilibrium is given by a price vector $\{r_t, w_t\}$ and an allocation of quantities $\{y_t, c_t, x_t, l_t, k_t, z_t, g_t, \tau_t, \omega_{e,t}, \omega_{g,t}, \omega_{k,t}, \omega_{l,t}\}$ such that: (a) the household maximizes utility given $\{r_t, w_t, \tau_t, \omega_{k,t}, \omega_{l,t}\}$; (b) the firm maximizes profits given $\{r_t, w_t, z_t\}$; (c) the government budget constraint (6) and the resource constraint (7) holds; and (d) the wedges follow the stochastic process (9). The competitive equilibrium is characterized by a set of first-order conditions given by: (a) the capital Euler equation (first order condition with respect to capital) equalizing present discounted value of marginal utility of future consumption to its marginal cost:

$$\frac{1}{c_t} = \widehat{\beta} E_t \left[\frac{1}{c_{t+1}} \left(\omega_{k,t+1} \theta \frac{y_{t+1}}{k_{t+1}} + 1 - \delta \right) \right], \tag{10}$$

where $\widehat{\beta} = \frac{\beta}{n\gamma}$, (b) the first-order condition with respect to labor equating marginal rate of substitution between consumption and leisure to the marginal product of

[9] Aggregate demand is comprised of household consumption, private investment and government expenditure.

labor:

$$\frac{1-\Psi}{\Psi}\frac{c_t}{1-l_t} = \omega_{l,t}(1-\theta)\frac{y_t}{l_t}, \tag{11}$$

(c) the resource constraint (7) given (8), (d) the capital law of motion (5), and (e) the production function (1) given (3).

3 Quantitative Analysis

3.1 Parameter Values

We collect annual national accounts data for the period 1990 to 2009 from Penn World Tables (PWT) 7.0., its updated version (PWT 7.1 published in November, 2012) and its extensions made by Duncan Foley. In addition, we collect population data from LABORSTA database of International Labor Organization and household expenditure data from Euromonitor Global Market Information database. The details of data construction are outlined in the data appendix. The key parameter and steady state values are listed in **Table 3**.

The first step in BCA implementation is to obtain the parameters of the model through usual calibration techniques for each country. Capital share θ is calibrated to match the capital income share derived from data[10]. The productivity growth trend a is computed as the average growth rate of per capita output. The population growth trend n is directly computed from adult population data[11]. The annual depreciation rate δ is computed from total capital stock and investment data[12]. The preference weight Ψ is calibrated using the steady state labor first order condition (11) to match the average consumption-output ratio and labor level in data assuming that the steady state labor wedge is equal to one[13]. The steady state efficiency wedge is normalized to one. The steady state government consumption wedge is calibrated to match the average consumption-output ratio and investment-output ratio.

The next step is to estimate the stochastic process of the wedges (9) for which we employ the Bayesian techniques. Structural estimation is necessary for the business cycle accounting procedure since investment wedges depend on expectations about the future state of the economy which is not directly observable. The estimated

[10] We follow Gollin (2002) and compute the income share of capital from national income statistics. These are 0.474, 0.475, 0.294, and 0.401 for Brazil, Russia, India and China respectively. We further adjust for the imputed service income from consumer durables as explained in the data appendix.

[11] We used total population for China since we do not have adult population data.

[12] We construct the total capital stock series as the sum of net fixed capital stock and household durables and the total investment series as the sum of gross domestic capital formation and household expenditures on durables.

[13] This assumption is not important as the preference weight and steady state level of labor wedges do not appear in the linearized system of equations.

parameters are the lag parameters in P, the standard deviation of the errors, and the cross-correlations between the errors in V. We also estimate the subjective discount factor $\widehat{\beta}$ along with the steady state investment wedge[14]. Since there are 4 exogenous variables, we use the time series data of output, consumption, investment and labor as observables. The Bayesian priors and the point estimates of these parameters are listed in the appendix.

3.2 Simulation

First, linear decision rules are derived using Uhlig (1999). Once we have the linear decision rules, we can back out the values of the linearized wedges using the data of output, consumption, investment and labor and their decision rules[15]. In the second step we compute the reaction of endogenous variables to the changes in the wedges by plugging their time series into the linear decision rules one-by-one. Upon reporting our results, we define a contribution indicator of each wedge ω_j on an endogenous variable v (Otsu , 2010*b*):

$$\begin{aligned} contv_j &= corr(\widetilde{v_t^{\omega_j}}, \widetilde{v_t}) * \frac{std(\widetilde{v_t^{\omega_j}})}{std(\widetilde{v_t})} \\ &= \frac{cov(\widetilde{v_t^{\omega_j}}, \widetilde{v_t})}{var(\widetilde{v_t})}, \end{aligned}$$

where $\widetilde{v_t^{\omega_j}}$ is the linearized fluctuation of variable v in response to $\widetilde{\omega_j}$ while $\widetilde{v_t}$ is that of the data of variable v. By construction, plugging in all wedges into the model will exactly reproduce the observable data so

$$\sum_j contv_j = 1.$$

due to linearity. Therefore, we can consider the value of the indicator as the contribution of each wedge to the fluctuation of the variable of interest.

3.3 Results

In **Figure 1,** we present the linearly detrended macroeconomic variables in BRICs during $1990 - 2009$[16]. In reporting our results, we show the log deviations of the

[14] We cannot make a distinction between $\widehat{\beta}$ and ω_k in the benchmark model so the estimated values are the same. However, they are distinguishable in the alternative models we explore in the following section.

[15] The detailed procedure is explained in the appendix.

[16] The variables are plotted as log deviations from their 1990 value (1992 in case of Russia) and detrended using the average growth rate during the sample period. We also conduct a robustness check detrending all countries by a common rate of 1.5% in the appendix.

variables with respect to the steady state.

<Figure 1 about here>

In **Figure 2,** we plot the time paths of the computed wedges for each country. For the most part, we do not find much commonality in wedge movements in the four nations. For example, while efficiency wedges have been above the trend in Brazil and Russia throughout the entire period, it has been below trend for most of the time in India and China. In Brazil, there was a temporary slow down in the growth of efficiency during $1997 - 2003$. In Russia, it took off in 1998 and kept growing at an enormous rate, suggesting a positive impact of efficiency on growth. In India, while efficiency wedges temporarily improved in 2005, since then it has suddenly collapsed. In China, while efficiency wedges deteriorated during the $1995 - 2001$ period, it shows a gradually improvement ever since. It is hard to find common patterns in government consumption wedges and labor wedges as well, except for China and Brazil that saw an improvement in government consumption wedge during mid-$2000s$. Perhaps the one common trend would be investment wedge movements, that show improvements in all BRIC nations since 2000s, though still below trend in Brazil and Russia while above trend in India and China at the end of 2009.

<Figure 2 and Table 4 about here>

In **Table 4**, we report the standard deviation of wedges with respect to output and the correlations of wedges with output for various leads and lags[17] to ascertain various comovements. The standard errors are reported in the parenthesis. A positive correlation indicates a positive association between a given wedge and the observed economic outcome, and vice versa. Efficiency wedges, for the most part, are positively correlated with output in all countries, and significantly so for Russia, India and China. Investment wedges also show a positive correlation for the most part, particularly significant in India. Labor wedges are positively correlated with output in Brazil and Russia, but negatively correlated in India. In China, while labor wedges become positively correlated for contemporaneous periods and leads $+1$, $+2$, the magnitude remains low. As for government consumption wedges, while they are positively correlated with output in Brazil (with the exception of the leads $+1$, $+2$), in India, and China, they are negatively correlated with output in Russia for all leads and lags. Next, we feed the back the wedges in our model individually and report their contribution to output fluctuations in **Figure 3** and decompositions in **Table 5**. The recovery period of $2000 - 2009$ is discussed specifically as well.

[17] As defined in CKM (2007), a "$k - th$ lag" is the correlation between the $t - k$ th value of the variable of interest with output at period t.

<Figure 3 and Table 5 about here>

In Brazil, efficiency, investment and labor wedges all contribute significantly explaining 30.2%, 30.6%, and 52.8% of output fluctuations respectively. Efficiency wedges are particularly significant in the 2000*s* with a contribution of 98.7%, while the contributions of investment and labor wedges, though positive, are much lower. Efficiency improvements by themselves predict output to be 14 percentage points above the trend by 2009. Investment and labor wedges for their part account for the sub-par economic performance of the 1990*s* and only marginally contribute to the recovery of the 2000*s*. A similar pattern is observed in Russia with efficiency wedges contributing higher than 100% while investment wedges having a large negative effect. The model with only efficiency wedges predicts a much faster economic recovery leading to a much higher output level in the 2000*s* than it actually did. On the other hand, investment wedges by themselves predict a decline in output throughout the entire period, contributing to the 1990*s* crisis. Our findings suggest that efficiency wedges aided Russia to get back on the development track in spite of sub-par investment market conditions.

In India, investment wedges contribute the most to the fluctuation of output with an overall contribution of 63.2% over the entire period. This is mainly because of the 2000*s* where the contribution of investment wedge rises to 71.2%. Interestingly, during the 1990*s* the contribution of efficiency wedge at 73.1% was much higher than that of the investment wedge at 20.6%. When we run the model with only efficiency wedge, it performs quite well in predicting the fluctuation in output until 2005. However, it fails to predict the rapid growth after 2005. This is where the investment wedge comes in and investment wedges alone do a better job of accounting for the rapid acceleration of Indian growth during the 2000*s* well to the sample end. Labor and government consumption wedge have a minimal contribution. China presents a similar picture. Efficiency wedges account for 82.6% of output fluctuations overall. However, during the 2000*s* the contribution of investment wedges, at 85.2%, becomes larger than that of efficiency wedges, at 30.3%. Mirroring the experience of India, efficiency wedges fail to account for the rapid growth after 2004, while investment wedges continue to be an important contributor to the economic development.

In summary, we primarily document that while Brazilian and Russian booms were facilitated by improvements in production efficiency, India and China benefitted from declines in investment market frictions, particularly in the latter half of the 2000*s*. The contributions of labor and government consumption wedges to the recovery remain marginal across the spectrum.

4 Sensitivity Analysis

In this section we will test the robustness of the benchmark model to alternative settings: a model with investment adjustment costs; a factor hoarding model; and a small open economy model with stochastic trends[18]. We report additional key parameter values in **Table 6.**

4.1 Model with Investment Adjustment Costs

In the benchmark model capital stock is accumulated following the capital law of motion (5). However, Christiano and Davis (2006) claim that introducing investment adjustment cost could affect the relative importance of the wedges. In this section we modify the capital accumulation equation to include quadratic investment adjustment costs:

$$n\gamma k_{t+1} = x_t + (1-\delta)k_t - \Phi\left(\frac{x_t}{k_t}\right)k_t \tag{12}$$

where

$$\Phi\left(\frac{x_t}{k_t}\right) = \frac{\phi}{2}\left(\frac{x_t}{k_t} - \lambda\right)^2.$$

The constant λ is set at $\lambda = na - (1-\delta)$ so that the adjustment cost is equal to zero in the steady state. The parameter ϕ is calibrated to match the marginal Tobin's Q to one:

$$\frac{d\log q}{d\log\left(x/k\right)} = 1,$$

where q is the effective price of investment relative to consumption:

$$q = \frac{1}{1-\Phi'}.$$

This leads to $\phi = \frac{k}{x}$.

<Figure 4 and Table 7 about here>

We plot the simulation results of output in **Figure 4**. Output decompositions are presented in **Table 7.** While the results are quite similar to those from the benchmark model, some subtle differences are noted. First, the impact of investment wedge increases (both negatively for Russia and positively for the rest). Second, the

[18] Equilibrium conditions are listed in the appendix.

role of government wedge increases considerably in India during the 1990s and in China during the 2000s. Third, the role of efficiency wedges decline considerably in India and China. Nonetheless, the main result that the emergence of India and China is mainly accounted for by improvements in investment wedges and the recovery of Brazil and Russia is mainly accounted for by improvements in efficiency wedges holds.

4.2 Factor Hoarding Model

In the benchmark model efficiency wedges are measured as Solow residuals. However, Solow residuals misrepresent production efficiency when production factors are mismeasured due to factor hoarding. We apply the factor hoarding BCA model of Klein and Otsu (2013) to the BRIC economies in order to test the robustness of our main results. The difference between the benchmark model and the factor hoarding model is that in the latter the rate of factor utilization is time-varying. In terms of labor utilization, increasing utilization increases labor input on one hand and reduces utility on the other as in Burnside, Eichenbaum and Rebelo (1993). The preference is defined as

$$u(c_t, 1 - l_t) = \Psi \ln c_t + (1 - \Psi) \ln(1 - l_t) - l_t u_{l,t}^{\mu},$$

where $u_{l,t}$ is the endogenous labor utilization rate. In terms of capital utilization, increasing utilization increases capital input on one hand and increases the depreciation rate of capital on the other as in Greenwood, Hercowitz and Huffman (1988). The depreciation rate is defined as

$$\delta_t = \delta u_{k,t}^{\chi},$$

where $u_{k,t}$ is the endogenous capital utilization rate. The elasticity parameters μ and χ are obtained through structural estimation jointly with the stochastic process.

<Figure 5 and Table 8 about here>

The output simulations are plotted in **Figure 5** while the output decompositions are presented in **Table 8**. The figures look similar to those in the benchmark case except for Russia. In Brazil, the contribution of investment wedges fall whereas the contributions of efficiency and labor wedges increase. In Russia, investment wedges not only account for the decline in output during the 1990s but also part of the recovery in the 2000s. Moreover, labor wedges have the highest contribution during the 2000s instead of efficiency wedges. Nonetheless, the combination of efficiency and investment wedges account for nearly half of the fluctuation in output during the 2000s. In India, the contribution of investment increases whereas the contribution of efficiency wedges fall. In China, the contribution of efficiency wedges increase

whereas the contribution of investment wedges fall. Despite the change in the quantitative impact of the wedges, the result that efficiency and investment wedges are important in accounting for the emergence of the BRICs in the 2000s holds even with endogenous factor hoarding.

4.3 Small Open Economy Model with Stochastic Trend

The benchmark model considers a closed economy, though the BRICs were far from closed to the international trade and financial markets during the $1990-2009$ period. Furthermore, the benchmark model defines efficiency wedges as temporary shocks to productivity whereas the BRIC economies experienced large business cycle fluctuations with possible structural breaks over the $1990-2009$ period, which might be better explained by shocks to productivity growth trends. Therefore, we construct a small open economy model with cyclical and trend components of productivity based on Aguiar and Gopinath (2007)[19]. In the benchmark model the trade balance was included in the government consumption wedge whereas in this model the two are distinguished. In the small open economy model the trade balance is defined as the net flow of international assets d_t :

$$tb_t = \gamma n Q d_{t+1} - d_t,$$

where Q is the fixed price of the asset. The resource constraint is modified accordingly as:

$$y_t = c_t + x_t + g_t + tb_t.$$

Next, we define the growth trend $\Gamma_t = \Delta_t \gamma_t$ where Δ_t grows at a constant rate γ and γ_t is a random walk variable. We define trend wedges as shocks to the growth rate of the random walk component:

$$\omega_{\tau,t} = \frac{\gamma_t}{\gamma_{t-1}}.$$

Incorporating trend wedges into a small open economy model is convenient for BCA. Since we need as many observable variables as wedges, we can add government consumption, separate from the trade balance, as an observable variable while adding the trend wedge. Now we have a model with five wedges and five observable variables to conduct the structural estimation and simulation[20].

<Figure 6 and Table 9 about here>

[19] Rothert and Rahmati (2011) also apply BCA to the Aguiar and Gopinath (2007) model.

[20] On estimating the stochastic process, we impose a restriction on the lag matrix P such that there is no spill-over into/from the trend wedge from/into the other wedges.

The output simulations are plotted in **Figure 6** while **Table 9** provides the decomposition results. The figures show that adding the trend wedge does not change the general patterns. In Brazil, efficiency wedges are the most important driver of output fluctuation especially during the 2000s while labor and investment wedges accounted for the stagnation during the 1990s. The trend wedges have helped the economy during the 2000s. In Russia, efficiency wedges are important in accounting for the slump in the 1990s and the emergence in the 2000s. Investment wedges have a strong negative effect on output throughout the entire period. In India, efficiency wedges are important in accounting for the sub-par output growth during the 1990s while investment wedges are important in accounting for the emergence during the 2000s. In China, efficiency wedges can account for most of the fluctuation in output while investment wedges have been helping the economy throughout the entire period. On the other hand, trend and labor wedges have been dragging the economy down. Therefore, once again the findings suggest that efficiency wedges for Brazil and Russia and investment wedges for China and India are the key drivers for the output boom during the 2000s.

5 Discussion: Decomposition, Wedges and Policies

The accounting results highlight the importance of efficiency and investment wedges in output fluctuations. Can we tie our wedge fluctuations to some primary factors like institutional and policy reforms?

After the 1990s debt and financial crisis that hit all BRICs but China[21], 2000s was a period of reforms. Brazil attempted fiscal stabilization with reduction of inflation indexed debt, while Russia took steps to privatize and liberalize after undergoing ruble devaluation and debt default. India's foreign exchange crisis in 1991 and the subsequent $1.8 billion IMF bailout required de-licensing the "license Raj" and encouraging FDI. China's WTO membership also required conforming to substantial liberalization measures like removing foreign exchange controls and import quotas (details of these measure are outlined in online Appendix 5).

As a result of these measures, credit availability (**Figure 7a)** and credit worthiness (**Figure 7b)**[22] both improved , leading to an improvement in the observed investment wedges. Financial liberalization increases the availability of capital by removing investment market distortions and enables firms to seize profitable investment opportunities. As a result, investment rises which brings down its expected

[21] China had its own share of political troubles brewing from the Tiananmen Square massacre of 1989.

[22] Data is collected from the IMD World Competitiveness Yearbook (henceforth, WCY)

return due to diminishing marginal product of capital. Therefore, the gap between the intertemporal marginal rate of substitution and the expected return on capital shrinks, and this would be reflected in a higher value of investment wedge, $1 - \tau_{k,t}$, in the BCA model.

Financial development is consistent with observed production efficiency as well. An increase in FDI leads to productivity spillovers through import of foreign managerial and organizational talent (Findley, 1978). At the same time, international financial integration imposes market discipline (Rajan and Zingales, 2003), which is conducive to growth.

To track market discipline, we turn to six institutional and governance indicators tracked by the World Bank-Voice & Accountability, Political Stability & Non Violence, Government Effectiveness, Regulatory Quality, Rule of Law, Control of Corruption (definitions and explanations are in the online appendix 6.3). These indicators are measured on a scale of -2.5 (weak) to 2.5 (strong). We present their evolution over the two decades in Table 10. Government effectiveness stands out with Brazil, Russia and China climbing 10 points in the world ranking, with India climbing 2 points. Political stability, mostly in Russia, also aids the BRICs, though control of corruption, which Antunes and Cavalcanti (2003) and Antunes, Cavalcanti & Villamil (2008) have stressed is an important pillar of development, remains an issue (**Table 10** & **Figure 7c**).

<Table 10 and Figure 7c about here>

6 Conclusion

Using the BCA methodology to chart the remarkable recovery of the BRICs since $2000s$, our paper documents the importance of efficiency improvements and decline in investment market frictions for economic growth. While the history and timeline of improvement of these nations suggest that efficiency improvement is essential to jump-start growth after a crisis (Brazil and Russia), improvements in investment market emerge as an important factor to help sustain growth (India and China). Further analysis is needed to explore why this might be the case, and if indeed, this is the pattern for all developing economies, or something of an aberration noticed only in the BRICs.

From a policy perspective, while there have been some improvements in their institutional and governance indicators, BRIC nations have a long way to go before they catch up with the US standards. Control of corruption remains an area of concern, as acknowledged by Dr. Kim, President, World Bank Group, who reaffirmed on $January\ 13, 2013$, the World Bank's commitment to act on anti-corruption in the coming years, which could translate to a more vibrant, economically stronger BRICs.

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Table 1: GDP ranking by PPP methodology (% share in world GDP)
Source: International Monetary Fund Statistics

	World Ranking									
Year	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**9th**	**10th**
2011	U.S.	China	India	Japan	Germany	Russia	Brazil	U.K.	France	Italy
	(19.11)	(14.36)	(5.67)	(5.58)	(3.92)	(3.02)	(2.93)	(2.86)	(2.81)	(2.32)
2010	U.S.	China	Japan	India	Germany	Russia	U.K.	Brazil	France	Italy
	(19.53)	(13.61)	(5.81)	(5.46)	(3.96)	(3.00)	(2.93)	(2.93)	(2.87)	(2.39)
2005	U.S.	China	Japan	Germany	India	U.K.	France	Russia	Italy	Brazil
	(22.26)	(9.46)	(6.83)	(4.40)	(4.29)	(3.41)	(3.28)	(2.99)	(2.88)	(2.80)
2000	U.S.	Japan	China	Germany	India	France	U.K.	Italy	Brazil	Russia
	(23.55)	(7.61)	(7.14)	(5.07)	(3.72)	(3.63)	(3.59)	(3.31)	(2.92)	(2.65)
1995	U.S.	Japan	China	Germany	France	U.K.	Italy	India	Brazil	Russia
	(22.89)	(8.71)	(5.67)	(5.55)	(3.81)	(3.64)	(3.61)	(3.31)	(3.17)	(2.94)
1990	U.S.	Japan	Germany	France	Italy	U.K.	China	Brazil	India	Mexico
	(24.70)	(9.91)	(6.16)	(4.39)	(4.14)	(4.09)	(3.88)	(3.33)	(3.17)	(2.61)
1985	U.S.	Japan	Germany	France	Italy	U.K.	Brazil	China	Mexico	India
	(25.19)	(9.29)	(6.22)	(4.47)	(4.25)	(4.16)	(3.61)	(3.18)	(2.85)	(2.84)
1980	U.S.	Japan	Germany	France	Italy	U.K.	Brazil	Mexico	India	Spain
	(24.64)	(8.65)	(6.74)	(4.74)	(4.48)	(4.28)	(3.92)	(2.97)	(2.53)	(2.41)

Table 2: Aggregate GDP and GDP per capita growth rates

Data Source: World Bank and Penn World Tables

Column (1) summarizes growth in Aggregate GDP while column (2) summarizes growth in GDP per capita

		1960s		**1970s**		**1980s**		**1990s**		**2000s**	
		(1)	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**	**(1)**	**(2)**
U.S.	Mean	4.66%	3.33%	3.32%	2.24%	3.04%	2.09%	3.22%	1.96%	1.85%	0.90%
	St. Dev.	(1.68%)	(1.67%)	(2.58%)	2.56%	(2.55%)	2.56%	(1.55%)	(1.57%)	(2.12%)	(2.08%)
OECD	Mean	5.74%	4.42%	3.73%	2.67%	2.94%	2.13%	2.56%	1.74%	1.75%	1.04%
	St. Dev.	(0.74%)	(0.81%)	(1.89%)	(1.91%)	(1.44%)	(1.46%)	(0.80%)	(0.84%)	(2.20%)	(2.18%)
Brazil	Mean	5.90%	2.97%	8.47%	5.92%	2.99%	0.82%	1.70%	0.12%	3.67%	2.49%
	St. Dev.	(3.68%)	(3.68%)	(3.48%)	(3.39%)	(4.76%)	(4.67%)	(2.94%)	(2.94%)	(2.43%)	(2.48%)
Russia	Mean							−4.91%	−4.81%	5.35%	5.66%
	St. Dev.							(6.14%)	(6.24%)	(4.73%)	(4.81%)
India	Mean	6.67%	4.44%	2.93%	0.55%	5.69%	3.35%	5.63%	3.62%	7.36%	5.74%
	St. Dev.	(6.14%)	(6.01%)	(4.16%)	(4.06%)	(1.88%)	(1.86%)	(2.0%)	(2.03%)	(2.35%)	(2.38%)
China	Mean	3.02%	0.89%	7.44%	5.34%	9.75%	8.75%	9.99%	8.75%	10.30%	9.64%
	St. Dev.	(14.85%)	(13.74%)	(5.62%)	(5.37%)	(3.24%)	(3.23%)	(3.24%)	(3.23%)	(1.81%)	(1.86%)

Table 3. Parameters and Steady States

Source: Authors' calculations

		Brazil	**Russia**	**India**	**China**
Parameter	*Explanation*	*Values*			
γ	Average growth rate of per capita output	1.010	1.018	1.042	1.073
n	Average growth rate of population	1.017	0.999	1.019	1.007
θ	Capital income share of output	0.540	0.497	0.310	0.425
δ	Rate of depreciation	0.120	0.094	0.121	0.117
Ψ	Preference weight on consumption	0.282	0.173	0.202	0.217
l	Steady state labor	0.230	0.193	0.218	0.230
c/y	Steady state consumption-output ratio	0.605	0.440	0.623	0.433
x/y	Steady state investment-output ratio	0.217	0.260	0.298	0.414
$\widehat{\beta}$	Subjective discount factor	0.923	0.924	0.927	0.925
ω_k	Steady state investment wedge	0.923	0.924	0.927	0.925

Table 4: Properties of the wedges Benchmark Model

Note: *, **, *** show significance at 90%, 95%, and 99% respectively	Std. Dev.	Cross Correlations of wedges (std. error in paranthesis)				
		-2	-1	0	1	2
Brazil: Efficiency Wedges	2.55	0.26	0.42*	0.33	0.08	−0.13
		(0.30)	(0.07)	(0.16)	(0.74)	(0.62)
Brazil: Government Consumption Wedges	2.99	0.72***	0.37	0.14	−0.16	−0.44*
		(0.00)	(0.12)	(0.55)	(0.52)	(0.07)
Brazil: Investment Wedges	1.47	0.12	0.56**	0.63***	0.10	−0.12
		(0.62)	(0.01)	(0.00)	(0.70)	(0.63)
Brazil: Labor Wedges	1.55	0.16	0.27	0.50**	0.55**	0.40
		(0.53)	(0.26)	(0.02)	(0.01)	(0.10)
Russia Efficiency Wedges	4.52	0.92***	0.79***	0.55**	0.33	0.11
		(0.00)	(0.00)	(0.02)	(0.19)	(0.70)
Russia Government Consumption Wedges	0.71	0.13	−0.14	−0.29	−0.53**	−0.63**
		(0.62)	(0.59)	(0.25)	(0.03)	(0.01)
Russia Investment Wedges	1.32	−0.45*	−0.14	0.20	0.36	0.56**
		(0.08)	(0.58)	(0.42)	(0.15)	(0.02)
Russia Labor Wedges	0.61	0.62**	0.62**	0.59**	0.76***	0.72***
		(0.01)	(0.01)	(0.01)	(0.00)	(0.00)
India Efficiency Wedges	0.78	0.45*	0.65***	0.76***	0.35	−0.01
		(0.06)	(0.00)	(0.00)	(0.15)	(0.98)
India Government Consumption Wedges	3.11	0.19	0.23**	0.44*	0.47**	0.23
		(0.25)	(0.01)	(0.06)	(0.04)	(0.36)
India Investment Wedges	2.39	0.88***	0.88***	0.78***	0.62***	0.42*
		(0.00)	(0.00)	(0.00)	(0.00)	(0.08)
India Labor Wedges	0.86	−0.55**	−0.51**	−0.39*	−0.06	0.19
		(0.02)	(0.03)	(0.09)	(0.80)	(0.45)
China Efficiency Wedges	1.86	0.59**	0.73***	0.77***	0.61***	0.41*
		(0.01)	(0.00)	(0.00)	(0.01)	(0.09)
China Government Consumption Wedges	3.48	0.55**	0.55**	0.49**	0.31	0.02
		(0.02)	(0.02)	(0.03)	(0.20)	(0.93)
China Investment Wedges	1.95	0.27	0.37**	0.33**	0.24	0.04
		(0.28)	(0.02)	(0.05)	(0.33)	(0.87)
China Labor Wedges	1.47	−0.02	−0.05	0.02	0.10	0.26
		(0.92)	(0.84)	(0.94)	(0.68)	(0.30)

Table 5: Decomposition of Output - Benchmark Model

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2009				
Efficiency Wedges	0.302	1.711	0.487	0.826
Government Consumption Wedges	−0.137	−0.033	0.013	−0.025
Investment Wedges	0.308	−0.711	0.632	0.190
Labor Wedges	0.528	0.033	−0.131	0.009
1990:1999				
Efficiency Wedges	−0.571	−0.086	0.731	1.237
Government Consumption Wedges	−0.038	−0.159	0.039	−0.056
Investment Wedges	0.566	1.243	0.206	−0.313
Labor Wedges	1.043	0.002	0.024	0.132
2000:2009				
Efficiency Wedges	0.987	1.603	0.432	0.303
Government Consumption Wedges	−0.140	0.032	−0.01	0.052
Investment Wedges	0.076	−0.716	.712	0.852
Labor Wedges	0.077	0.081	−0.135	−0.206

Table 6. Additional Parameters and Steady States for Alternative Models

Source: Authors' calculations

		Brazil	**Russia**	**India**	**China**
Parameter	*Explanation*	*Values*			
	Model with Investment Adjustment Costs				
$\widehat{\beta}$	Subjective discount factor	0.955	0.731	0.952	0.947
ω_k	Steady state investment wedge	0.931	0.912	0.937	0.935
ϕ	Sensitivity of investment to marginal Q	6.809	5.043	5.500	9.023
	Factor Hoarding Model				
$\widehat{\beta}$	Subjective discount factor	0.955	0.970	0.943	0.936
ω_k	Steady state investment wedge	0.933	0.936	0.927	0.925
μ	Labor utilization elasticity	1.550	1.501	1.500	1.507
χ	Capital utilization elasticity	1.861	1.328	1.450	1.540
	Small Open Economy Model with Stochastic Trend Components				
$\widehat{\beta}$	Subjective discount factor	0.876	0.893	0.925	0.899
ω_k	Steady state investment wedge	0.866	0.872	0.874	0.884
ϕ	Sensitivity of investment to marginal Q	6.809	5.043	5.500	9.023
g/y	Steady state government consumption-output ratio	0.173	0.180	0.119	0.142

Table 7: Decomposition of Output

Model with Investment Adjustment Costs

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2009				
Efficiency Wedges	0.271	2.217	0.293	0.549
Government Consumption Wedges	−0.092	−0.027	0.089	−0.136
Investment Wedges	0.381	−1.248	0.703	0.616
Labor Wedges	0.441	0.058	−0.085	−0.030
1990:1999				
Efficiency Wedges	−0.658	−0.023	0.352	0.925
Government Consumption Wedges	0.001	−0.065	0.382	−0.285
Investment Wedges	0.721	1.119	0.232	0.119
Labor Wedges	0.938	−0.031	0.034	0.242
2000:2009				
Efficiency Wedges	1.089	2.287	0.275	0.130
Government Consumption Wedges	−0.068	−0.041	0.004	0.235
Investment Wedges	0.022	−1.379	.811	1.126
Labor Wedges	−0.043	0.133	−0.089	−0.491

Table 8: Decomposition of Output

Factor Hoarding Model

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2009				
Efficiency Wedges	0.703	0.200	0.329	1.031
Government Consumption Wedges	−0.043	0.030	0.004	−0.000
Investment Wedges	−0.358	0.507	0.960	−0.053
Labor Wedges	0.612	0.264	−0.293	0.022
1990:1999				
Efficiency Wedges	−0.495	−0.060	0.516	1.522
Government Consumption Wedges	0.078	0.100	−0.016	0.089
Investment Wedges	0.080	0.967	0.381	−0.779
Labor Wedges	1.337	−0.127	0.120	0.169
2000:2009				
Efficiency Wedges	1.144	0.286	0.337	0.469
Government Consumption Wedges	0.063	−0.024	0.044	−0.196
Investment Wedges	−0.492	0.203	0.935	0.957
Labor Wedges	0.285	0.534	−0.317	−0.229

Table 9: Decomposition of Output

Small Open Economy Model with Stochastic Trend

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2009				
Efficiency Wedges	0.760	1.243	0.320	1.267
Government Consumption Wedges	0.002	−0.024	0.116	0.031
Investment Wedges	0.146	−0.729	1.867	−0.253
Labor Wedges	0.490	0.110	−0.365	0.049
Trend Wedges	−0.398	0.400	−0.938	−0.094
1990:1999				
Efficiency Wedges	0.253	0.682	0.793	1.010
Government Consumption Wedges	−0.055	0.028	0.109	0.033
Investment Wedges	0.433	0.477	−0.141	−0.645
Labor Wedges	0.790	−0.098	−0.085	0.524
Trend Wedges	−0.420	−0.090	0.325	0.078
2000:2009				
Efficiency Wedges	0.931	1.034	0.263	1.802
Government Consumption Wedges	0.059	−0.030	0.125	0.041
Investment Wedges	−0.278	−0.575	2.147	0.537
Labor Wedges	0.423	0.266	−0.367	−0.781
Trend Wedges	−0.136	0.305	−1.169	−0.600

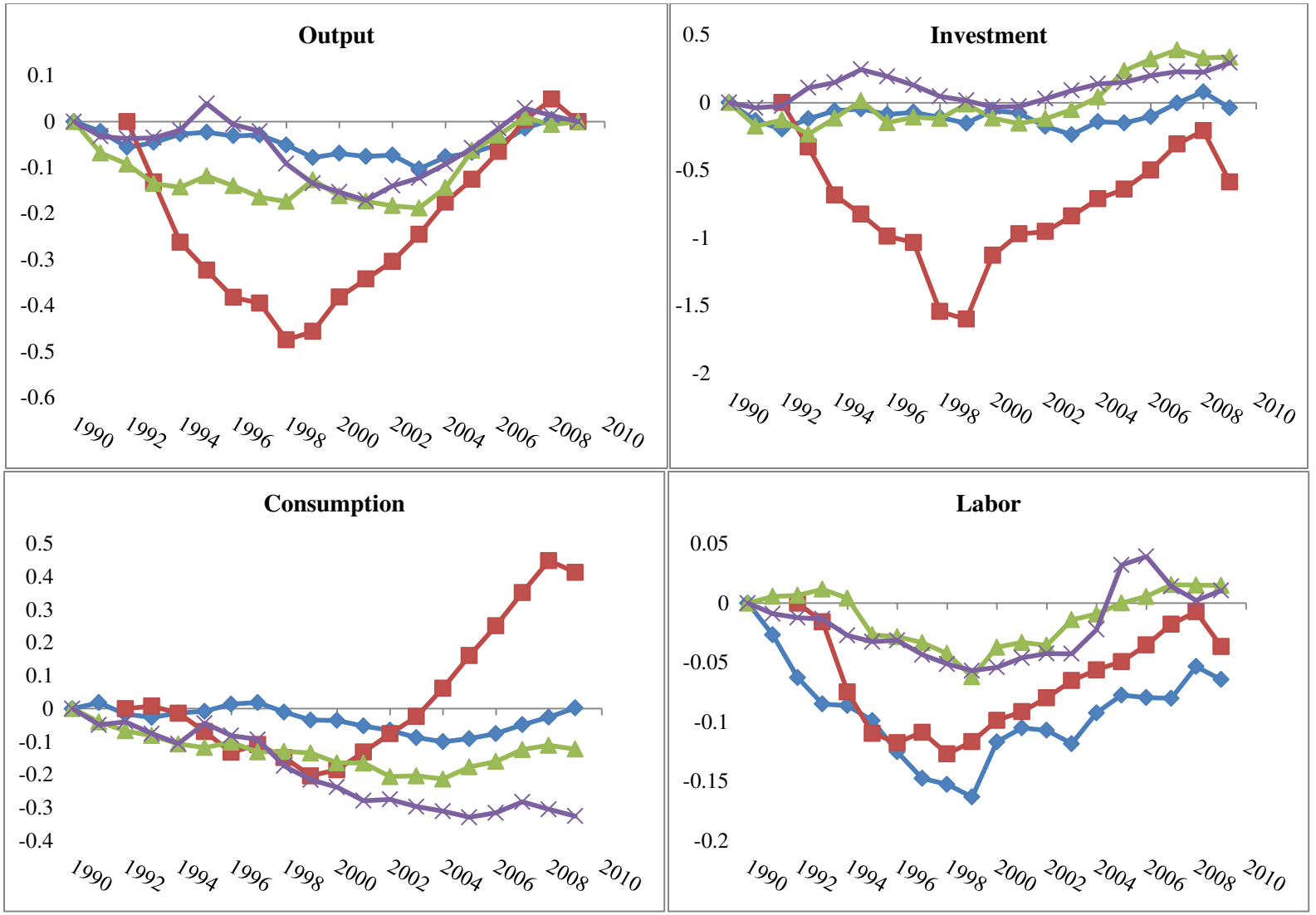
Table 10: Average score of BRIC economies over the last two decades

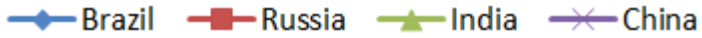
Source: The Worldwide Governance Indicators of the World Development Index

	1990s				2000s			
	Brazil	**Russia**	**India**	**China**	**Brazil**	**Russia**	**India**	**China**
Voice & Accountability	0.14	−0.42	0.33	−1.33	0.44	−0.76	0.40	−1.57
	(0.06)	(0.18)	(0.09)	(0.05)	(0.11)	(0.22)	(0.06)	(0.12)
Political Stability	−0.31	−1.17	−1.01	−0.30	−0.05	−1.02	−1.21	−0.52
	(0.08)	(0.08)	(0.14)	(0.18)	(0.22)	(0.26)	(0.17)	(0.14)
Government Effectiveness	−0.13	−0.64	−0.09	−0.18	0.00	−0.44	−0.05	0.06
	(0.03)	(0.18)	(0.01)	(0.10)	(0.10)	(0.12)	(0.07)	(0.12)
Regulatory Quality	0.41	−0.36	−0.43	−0.20	0.13	−0.32	−0.31	−0.25
	(0.01)	(0.11)	(0.02)	(0.09)	(0.14)	(0.13)	(0.08)	(0.12)
Rule of Law	−0.32	−0.92	0.28	−0.39	−0.30	−0.90	0.07	−0.44
	(0.02)	(0.07)	(0.02)	(0.06)	(0.17)	(0.11)	(0.11)	(0.07)
Control of Corruption	−0.04	−0.98	−0.34	−0.25	−0.01	−0.93	−0.43	−0.54
	(0.05)	(0.06)	(0.09)	(0.00)	(0.11)	(0.15)	(0.08)	(0.13)

Note: The mean scores for the decades are outlined with the standard deviation in parenthesis
Scores range from -2.5 to +2.5 with a positive number indicating more effective governance

Figure 1: Real Macro Aggregates





Note: "Output (Y)" includes GDP and the imputed service flow from consumer durables. It is decomposed into "Consumption (C)" that consists of household consumption of non-durables and services (where the imputed service flow from consumer durables are included) and "Investment (X)" that includes gross domestic capital formation and household expenditures on consumer durables while the residual is defined as "Government Consumption (G)" so that Y=C+X+G "Labor (L)" represents total hours worked which consists of total employment and hours worked per workers. All variables are divided by the adult population. Output, consumption and investment are linearly detrended by the average per adult output growth rate over the 1990-2009 period setting 1990 at the trend level

Source: The data is primarily collected from the Penn World Tables edition 7.0, its updated version PWT 7.1 and its extension made by Duncan Foley

Figure 2: Estimated Wedges in the benchmark model

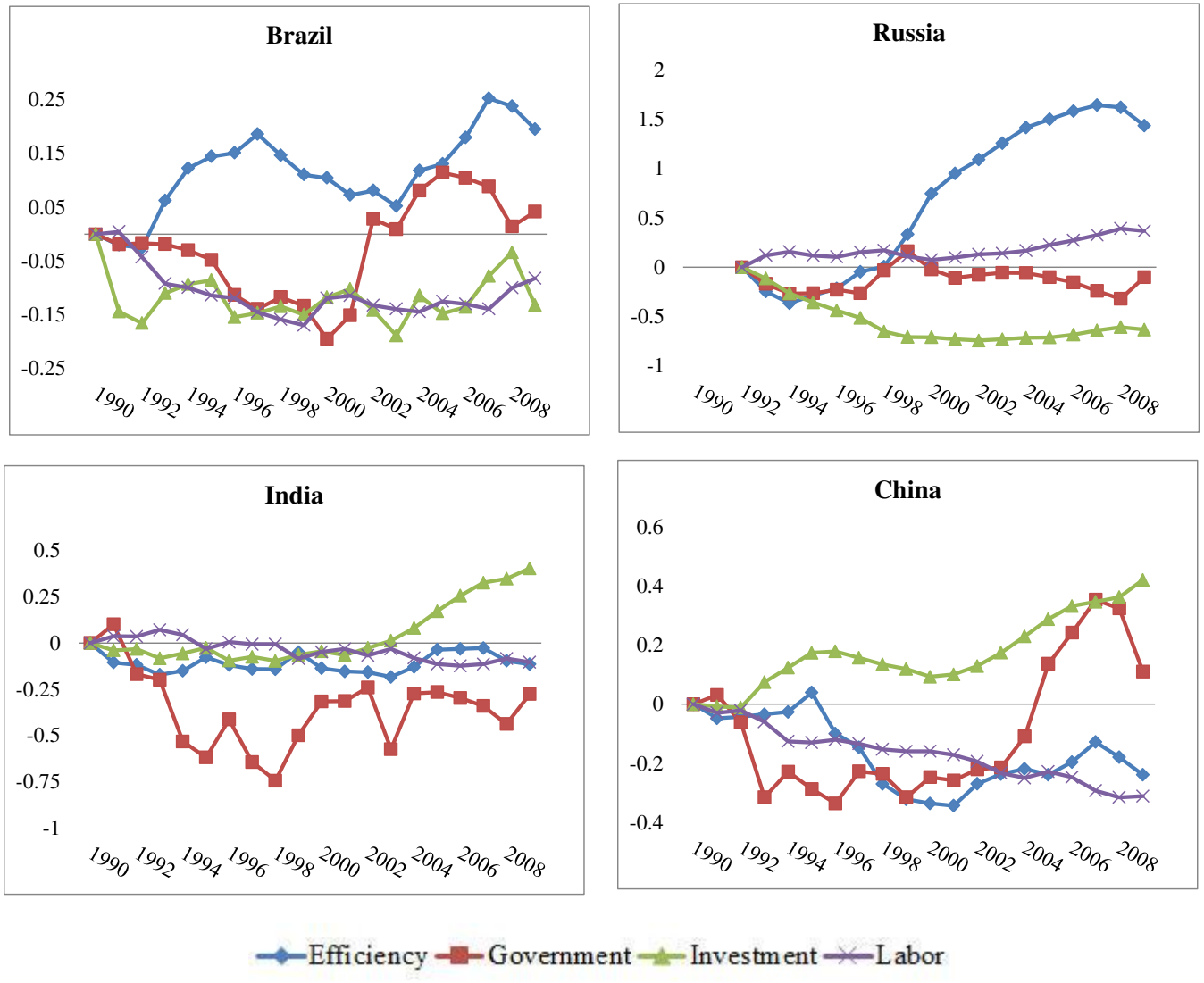


Figure 3: Simulated Output in the benchmark model

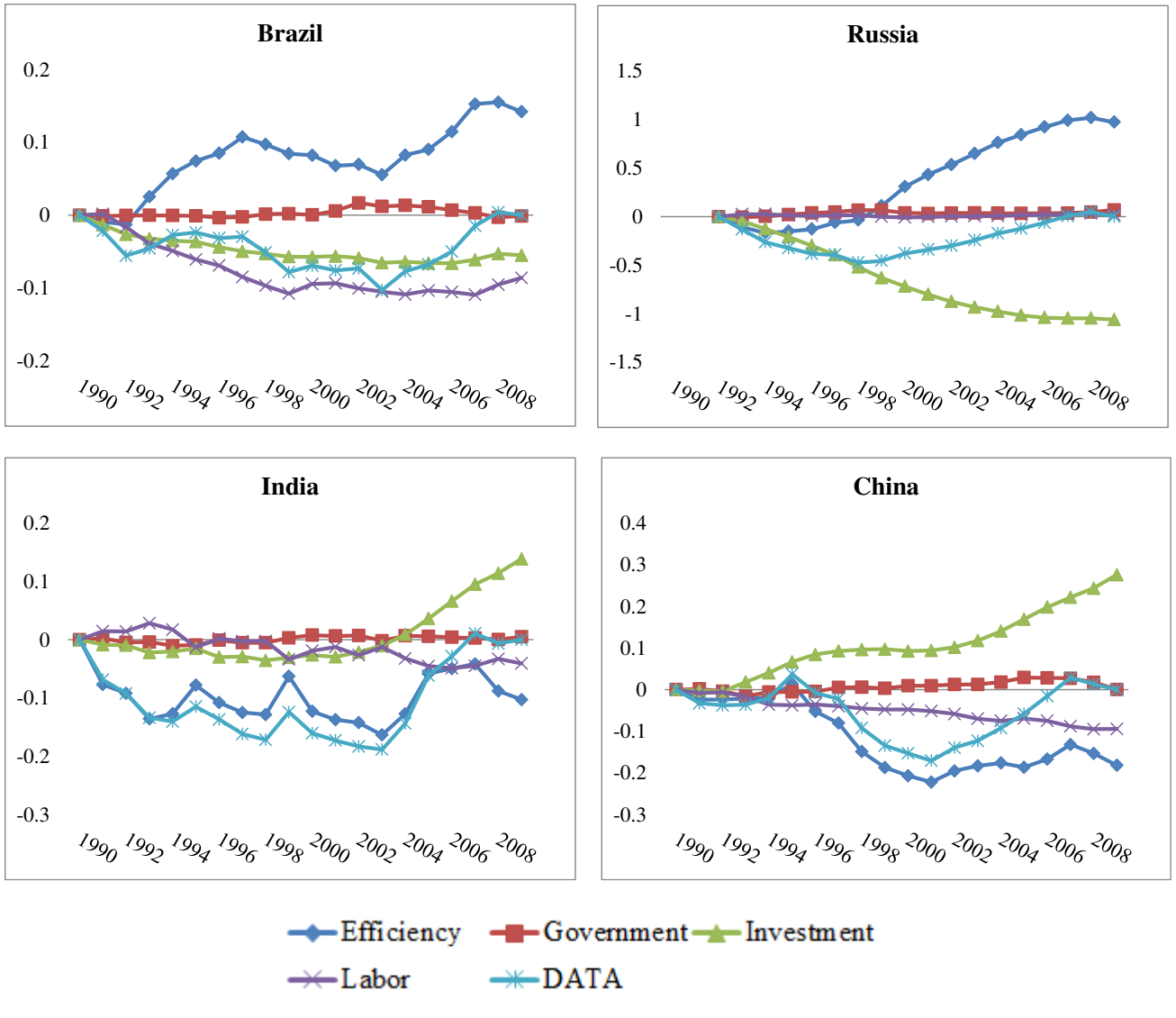
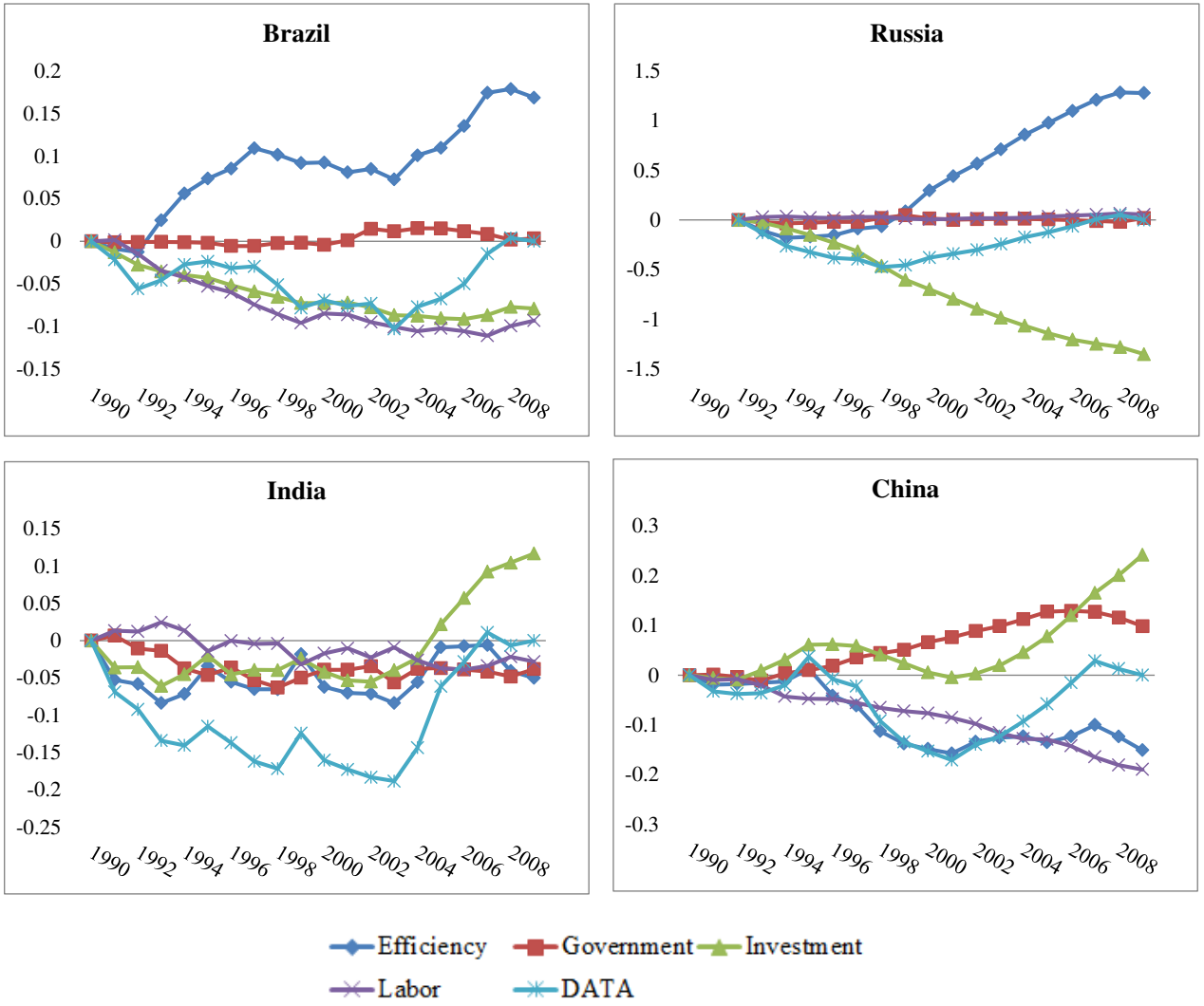
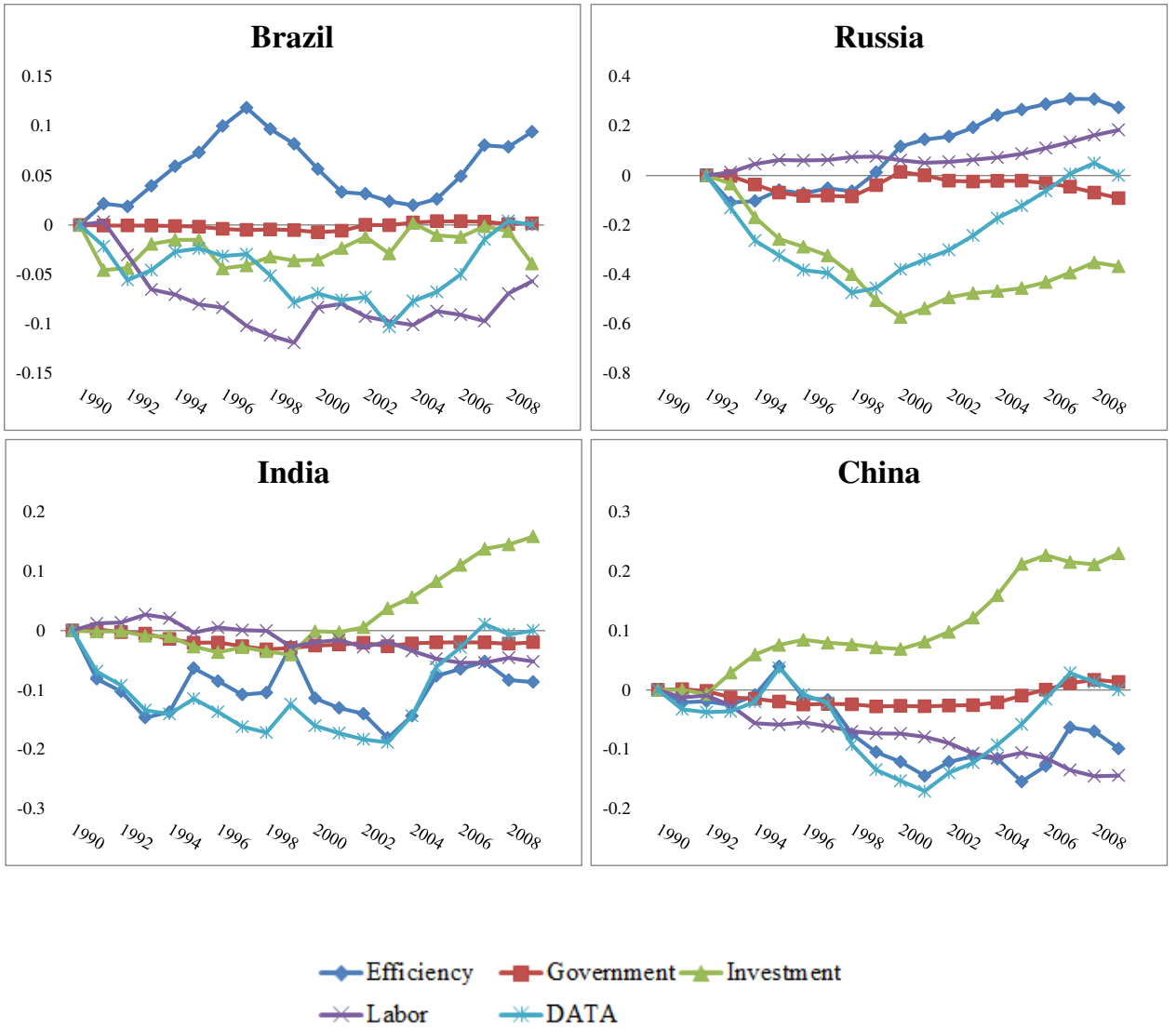


Figure 4: Simulated output in the benchmark model adjusted for investment adjustment costs



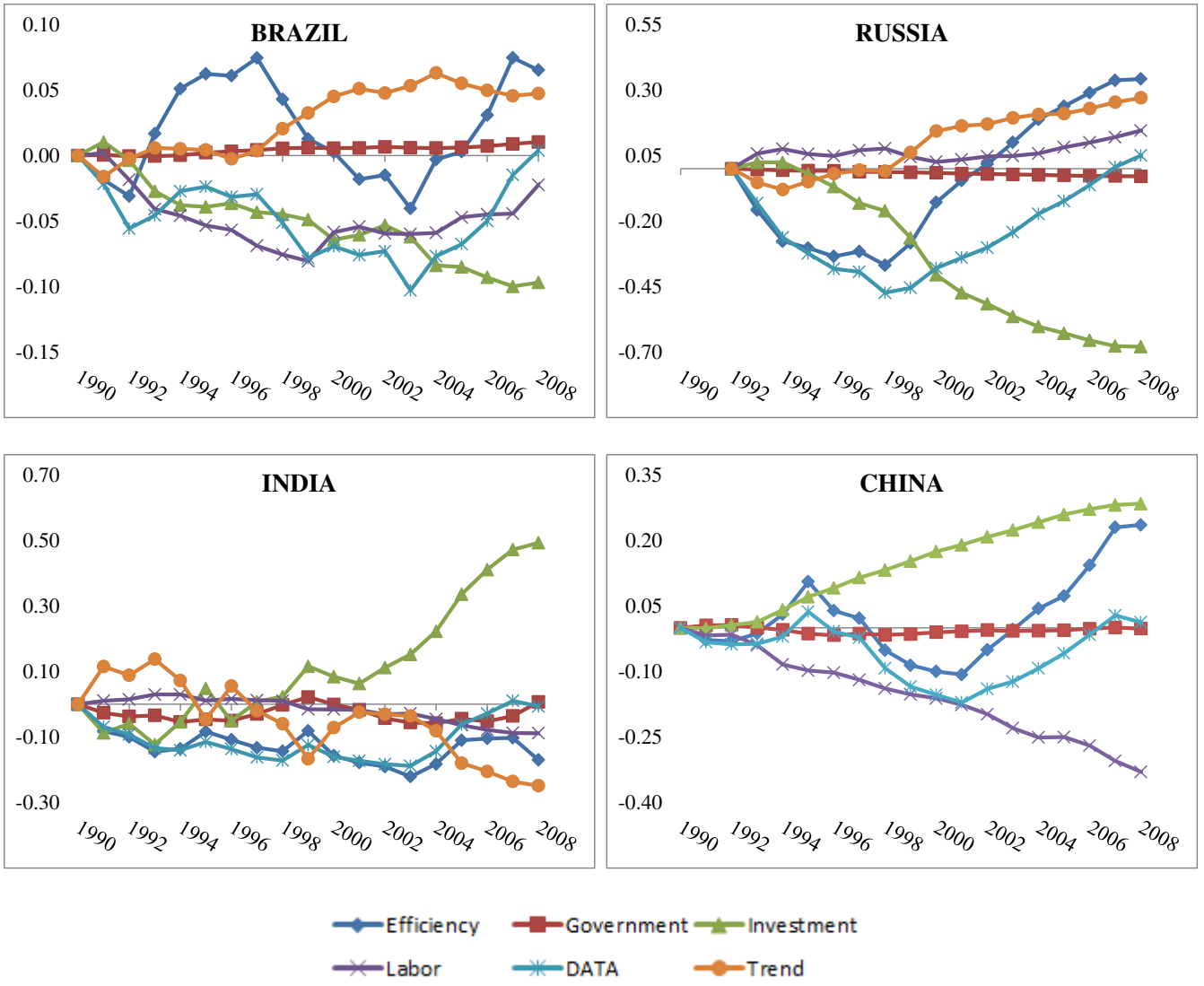
Note: A quadratic investment adjustment cost is introduced in an otherwise benchmark model to capture the fact that output cannot be costlessly transformed to capital stock

Figure 5: Simulated output in the benchmark model adjusted for factor hoarding



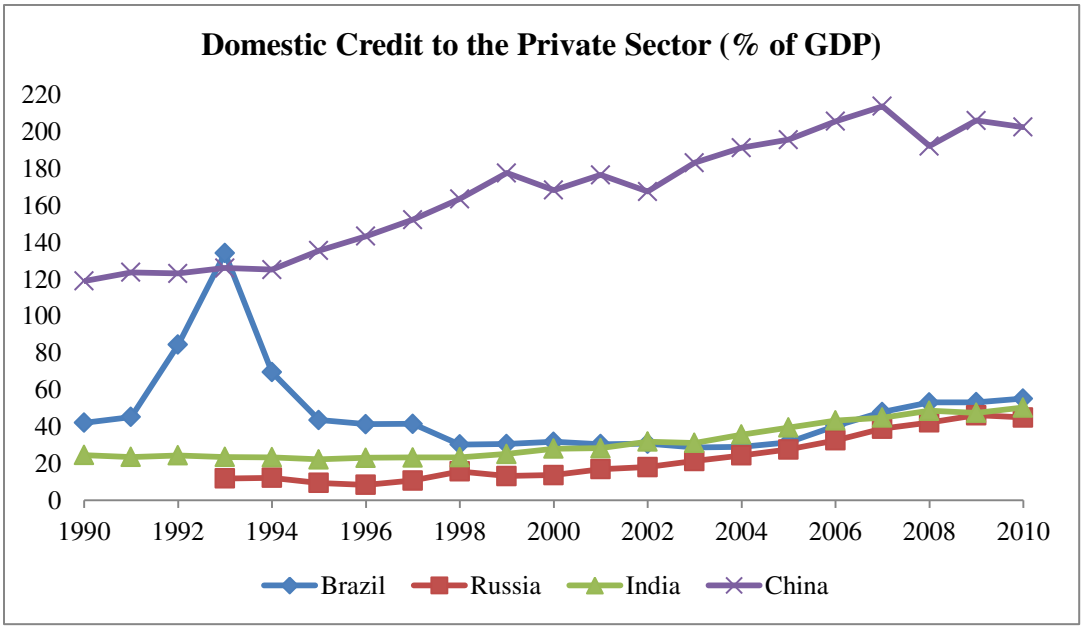
Note: We modify the benchmark model to allow for variable utilization of labor and capital

Figure 6: Simulated output in a small, open economy model



Note: We modify the closed economy benchmark model to a small, open economy set-up. In addition, wedges, cycles and trends are estimated jointly

Figure 7a: Flow of Domestic Credit to Private Sector and Inflows of FDI



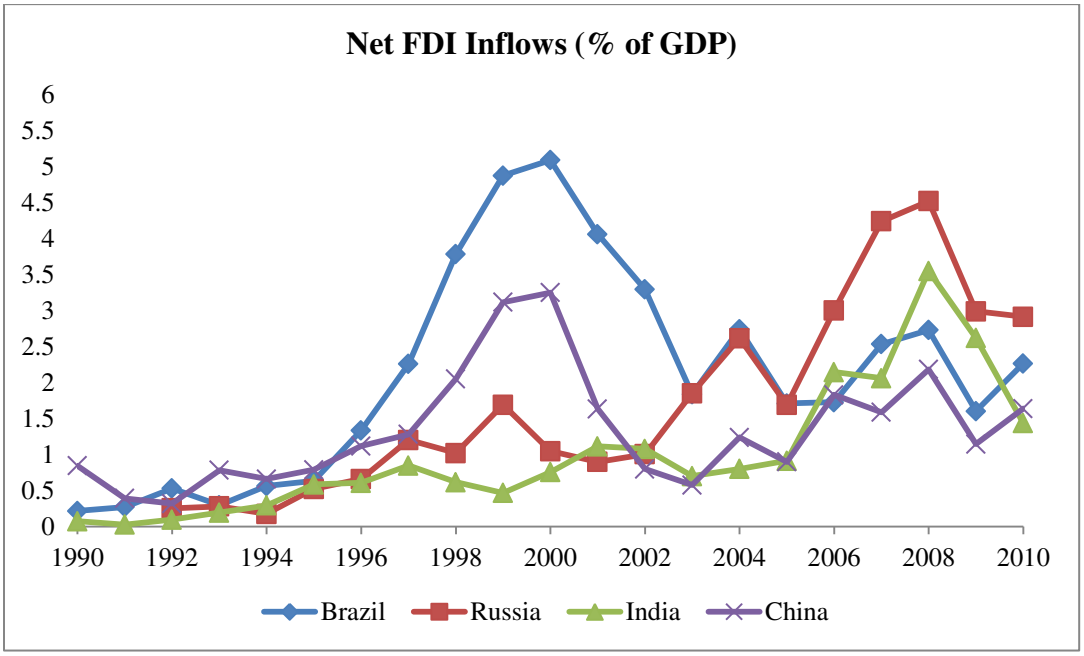
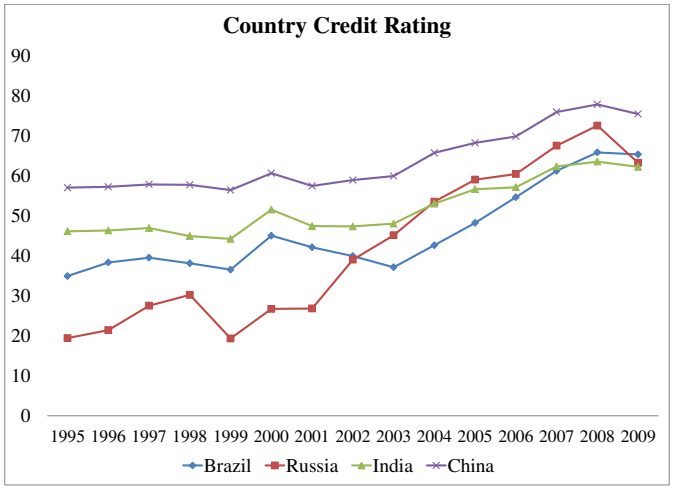
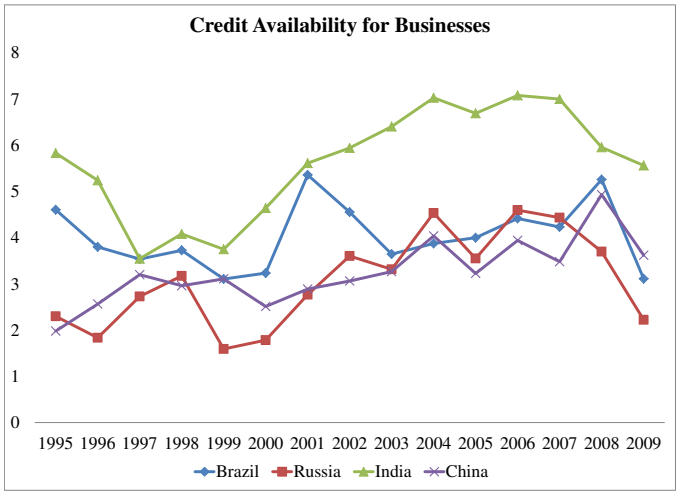


Figure 7b: Financial Market Indicators





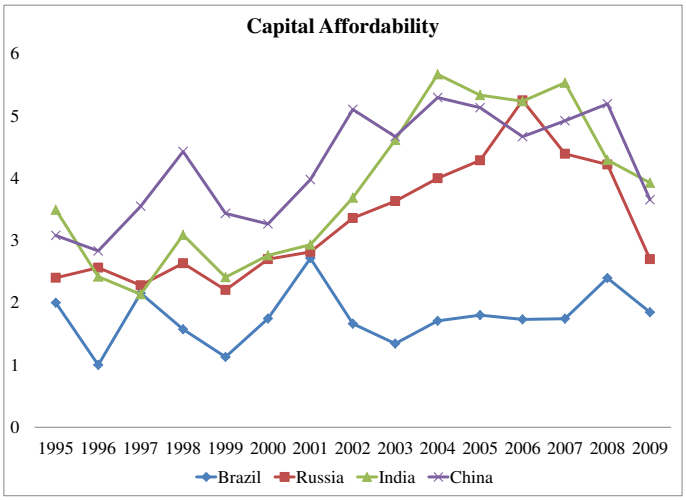
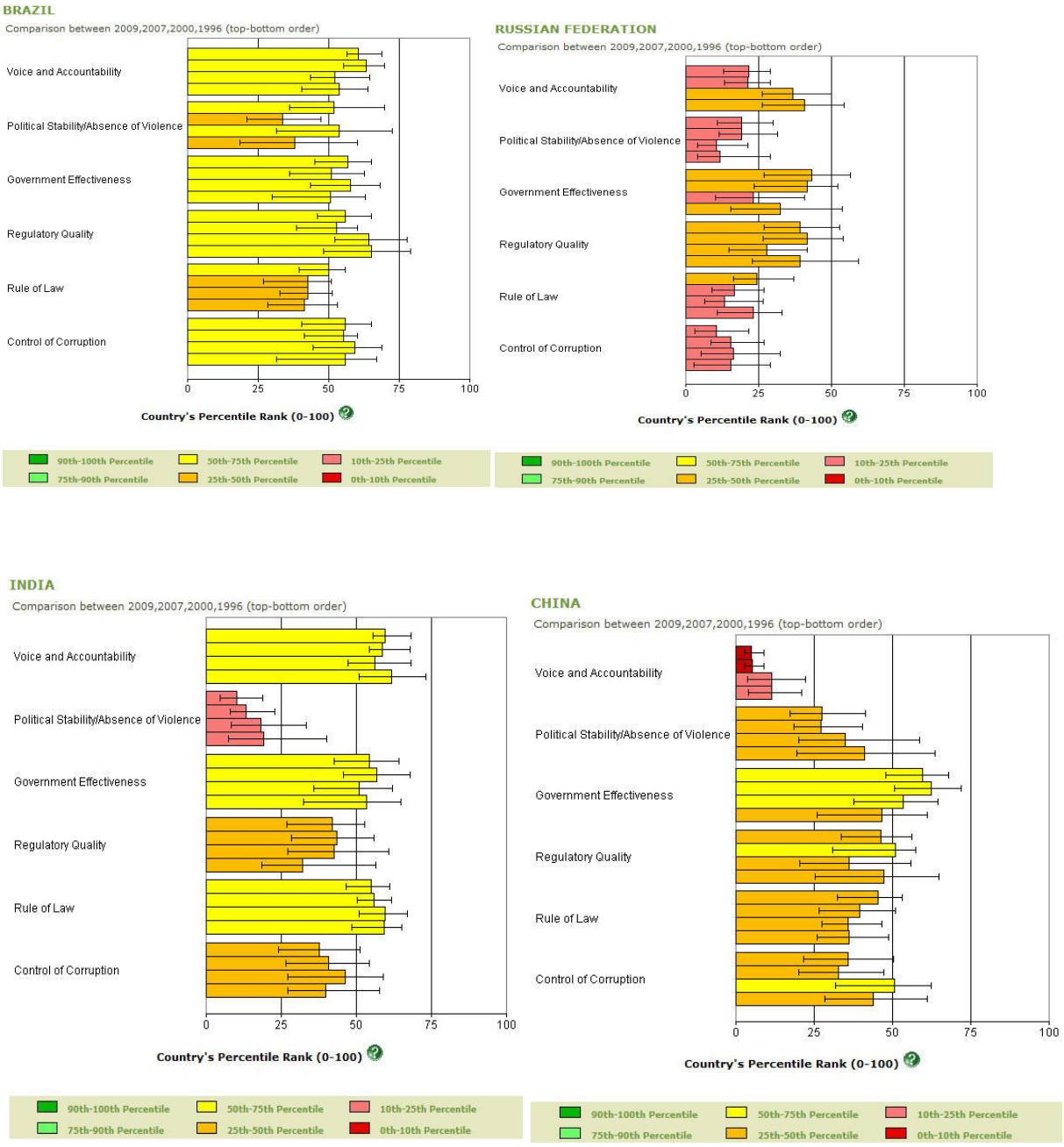


Figure 7c: Measures of Institutional and Policy Reforms



Note: We provide the percentile rank of the BRICs over a given span of time (years 1996 –when the data first becomes available, 2000, 2007 and 2009 –the end of our sample period) in terms of the six governance indicators. An improvement in rank is consistent with institutional improvement conducive to growth.

ONLINE APPENDIX FOR "BUSINESS CYCLE ACCOUNTING OF THE BRIC ECONOMIES"

June 1, 2013

1 Parameter Estimation

Given that investment wedges are not directly observable, we employ Bayesian techniques to structurally estimate the parameters governing the stochastic process of the wedges using data on output, consumption, investment and labor in Brazil, Russia, India and China. The parameters estimated are lag parameters in the transition matrix of wedges, the standard deviations and correlation coefficients that define the variance covariance matrix of the error terms and the steady state level of investment wedges along with the subjective discount factor.

The estimation results for the benchmark model are presented in **Tables A1 (a)-(d)**. The left panel of the tables presents the prior distribution shape, mean, standard error and support for each parameter. The right panel reports the posterior mode and its standard error as well as the posterior mean and its 95 percent confidence interval for each parameter. We choose to use the posterior mode as our point estimates in the simulations[1].

The estimation gives a range of parameter estimates across countries. For instance, in terms of the persistence parameters Russia has higher P_{kk}, P_{ee} and P_{ll} compared to those in the other countries. This is reflected in the strong trends in the Russian wedges presented in Figure 2 of the text. In Brazil there are large positive spillovers from investment wedges onto labor wedges, P_{lk}. In Russia, the spillover from government and labor wedges onto efficiency wedges, P_{ge} and P_{le}, are strongly positive while that of investment wedges onto efficiency wedges, P_{ke}, is strongly negative. In India the spillover from efficiency wedges onto government wedges, P_{ge}, is strongly positive while that of labor wedges onto investment wedges, P_{kl}, is strongly negative. In China, the spillover of labor wedges onto investment wedges are strongly negative. In terms of volatility, the standard deviation of the shocks to government

[1] Using the posterior mean for each parameter instead of the mode does not make much difference in the simulation results.

wedges σ_g are larger than those to the other wedges in all countries. In addition, Russia has a much lower σ_k than other countries. Finally, in terms of correlation, government wedges and labor wedges are strongly negatively correlated in Brazil and Russia, i.e. ρ_{gl} is close to -1, while efficiency wedges and labor wedges are strongly negatively correlated in India, i.e. ρ_{el} is close to -1.

2 Simulation

The first step in the simulation process is to solve the model for linear decision rules for linearized endogenous variables $\widetilde{k_{t+1}}$ and $\widetilde{q_t} = (\widetilde{y_t}, \widetilde{c_t}, \widetilde{x_t}, \widetilde{l_t})'$:

$$\begin{aligned} \widetilde{k_{t+1}} &= A\widetilde{k_t} + B\widetilde{\omega_t}, \\ \widetilde{q_t} &= C\widetilde{k_t} + D\widetilde{\omega_t}. \end{aligned}$$

Note that the entire series of $\widetilde{k_t}$ can be directly generated from the equation (assuming an initial value $\widetilde{k_0} = 0$):

$$\widetilde{k_{t+1}} = \frac{x}{nak}\widetilde{x_t} + \frac{1-\delta}{na}\widetilde{k_t},$$

and the observed series of investment. Then the wedges can be computed as

$$\widetilde{\omega_t} = D^{-1}\left(\widetilde{q_t} - C\widetilde{k_t}\right).$$

Once the wedges are computed, they are used for simulation. We compute the endogenous reaction of selected variables to the changes in a chosen wedge $\widetilde{\omega_{j,t}}$ by plugging its time series into the linear decision rules of endogenous variables:

$$\begin{aligned} \widetilde{k_{t+1}^{\omega_j}} &= A\widetilde{k_t^{\omega_j}} + B\widetilde{\omega_{j,t}}, \\ \widetilde{q_t^{\omega_j}} &= C\widetilde{k_t^{\omega_j}} + D\widetilde{\omega_{j,t}}. \end{aligned}$$

By definition, plugging in all wedges into the model will exactly reproduce the observable data:

$$\widetilde{q_t^{\omega}} = C\widetilde{k_t} + D\widetilde{\omega_t} = C\widetilde{k_t} + DD^{-1}\left(\widetilde{q_t} - C\widetilde{k_t}\right) = \widetilde{q_t}.$$

Therefore, we can easily decompose the effects of each wedges on the observables due to linearity of the decision rules:

$$\widetilde{q_t^{\omega_e}} + \widetilde{q_t^{\omega_g}} + \widetilde{q_t^{\omega_k}} + \widetilde{q_t^{\omega_l}} = \widetilde{q_t^{\omega}}.$$

3 Alternative Models

3.1 Factor Hoarding

3.1.1 Household

The household's problem is

$$\max U = \sum \beta^t \left[\Psi \ln c_t + (1-\Psi)\left(\ln(1-l_t) - \alpha l_t u_{l,t}^{\mu}\right)\right]$$

$$sub.to\ \omega_{l,t} w_t l_t u_{l,t} + \omega_{k,t} r_t k_t u_{k,t} + \pi_t + \tau_t = c_t + x_t$$

$$\gamma n k_{t+1} = x_t + \left(1 - \delta u_{k,t}^{\chi}\right) k_t$$

where $u_{l,t}$ and $u_{k,t}$ are labor and capital utilizations.

3.1.2 Firm

The firm's problem is

$$\max \pi_t = y_t - w_t l_t u_{l,t} - r_t k_t u_{k,t}$$

$$sub.to\ y_t = \left(k_t u_{k,t}\right)^{\theta} \left(\omega_{e,t} l_t u_{l,t}\right)^{1-\theta}$$

3.1.3 Equilibrium Conditions

The competitive equilibrium is characterized by the following 7 equations:

$$\begin{aligned}
\frac{\Gamma}{c_t} &= \beta E_t \left[\frac{1}{c_{t+1}}\left(\omega_{k,t+1}\theta\frac{y_{t+1}}{k_{t+1}} + 1 - \delta u_{k,t+1}^{\chi}\right)\right] \\
\frac{1}{1-l_t} &= (\mu-1)\,\alpha u_{l,t}^{\mu} \\
\omega_{l,t}\,(1-\theta)\,\frac{y_t}{l_t} &= \frac{1-\Psi}{\Psi}\frac{\mu}{\mu-1}\frac{c_t}{1-l_t} \\
\omega_{k,t}\theta\frac{y_t}{k_t} &= \chi\delta u_{k,t}^{\chi} \\
y_t &= \left(k_t u_{k,t}\right)^{\theta}\left(\omega_{e,t} l_t u_{l,t}\right)^{1-\theta} \\
\gamma n k_{t+1} &= x_t + \left(1 + \delta u_{k,t}^{\chi}\right) k_t \\
y_t &= c_t + x_t + \omega_{g,t}
\end{aligned}$$

where there are 7 endogenous variables $\{k_{t+1}, y_t, c_t, x_t, l_t, u_{l,t}, u_{k,t}\}$.

3.2 Small Open Economy Model with Stochastic Trends

3.2.1 Household

The household's problem is

$$\max U = \sum \beta^t \left[\Psi \ln c_t + (1-\Psi)\ln(1-l_t)\right]$$
$$sub.to\ \omega_{l,t} w_t l_t + \omega_{k,t} r_t k_t + d_t + \pi_t + \tau_t = c_t + x_t + \gamma n Q_t d_{t+1},$$
$$\gamma n k_{t+1} = x_t + (1-\delta)k_t - \Phi_t k_t,$$

where

$$\Phi_t = \frac{\phi}{2}\left(\frac{x_t}{k_t} - \Omega\right)^2.$$

3.2.2 Firm

The firm's problem is

$$\max \pi_t = y_t - w_t l_t - r_t k_t$$
$$sub.to\ y_t = k_t^{\theta}\left(\omega_{e,t}\gamma_t l_t\right)^{1-\theta}.$$

3.2.3 Equilibrium Conditions

The equilibrium is characterized by the following 8 equations

$$\begin{aligned}
\frac{1-\Psi}{\Psi}\frac{c_t}{1-l_t} &= \omega_{l,t}(1-\theta)\frac{y_t}{l_t}, \\
y_t &= k_t^{\theta}\left(\omega_{e,t}\gamma_t l_t\right)^{1-\theta}, \\
\gamma n k_{t+1} &= x_t + (1-\delta)k_t - \Phi_t k_t, \\
y_t &= c_t + x_t + tb_t + g\omega_{g,t}, \\
tb_t &= \gamma n Q d_{t+1} - d_t, \\
\frac{1}{(1-\Phi_t')}\frac{\Psi}{c_t} &= \widehat{\beta} E_t\left[\frac{\Psi}{c_{t+1}}\left(\omega_{k,t+1}\theta\frac{y_{t+1}}{k_{t+1}} + \frac{1}{\left(1-\Phi_{t+1}'\right)}\left(1-\delta-\Phi_{t+1}+\Phi_{t+1}'\frac{x_{t+1}}{k_{t+1}}\right)\right)\right], \\
Q\frac{\Psi}{c_t} &= \widehat{\beta} E_t\left[\frac{\Psi}{c_{t+1}}\right], \\
\gamma_t &= \omega_{\tau,t}\gamma_{t-1},
\end{aligned}$$

where there are 8 endogenous variables $\{k_{t+1}, d_{t+1}, \gamma_t, y_t, c_t, x_t, l_t, tb_t\}$.

4 More Sensitivity Analysis

4.1 Non-Separable Preferences

In the benchmark model, we considered log preferences. In this section we consider Cobb-Douglas preferences with a higher risk aversion parameter

$$u(c_t, 1-l_t) = \frac{\left(c_t^{\Psi}(1-l_t)^{1-\Psi}\right)^{1-\sigma}}{1-\sigma},$$

where $\sigma = 5$[2].

The alternation does not affect the measurement of efficiency, government and labor wedges. However, since consumption and leisure are non-separable, the leisure term shows up in the capital Euler equation and affects the measurement of investment wedges. The decomposition results reported in **Table A2** show that the results are very similar to the benchmark model.

4.2 Common Growth Trend

In the benchmark model we focus on the medium term cycles and detrend all variables with the average output growth rate over the period. If we instead consider the implication of wedges on long run growth, we should consider an alternative growth trend. In this section we consider the trend growth rate to be 1.5% which is the average US GDP per capita growth rate over the sample period $1990 - 2009$.

Changing the trend does not affect the measurement of efficiency, government and labor wedges. However, the alternation of the growth trend affects the capital Euler equation. Furthermore, for China and India there will be a noticeable growth trend in the detrended data which affects the estimation. Finally, one caveat for this detrending method is that we have to define the level of the long run growth path. We report results for simulations assuming that the economies start at the long run trend level in 1990, however, obviously this may not be the case.

The decomposition results are reported in **Table A3**. The results for Brazil is almost identical to those in the benchmark model. In Russia, the importance of investment wedges significantly increases. Specifically, the recovery during the $2000s$ are captured primarily by improvements in investment climate. In India, the detrended output has a growing trend which can be accounted for by efficiency wedges. The results for China are quite different from the benchmark case. The rapid growth throughout the entire period is fully accounted for by continuous improvements in investment wedges.

[2]The benchmark model can be considered as a special case when $\sigma = 1$.

4.3 The Effect of the Global Recession

In the benchmark results, we consider the $1990 - 2009$ period. From Figure 1 we can see that the global recession of 2008 affected the BRIC economies in different extents. In Brazil, output growth slowed down in 2008 but was still faster than its trend level. In Russia, the recession hit the economy sharply on 2009. In India and China, the impact of the recession was felt in 2008. In this section, we will remove the final two years from the sample in order to focus on the pre-global recession period.

In order to make a comparison to the benchmark case, we maintain the trend levels the same and simply remove the final two entries of the dataset. The calibrated parameters remain the same but the stochastic process is reestimated and the simulation is based on the newly estimated parameters. The contribution of each wedges are computed over the $1990 - 2007$ period.

The decomposition results are reported in **Table A4**. The results for Brazil shows that the overall contribution of efficiency wedges falls while that of labor wedges rises. Nonetheless, the main result that the labor wedges are responsible for the downturn during the $1990s$ and the efficiency wedges played an important role in the growth during the $2000s$ holds. In Russia, the results are very similar to those from the benchmark simulation. In India and China, the overall contribution of efficiency wedges rise while that of investment wedges fall during the $2000s$ as compared to the benchmark which is to be expected since investment wedges have started playing a major role only since 2005 and our sub-sample ends at 2007.

5 Institutional & Policy Reforms -BRICs over the decades

While Brazil, Russia, India and China share impressive growth experiences in the $2000s$ leading economists to club them into one group, each has its unique history and time path to present growth. To better understand the "BRIC" patterns of growth, we start by looking deeper into their economic performance and policies that led to their economic resurgence, one country at a time.

5.1 Brazil

Brazil has experienced turbulent periods of boom and bust since the early $20th$ century. During the late $1930s$ well into the $1940s$, external shocks like the Great Depression and World War II as well as internal focus on protectionism isolated Brazilian economy from much of the developed world. However, the proactive role of the Alliance for Progress and the Inter-American Development Bank ensured the

growth of trade and a period of economic recovery during the later 1950s and 1960s. The government and the private sector borrowed heavily from abroad to generate this high economic growth, which was proved unsustainable as the accumulated foreign debt caused a debt crisis when oil prices increased in both 1974 and 1979 and the interest rates rose in 1980 (Cardoso and Teles, 2010)[3]. The 1980s came to be known as the lost decade of Brazil illustrated with low economic growth accompanied by a decline in productivity (Graminho 2006). As the government tried to finance the fiscal imbalances through seigniorage, it created high inflation over the decade.

In the early 1990s, in order to turn around the stagnant economy and reduce government debt, the government moved towards privatization of inefficient state-owned-enterprises, which increased productivity (Schmitz and Teixeira, 2008), and output started to recover in 1993. Following the East Asian growth model, financial liberalization took place as prohibition on FDI into certain sectors was lifted and bureaucratic obstacles were reduced ('de Paula 2007). In order to contain the inflation, the government instituted the "Real Plan" in 1994 pegging its currency to the US dollar. However, the fixed exchange rate regime collapsed in 1999. After the currency crisis, as a condition on the $41 billion loan received in 1998, the government accepted the IMF Article $VIII$ obligations which precludes members from imposing foreign exchange restrictions. To further improve the investment climate, "2000 Fiscal Responsibility Act" was put in place, imposing severe penalties on administrators who exceed budget limits. Federal debt was restructured, eliminating currency-indexed bonds, reducing inflation-indexed debt and increasing fixed-rate proportion. These measures upgraded Brazil's investment grade status (BNY Mellon). While net inflows of FDI slowed down after the crisis, their percentage to GDP averaged 2.7% during the 2000s, almost doubling over the previous decades.

A virtuous cycle of BRIC emergence helped Brazil during the 2000s as growing China increased its demand for commodities, of which Brazil had a comparative advantage. As reported by ISI Emerging Markets "Brazil's exports to China grew by a Compound Annual Growth Rate (CAGR) of 46.9% annually while imports from China grew by a CAGR of 37.8% annually from 1999 to 2010. The growth rates are high compared to its aggregate exports and imports which saw a CAGR of 12.7% and 11.5% respectively. By 2009, growth in Brazil-China trade catapulted China as Brazil's largest trade partner, overtaking the United States. China presently accounts for 14.7% of Brazil's total trade flows". Overall average annual growth rate of exports increased to 7.13% almost catching up with the pre-1980s numbers.

[3] While average annual growth rate of exports of goods and services stood at 10.5% during the later 1970s and early 1980s, the growth rate dropped to 5.3% in mid to late 1980s and early 1990s.

5.2 Russia

The political disintegration of the erstwhile Soviet Block in 1991 and formation of the Russian Federation makes Russia a unique country for our analysis. Since the economic and political movements of the earlier Soviet Union are too vast to concisely summarize in our paper, we begin our discussion by an analysis of the newly found Russian Federation. After the break-up of the Soviet Union in 1991, the world saw a transition of yet another socialistic economy to a more market based economic structure. President Boris Yelstin, who took the reins of the new country, vowed radical, market-oriented reforms, referred to as a "shock therapy" for its abrupt nature.

Russia's initial experience with market economy did not go smoothly as hyperinflation coupled with unsustainable government budget deficits prevailed during the $1990s$. In addition, political unrest due to the emergence of oligarchs who now came to control the vast earlier state-owned enterprises bred discontent while the war in Chechnya did not help matters. The failure of exchange rate-based stabilization in 1995 and disappointing macroeconomic performance eventually led to the Russian Financial Crisis in 1998 (Merlevede, Schoors and Van Aarle 2009). When the Asian Financial Crisis led to a decline in the demand for crude oil (one of Russia's biggest exports), the economy was further hit and growth numbers turned negative. Annual growth rate of exports fell to the tune of 1.8%, while aggregate GDP growth fell by 4.8% (per capita GDP fell by 4.9%), requiring a $22.6 billion bailout from IMF and World Bank. To stabilize Russia, leaders of the $G-8$ also agreed to explore ways to write-off the old Soviet debt that Russia had assumed. Government of Russia also took pro-active steps to curtail the effects of a sudden decline in oil prices- a hard lesson learned during the East Asian Crisis- with the set-up of the Oil Stabilization Fund of Russian Federation in 2004.

After surviving the political turmoil of early $1990s$ and the 1998 crisis, Russia too instituted strong reforms outlined in two resolutions: (a) Measures Planned by the Government of the Russian Federation and the Central Bank of the Russian Federation to Stabilize Socioeconomic Conditions in Russia (Nov 16, 1998) and (b) Letter of Development Policy for the Third Structural Adjustment Loan ($July$ 19, 1999). While the first plan was more consistent with Russian system of state control, the second plan was formulated after consultations with international financial institutions. In a move towards privatization, 15 companies were identified to be privatized by early $2000s$. The government also lifted the January 1999 moratorium on insolvency claims of companies, encouraging private investment. However, on the trade front, government re-introduced export tariffs and quotas in a bid to reign in Russian over-dependence on international trade.

President Vladimir Putin, who succeeded Boris Yelstin, spearheaded a concerted effort to revamp infrastructure and increase production, both industrial and agrarian.

The Oil Stabilization Fund played a crucial role in maintaining the fiscal surplus through the oil revenue. According to 'de Paula (2007), "some flexibility in the fiscal policy was introduced in 2006 with the creation of an Investment Fund in the federal budget. The aim of the fund is to finance infrastructure investment and innovation related projects in joint public-private partnerships". The recent 2008 global crisis hit Russia comparatively harder than its BRIC peers due to Russian dependence on crude oil and commodities trade for its economy[4]. However, the recovery was also swift as output growth turned positive in mid-2009, and by 2010, GDP growth rate reached 4.0%, after a negative growth of -7.8% in 2009 (GDP per capita growth rates are comparable).

5.3 India

After emerging from its colonial era in 1947, India embarked on a socialistic development path by successive formulation of the "Five Year Plans" of economic growth. The central tenets of the growth plans were an emphasis on the public sector, strong move towards licensing and import restrictions and agrarian development. After a relative slowdown in the $1970s$, reform measures in India started in the $1980s$, with a move towards de-licensing and infrastructural investment accompanied by a pro-business attitude (Bosworth and Collins, 2008 ; Rodrik and Subramanian, 2005).

India faced a serious crisis in 1991 during the first gulf war and was at the verge of defaulting on its domestic loans reaching a crisis point in terms of foreign exchange reserves. India asked for a $1.8 billion bailout loan from the IMF, which in return demanded reforms. The reforms since then, initiated by the then Finance Minister (current Prime Minister) of India, Dr. Manmohan Singh, was a complete reversal of the earlier era of socialistic growth. Following the East Asian model, India initiated a two-pronged reform approach: major macroeconomic management reforms and structural and sector specific economic reforms. India started widespread privatization and financial liberalization, de-licensing the "License Raj" and encouraging foreign direct investment in many major industries. Subsidies to agriculture (particularly fertilizer and food) was reduced to narrow the budget deficit. Taxes were lowered, export subsidies were abolished and import tariffs were reduced. India initiated the formation of special economic zones, with a gradual liberalizing of organized manufacturing sector. India continues its liberalization effort initiating a move towards foreign direct investment in retail sector (which is still to pass muster with all political parties) and setting up of agro-economic zones to encourage agricultural exports.

These moves catapulted India in the last decade into the elite group of top ten na-

[4]The ruble fell 35% against the dollar from the onset of the crisis to January 2009, as the foreign exchange reserves fell by $210 billion.

tions, primarily aided by a strong service sector and information technology industry. According to Bollard, Klenow and Sharma (2012), manufacturing TFP growth in India saw substantial speedup at over 5 percentage points per year during $1993 - 2007$ as opposed to the previous decade. While its economic transition was threatened during the current global crisis, India weathered the 2008 crisis well, as seems to be true of most BRIC nations. While average output growth did slow down to 7.0% during $2008 - 2009$, since then it has recovered to 9.0% , with a per capita GDP growth of 7.4%[5]. For the first time in decades, average annual growth rate of Indian exports crossed the double digit mark, reaching 14.4% during the last decade, as opposed to an average increase of 7.6% during the previous decades. The same trend was evident in inflows of foreign direct investment that totaled 1.6% of GDP during the $2000s$ as compared to an average of 0.15% of GDP during the previous decade[6].

5.4 China

China is one of the classical growth stories of development economics. Primarily formed as a communist country after the 1949 revolution by its patriarch, Mao Zedong, China yielded minimal economic power till the late $1970s$ and was known as a slow growth, tightly reined communist nation. During this period, the Chinese trade policy was focused on import substitution. The government protected the steel and machinery industries from foreign competition by controlling imports and foreign exchange transactions. Trade was limited to the Central Foreign Trade Ministry and its twelve trade corporations. These trade corporations exported agricultural and primary goods in order to finance the controlled imports of industrial equipment.

In late $1970s$ Deng Xiaoping introduced the *Gaige Kaifang* (Reform and Opening-up) policy. Since then the Government of China has pursued aggressively a pro-reform, market-oriented growth agenda, making China one of the most successful examples of state led capitalism today. 1978 marked the year when China started allowing foreign direct investment into "special economic zones" that became conduits for growth while dramatically increasing the number of firms that are allowed to engage in foreign trade. Since 1984, economic reforms picked up in earnest with a decline in government intervention, coupled with increases in decentralization and privatization of the state sector. Gradually through the $1980s$, China started adopting an export-oriented growth model.

While the $1990s$ was a period of political volatility and the East Asian Crisis that affected Chinese growth to some extent, China continued on the reform process.

[5] As reported by the World Development Indicators, at its worst in 2008, output growth declined to 4.9% before recovering.

[6] The growth in exports started in the $1990s$ in response to privatization and liberalization and exports grew by almost 12% in the mid to late $1990s$. However, inflows of FDI did not pick up till the $2000s$.

"In 1996 China accepted the IMF Article VII, that resulted in the liberalization of foreign exchange controls related to current account transactions" ('de Paula 2007). China entered a new era in December 2001 by joining the World Trade Organization (WTO) and agreeing to a host of globalization measures. Import quotas were removed and tariffs were gradually reduced. Production and exports shifted toward labor-intensive goods while imports of consumer durables and investment goods increased dramatically. Institutional changes were also apparent since the Chinese Communist Party's meeting in 2003 that encouraged protection of property rights and massive public investment in infrastructure development that would further encourage foreign investment. The liberalization policies were successful and by 2005, domestic private sector accounted for more than 50% of Chinese GDP. The efforts have borne fruit and during the first half of the last decade, the average growth rate of GDP has averaged roughly 10%- the highest in the world.

The Chinese government, as its BRIC counterparts, was also well equipped to deal with the global crisis. China announced a stimulus package to the tune of RMB 4 trillion (approximately US $586 billion) that would be used for public investment. In addition, China is turning from export dependence to home market to keep up growth. Given China's success in stemming the crisis from affecting its economy, World Bank revised its estimate of Chinese growth forecast from 6.5% to 7.3% in 2010. China was successful in attaining an actual GDP growth rate of 10.4% (per capita GDP growth rate of 9.83% - World Bank estimates). For its part, exports still played a very important role in Chinese growth with average annual exports growing by almost 20% during the 2000s, ably aided by an equally robust growth in FDI inflows that reached almost 4% of Chinese GDP, and was the largest amongst the BRIC nations[7].

6 Data Appendix

6.1 Sources of Macro Level Data

"Output (Y)" includes GDP and the imputed service flow from consumer durables. It is decomposed into "Consumption (C)" that consists of household consumption of non-durables and services (where the imputed service flow from consumer durables are included) and "Investment (X)" that includes gross domestic capital formation

[7]Chinese dominance in terms of its export growth and ability to lure FDI preceded that of India and in terms of timing was closer to Brazil's resurgence. Both China and Brazil saw an uptick in export growth and inflows of FDI in the 1990s. It took another decade for India to follow in the same path. As for Russia, we only have numbers for the last two decades, and it certainly seems to be the case that the Russian resurgence also happened in the last decade, following a time-line similar to India.

and household expenditures on consumer durables while the residual is defined as "Government Consumption (G)" so that $Y = C + X + G$[8]. "Labor (L)" represents total hours worked which consists of total employment and hours worked per workers. All variables are divided by the adult population[9]. Output, consumption and investment are linearly detrended by the average per adult output growth rate over the $1990 - 2009$ period setting 1990 at the trend level[10]. The data is primarily collected from the Penn World Tables edition 7.0 (and its update 7.1 published in November, 2012) and its extension made by Duncan Foley[11]. **Table A5** presents the original sources of our dataset. PWT stands for Penn World Tables edition 7.0 (and updates in version 7.1) and the extensions made by Duncan Foley. EM stands for the Eurominotor Global Market Information Database. ILO stands for the International Labor Organization LABORSTA database.

6.2 Constructing Data Series

6.2.1 Labor and Demographic Data

Employment E is computed from the PWT data of GDP per capita ($rgdpl2$) and GDP per person counted in total employment ($rgdpl2te$) and population (POP):

$$E = \frac{rgdpl2}{rgdpl2te} \times POP.$$

Labor L, which is defined as total hours worked, is the product of hours worked per worker h and employment.

The adult population N is computed using the data from ILO of the adult share in total population and the population data from PWT:

$$N = adult\ share \times POP.$$

6.2.2 Consumption and Investment Data

Consumption expenditure C_x is defined as

$$C_x = C_{nd} + C_s + X_d,$$

[8] Therefore, G includes government purchases of goods and services as well as net exports. The inclusion of net exports in government consumption follows the tradition of a closed economy BCA model (Chari, Kehoe and McGrattan (2007)).

[9] We use total population for China due to data availability.

[10] Therefore, the output series will start at the trend level in 1990 and end at the trend level in 2009.

[11] Source: https://sites.google.com/a/newschool.edu/duncan-foley-homepage/home/EPWT

where C_{nd}, C_s and X_d stand for the household expenditures on non-durables, services and durables. However, total consumption in the model C is defined as

$$C = C_{nd} + C_s + C_d,$$

where C_d stands for the services flow generated from durable stocks. Therefore, there is a need to disentangle X_d from C_x and replace it with C_d.

The service flow from consumer durables C_d is imputed as

$$C_d = K_d(R_k + \delta_d).$$

where K_d is the stock of consumer durables, R_k is the net return on capital stock and δ_d is the depreciation rate of consumer durables assumed to be equal to 0.2.

The stock of consumer durables follows a law of motion:

$$K_{d,t+1} = (1 - \delta_d)K_{d,t} + X_{d,t},$$

where the stock of consumer durables in 1990 is set equal to

$$K_{d,1990} = \frac{X_{d,1990}}{\delta_d}.$$

In order to compute the household expenditure on durables X_d, we use the consumer expenditure data of EM and the data of PWT for consumption share of GDP (kc), GDP per capita ($rgdpch$) and population (POP):

$$X_d = \frac{\text{consumer expenditure on durables}}{\text{consumer expenditure}} \times kc \times rgdpl2 \times POP.$$

The net return on capital is defined as

$$R_k = \theta_f \frac{GDP}{K_f} - \delta_f,$$

where K_f is net fixed capital stock while θ_f and δ_f are the income share and depreciation rate of K_f respectively. The income share θ_f is computed following Gollin (2002). The depreciation rate δ_f is computed as

$$\delta_f = \frac{\Delta}{K_f},$$

where Δ is the consumption of net fixed capital stock.

Total investment X is defined as

$$X = X_f + X_d$$

where X_f is gross domestic capital formation. Therefore, total output Y is defined as

$$\begin{aligned} Y &= C + X + G \\ &= (C_x - X_d + C_d) + (X_f + X_d) + G \\ &= GDP + C_d. \end{aligned}$$

Finally, total capital stock K is defined as

$$K = K_d + K_f.$$

and the income share of total capital stock θ can be computed as

$$\theta = \frac{rK}{Y} = \frac{Y_f + C_d}{Y},$$

where Y_f is the income from net fixed capital income

$$Y_f = \theta_f \times GDP,$$

and C_d is considered as the flow income from consumer durables.

6.3 Institutional and Governance Indicators of World Bank-Definitions and measurement details

World Bank collects data on a set of institutional and governance indicators from 212 nations and we have the time series since 1996. In each instance, measures range from -2.5 to $+2.5$ with standard errors reflecting variability around the point estimate. The indicators are based on 30 aggregate data sources, survey and expert assessments. The details can be found in:

Daniel Kaufmann, Aart Kraay and Massimo Mastruzzi (2010). "The Worldwide Governance Indicators : A Summary of Methodology, Data and Analytical Issues", World Bank Policy Research Working Paper No. 5430:

http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1682130

(1) Voice and Accountability - reflects perceptions of the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media

(2) Political Stability and Absence of Violence/Terrorism - reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism

(3) Government Effectiveness - reflects perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political

pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies

(4) Regulatory Quality - reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development

(5) Rule of Law - reflects perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence

(6) Control of Corruption - reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests.

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Table A1(a). The Bayesian Estimation Priors and Posteriors for Brazil

Name	Prior				Posterior				
	Dist.	Mean	S.E.	Support	Mode	S.E.	Mean	Conf. Interval	
P_{ee}	norm	0.8	0.2	$\boldsymbol{R}$	0.7613	0.1059	0.7302	[0.5403,	0.9081]
P_{gg}	norm	0.8	0.2	$\boldsymbol{R}$	0.7836	0.0958	0.7470	[0.5905,	0.8907]
P_{kk}	norm	0.8	0.2	$\boldsymbol{R}$	0.6724	0.1445	0.6766	[0.4673,	0.8560]
P_{ll}	norm	0.8	0.2	$\boldsymbol{R}$	0.8148	0.0960	0.7794	[0.6201,	0.9304]
P_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.1864	0.0761	0.1765	[0.0310,	0.3193]
P_{ek}	norm	0	0.3	$\boldsymbol{R}$	-0.2272	0.1583	-0.2156	[-0.4690,	0.0646]
P_{el}	norm	0	0.3	$\boldsymbol{R}$	-0.1784	0.1065	-0.1586	[-0.3386,	0.0247]
P_{ge}	norm	0	0.3	$\boldsymbol{R}$	-0.2360	0.1522	-0.2082	[-0.4941,	0.0923]
P_{gk}	norm	0	0.3	$\boldsymbol{R}$	0.1632	0.2041	0.1707	[-0.1405,	0.5264]
P_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.1580	0.1433	-0.1448	[-0.3948,	0.1568]
P_{ke}	norm	0	0.3	$\boldsymbol{R}$	-0.0860	0.0693	-0.1071	[-0.2820,	0.0188]
P_{kg}	norm	0	0.3	$\boldsymbol{R}$	0.0511	0.0511	0.0495	[-0.0783,	0.1796]
P_{kl}	norm	0	0.3	$\boldsymbol{R}$	0.0741	0.0741	-0.0216	[-0.1568,	0.1178]
P_{le}	norm	0	0.3	$\boldsymbol{R}$	0.1033	0.1033	0.0047	[-0.2086,	0.1781]
P_{lg}	norm	0	0.3	$\boldsymbol{R}$	0.0734	0.0734	0.0115	[-0.1457,	0.1734]
P_{lk}	norm	0	0.3	$\boldsymbol{R}$	0.1489	0.1489	0.5064	[0.2718,	0.7255]
σ_e	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0269	0.0039	0.0325	[0.0235,	0.0416]
σ_g	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0425	0.0061	0.0483	[0.0346,	0.0613]
σ_k	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0282	0.0095	0.0384	[0.0219,	0.0587]
σ_l	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0131	0.0019	0.0152	[0.0119,	0.0181]
ρ_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.0322	0.1622	-0.0142	[-0.2732,	0.2896]
ρ_{ek}	norm	0	0.3	$\boldsymbol{R}$	0.2104	0.1978	0.1580	[-0.1732,	0.4430]
ρ_{el}	norm	0	0.3	$\boldsymbol{R}$	-0.1852	0.1614	-0.1623	[-0.4778,	0.0902]
ρ_{gk}	norm	0	0.3	$\boldsymbol{R}$	-0.0033	0.2124	-0.0074	[-0.3147,	0.2969]
ρ_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.3713	0.1645	-0.3216	[-0.5615,	-0.0793]
ρ_{kl}	norm	0	0.3	$\boldsymbol{R}$	0.0912	0.1904	0.1090	[-0.2131,	0.4503]
$\widehat{\beta}$	beta	0.9	0.05	[0,1]	0.9227	0.0465	0.9015	[0.8090,	0.9731]
ω_k	beta	0.9	0.05	[0,1]	0.9227	0.0465	0.8915	[0.8161,	0.9742]

Table A1(b). The Bayesian Estimation Priors and Posteriors for Russia

Name	Prior				Posterior				
	Dist.	Mean	S.E.	Support	Mode	S.E.	Mean	Conf. Interval	
P_{ee}	norm	0.8	0.2	$\boldsymbol{R}$	0.8867	0.0481	0.8628	[0.7809,	0.9417]
P_{gg}	norm	0.8	0.2	$\boldsymbol{R}$	0.6816	0.1169	0.6777	[0.5151,	0.8821]
P_{kk}	norm	0.8	0.2	$\boldsymbol{R}$	1.0756	0.0337	1.0509	[0.9796,	1.1125]
P_{ll}	norm	0.8	0.2	$\boldsymbol{R}$	0.8943	0.0798	0.8093	[0.6979,	0.9316]
P_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.4713	0.1381	0.4821	[0.2421,	0.6794]
P_{ek}	norm	0	0.3	$\boldsymbol{R}$	-0.4172	0.1918	-0.4119	[-0.6786,	-0.1288]
P_{el}	norm	0	0.3	$\boldsymbol{R}$	0.3160	0.1680	0.3267	[0.0387,	0.6241]
P_{ge}	norm	0	0.3	$\boldsymbol{R}$	-0.0613	0.0448	-0.0696	[-0.1761,	0.0257]
P_{gk}	norm	0	0.3	$\boldsymbol{R}$	-0.0722	0.1114	-0.1128	[-0.4180,	0.1441]
P_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.0872	0.1364	-0.0659	[-0.3882,	0.2461]
P_{ke}	norm	0	0.3	$\boldsymbol{R}$	0.0477	0.0097	0.0565	[0.0324,	0.0797]
P_{kg}	norm	0	0.3	$\boldsymbol{R}$	-0.0133	0.0222	-0.0196	[-0.0617,	0.0299]
P_{kl}	norm	0	0.3	$\boldsymbol{R}$	-0.0479	0.0375	-0.0945	[-0.1996,	0.0017]
P_{le}	norm	0	0.3	$\boldsymbol{R}$	0.0506	0.0168	0.0528	[0.0256,	0.0829]
P_{lg}	norm	0	0.3	$\boldsymbol{R}$	-0.0869	0.0490	-0.1316	[-0.2062,	-0.0398]
P_{lk}	norm	0	0.3	$\boldsymbol{R}$	-0.0429	0.0735	-0.0456	[-0.1711,	0.0770]
σ_e	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0747	0.0144	0.0813	[0.0546,	0.1053]
σ_g	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0921	0.0131	0.1077	[0.0748,	0.1389]
σ_k	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0048	0.0013	0.0100	[0.0058,	0.0157]
σ_l	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0344	0.0057	0.0411	[0.0263,	0.0529]
ρ_{eg}	norm	0	0.3	$\boldsymbol{R}$	-0.0440	0.1691	-0.0643	[-0.3869,	0.1803]
ρ_{ek}	norm	0	0.3	$\boldsymbol{R}$	-0.1020	0.3074	-0.0669	[-0.4770,	0.3248]
ρ_{el}	norm	0	0.3	$\boldsymbol{R}$	-0.2907	0.1696	-0.2657	[-0.5497,	0.0173]
ρ_{gk}	norm	0	0.3	$\boldsymbol{R}$	-0.0971	0.3177	-0.0653	[-0.5025,	0.3819]
ρ_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.5086	0.1557	-0.4689	[-0.7077,	-0.2076]
ρ_{kl}	norm	0	0.3	$\boldsymbol{R}$	-0.1913	0.3146	-0.1562	[-0.4988,	0.2204]
$\widehat{\beta}$	beta	0.9	0.05	[0,1]	0.9247	0.0452	0.8973	[0.8290,	0.9734]
ω_k	beta	0.9	0.05	[0,1]	0.9247	0.0452	0.8952	[0.8236,	0.9801]

Table A1(c). The Bayesian Estimation Priors and Posteriors for India

Name	Prior				Posterior				
	Dist.	Mean	S.E.	Support	Mode	S.E.	Mean	Conf. Interval	
P_{ee}	norm	0.8	0.2	$\boldsymbol{R}$	0.8347	0.1087	0.7496	[0.5541,	0.9354]
P_{gg}	norm	0.8	0.2	$\boldsymbol{R}$	0.7579	0.0926	0.7150	[0.5335,	0.8752]
P_{kk}	norm	0.8	0.2	$\boldsymbol{R}$	0.9449	0.0374	0.8893	[0.8096,	0.9870]
P_{ll}	norm	0.8	0.2	$\boldsymbol{R}$	0.7862	0.0914	0.7334	[0.5576,	0.9225]
P_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.0153	0.0404	0.0255	[-0.0360,	0.0894]
P_{ek}	norm	0	0.3	$\boldsymbol{R}$	-0.0055	0.0950	0.1106	[-0.0527,	0.2957]
P_{el}	norm	0	0.3	$\boldsymbol{R}$	0.1187	0.1394	0.2384	[-0.0422,	0.4973]
P_{ge}	norm	0	0.3	$\boldsymbol{R}$	0.4071	0.2453	0.3089	[-0.1405,	0.8007]
P_{gk}	norm	0	0.3	$\boldsymbol{R}$	0.0139	0.2309	-0.0105	[-0.4658,	0.3294]
P_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.0659	0.2675	-0.1229	[-0.6010,	0.3341]
P_{ke}	norm	0	0.3	$\boldsymbol{R}$	-0.0600	0.0432	-0.1103	[-0.2029,	-0.0263]
P_{kg}	norm	0	0.3	$\boldsymbol{R}$	0.0234	0.0185	0.0484	[0.0008,	0.1052]
P_{kl}	norm	0	0.3	$\boldsymbol{R}$	-0.3375	0.0976	-0.4529	[-0.7232,	-0.2152]
P_{le}	norm	0	0.3	$\boldsymbol{R}$	0.0483	0.0705	0.1076	[-0.0133,	0.2309]
P_{lg}	norm	0	0.3	$\boldsymbol{R}$	0.0356	0.0260	0.0279	[-0.0145,	0.0632]
P_{lk}	norm	0	0.3	$\boldsymbol{R}$	0.0055	0.0620	-0.0383	[-0.1593,	0.0673]
σ_e	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0444	0.0061	0.0485	[0.0360,	0.0612]
σ_g	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.1470	0.0222	0.1706	[0.1264,	0.2207]
σ_k	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0116	0.0033	0.0294	[0.0146,	0.0504]
σ_l	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0264	0.0036	0.0274	[0.0216,	0.0327]
ρ_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.0812	0.1537	0.0704	[-0.1952,	0.3467]
ρ_{ek}	norm	0	0.3	$\boldsymbol{R}$	-0.1652	0.2205	-0.1809	[-0.5866,	0.2201]
ρ_{el}	norm	0	0.3	$\boldsymbol{R}$	-0.7917	0.0802	-0.6383	[-0.8328,	-0.4260]
ρ_{gk}	norm	0	0.3	$\boldsymbol{R}$	-0.0589	0.2775	-0.0716	[-0.5309,	0.3676]
ρ_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.1203	0.1537	-0.1522	[-0.3960,	0.1027]
ρ_{kl}	norm	0	0.3	$\boldsymbol{R}$	-0.2428	0.2188	-0.1002	[-0.4810,	0.3016]
$\widehat{\beta}$	beta	0.9	0.05	[0,1]	0.9268	0.0443	0.9003	[0.8166,	0.9740]
ω_k	beta	0.9	0.05	[0,1]	0.9268	0.0443	0.8933	[0.8007,	0.9763]

Table A1(d). The Bayesian Estimation Priors and Posteriors for China

Name	Prior				Posterior				
	Dist.	Mean	S.E.	Support	Mode	S.E.	Mean	Conf.	Interval
P_{ee}	norm	0.8	0.2	$\boldsymbol{R}$	0.8115	0.0739	0.7837	[0.6789,	0.8716]
P_{gg}	norm	0.8	0.2	$\boldsymbol{R}$	0.8771	0.0785	0.8345	[0.6757,	0.9714]
P_{kk}	norm	0.8	0.2	$\boldsymbol{R}$	0.7572	0.1428	0.6638	[0.4699,	0.8355]
P_{ll}	norm	0.8	0.2	$\boldsymbol{R}$	0.8068	0.0961	0.8267	[0.6881,	0.9619]
P_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.0573	0.0404	0.0490	[-0.0083,	0.1041]
P_{ek}	norm	0	0.3	$\boldsymbol{R}$	0.0111	0.2527	0.1315	[-0.1517,	0.4077]
P_{el}	norm	0	0.3	$\boldsymbol{R}$	0.0802	0.1328	0.1743	[0.0147,	0.3611]
P_{ge}	norm	0	0.3	$\boldsymbol{R}$	0.0018	0.1712	-0.0203	[-0.2795,	0.2926]
P_{gk}	norm	0	0.3	$\boldsymbol{R}$	0.2073	0.2631	0.2196	[-0.2108,	0.5496]
P_{gl}	norm	0	0.3	$\boldsymbol{R}$	-0.1053	0.1766	-0.1348	[-0.3848,	0.1271]
P_{ke}	norm	0	0.3	$\boldsymbol{R}$	-0.0163	0.0271	-0.0024	[-0.0684,	0.0657]
P_{kg}	norm	0	0.3	$\boldsymbol{R}$	0.0087	0.0176	0.0383	[0.0042,	0.0719]
P_{kl}	norm	0	0.3	$\boldsymbol{R}$	-0.1521	0.0838	-0.2014	[-0.3386,	-0.1089]
P_{le}	norm	0	0.3	$\boldsymbol{R}$	0.0837	0.0559	0.1181	[0.0094,	0.2132]
P_{lg}	norm	0	0.3	$\boldsymbol{R}$	0.0328	0.0281	0.0478	[-0.0016,	0.0904]
P_{lk}	norm	0	0.3	$\boldsymbol{R}$	-0.3694	0.1856	-0.2889	[-0.5038,	-0.0915]
σ_e	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0471	0.0069	0.0500	[0.0371,	0.0631]
σ_g	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0989	0.0143	0.1059	[0.0814,	0.1345]
σ_k	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0112	0.0045	0.0252	[0.0164,	0.0360]
σ_l	inv_g	0.01	0.1	$\boldsymbol{R}^+$	0.0194	0.0031	0.0214	[0.0158,	0.0261]
ρ_{eg}	norm	0	0.3	$\boldsymbol{R}$	0.2054	0.1617	0.1414	[-0.0995,	0.3688]
ρ_{ek}	norm	0	0.3	$\boldsymbol{R}$	-0.0340	0.2610	0.0182	[-0.3032,	0.3386]
ρ_{el}	norm	0	0.3	$\boldsymbol{R}$	-0.1492	0.1674	-0.1569	[-0.4071,	0.0686]
ρ_{gk}	norm	0	0.3	$\boldsymbol{R}$	0.0524	0.2615	0.09223	[-0.2580,	0.3771]
ρ_{gl}	norm	0	0.3	$\boldsymbol{R}$	0.1527	0.1668	0.1607	[-0.0884,	0.4082]
ρ_{kl}	norm	0	0.3	$\boldsymbol{R}$	-0.0633	0.2401	0.1389	[-0.1875,	0.4155]
$\widehat{\beta}$	beta	0.9	0.05	[0,1]	0.9241	0.0459	0.8980	[0.8215,	0.9732]
ω_k	beta	0.9	0.05	[0,1]	0.9241	0.0459	0.8979	[0.8340,	0.9762]

Table A2. Decomposition of Output

Benchmark model with alternative calibration

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2009				
Efficiency Wedges	0.269	1.698	0.466	0.839
Government Consumption Wedges	−0.258	0.035	0.013	−0.025
Investment Wedges	0.539	−0.281	0.575	0.185
Labor Wedges	0.451	−0.452	−0.054	0.002
1990:1999				
Efficiency Wedges	−0.680	−0.072	0.810	1.341
Government Consumption Wedges	−0.128	−0.537	−0.033	−0.081
Investment Wedges	0.851	1.193	0.185	−0.173
Labor Wedges	0.959	0.416	0.039	−0.086
2000:2009				
Efficiency Wedges	1.108	1.646	0.400	0.105
Government Consumption Wedges	−0.236	0.310	−0.003	0.100
Investment Wedges	0.176	−0.239	0.661	0.646
Labor Wedges	−0.049	−0.716	−0.058	0.150

Table A3. Decomposition of Output

Benchmark model with alternative trend

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2009				
Efficiency Wedges	−0.124	0.188	0.684	0.072
Government Consumption Wedges	−0.214	−0.001	0.133	0.222
Investment Wedges	0.532	0.506	0.488	1.013
Labor Wedges	0.806	0.307	−0.304	−0.307
1990:1999				
Efficiency Wedges	−0.687	−0.199	1.364	0.381
Government Consumption Wedges	−0.147	0.267	−0.557	0.051
Investment Wedges	0.735	1.202	0.841	0.905
Labor Wedges	1.099	−0.270	−0.649	−0.336
2000:2009				
Efficiency Wedges	1.351	−0.134	0.533	0.058
Government Consumption Wedges	−0.299	−0.230	0.161	0.273
Investment Wedges	−0.210	0.841	0.520	0.923
Labor Wedges	0.158	0.523	−0.213	−0.253

Table A4. Decomposition of Output

Benchmark model with alternative period

Source: Authors' calculations

	Brazil	**Russia**	**India**	**China**
1990:2007				
Efficiency Wedges	−0.215	1.711	0.487	0.826
Government Consumption Wedges	−0.137	−0.033	0.013	−0.025
Investment Wedges	0.473	−0.711	0.632	0.190
Labor Wedges	0.879	0.033	−0.131	0.009
1990:1999				
Efficiency Wedges	−0.626	−0.086	0.731	1.237
Government Consumption Wedges	−0.029	−0.159	0.039	−0.056
Investment Wedges	0.579	1.243	0.206	−0.313
Labor Wedges	1.076	0.002	0.024	0.132
2000:2007				
Efficiency Wedges	1.221	1.603	0.432	0.303
Government Consumption Wedges	−0.095	0.032	−0.010	0.052
Investment Wedges	−0.043	−0.716	0.712	0.852
Labor Wedges	−0.083	0.081	−0.135	−0.206

Table A5. Original Sources of the Data

GDP	PWT
Consumption share	PWT
Investment share	PWT
Employment	PWT
Hours worked per worker	EM
Population	PWT
Adult Share in Total Population	ILO
Household Expenditure on Durables	EM
Net fixed Capital Stock	PWT[12]
Depreciation	PWT[13]

[12]For Russian capital stock and depreciation we refer to Izyumov and Vahaly (2008) because the Foley database reports capital stock data only for the 2004-2008 period.

[13]Izyumov and Vahaly (2008) assume a constant 5% annual depreciation.