Working paper

International Growth Centre

Accounting for Bihar's Productivity Relative to India's

What can we Learn from Recent Developments in Growth Theory?

Areendam Chanda

August 2011

DIRECTED BY LSE UNIVERSITY OF OXFORD

FUNDED BY UKaid from the British people

Abstract

India's second most populous state, Bihar, also remains one of its poorest. However, over the past decade, Bihar has attracted a lot of attention for experiencing a turnaround, recording one of the fastest growth rates within India. In this paper we conduct a longer-term investigation into Bihar's relatively poor productivity. Drawing upon developments in the field of economic growth, we examine Bihar along the lines of convergence, development accounting, total factor productivity accounting, fertility–education trade-offs, etc. Some of our main findings include the following: Bihar's long-term lack of convergence can be explained by its poor initial human capital stock; in 2005, its total factor productivity remained the lowest among all Indian states, standing at 20% of Delhi's; about 60% of the variations in aggregate total factor productivity can be explained by variations in poor agricultural productivity; and finally, while all states have reduced fertility rates and increased literacy rates during the post-reform era, Bihar has lagged behind relatively in terms of literacy gains.

The paper also aims to serve as a useful reference point for those interested in further research on Bihar. It surveys the important contributions to growth theory as applied to the state and is also a source of relevant information and data on Bihar.

JEL Codes:

O4; O53; R11.

Keywords:

regional convergence; development accounting; structural change; dual economy; human capital and growth.

Acknowledgements

This paper reflects the findings and results from the project titled 'Growth Theoretical Appraisal of Bihar's Economic Performance', funded by the International Growth Center at the London School of Economics. I am grateful for the advice and comments given by Anjan Mukherji, Chirashree Das Gupta, and by the conference participants at Growth Week 2010 and Bihar Day 2010, sponsored by the International Growth Center. All errors are my own. Part of the project was undertaken during my visit to IGC-Bihar and ADRI Patna and I am grateful for their hospitality, particularly that of Dr Saibal Gupta.

Author contact: Department of Economics, 2107 Taylor Hall, Louisiana State University, Baton Rouge, LA 70803, USA. Email: achanda@lsu.edu.

1. Introduction

The state of Bihar is the second most populous in India. It is located on the fertile Gangetic plain and was initially endowed with vast natural resources. It has therefore occupied a central role in India's history going back to the period of the Buddha. Sir John Houlton, writing about Bihar in 1949, called his book *The Heart of India*. In the period immediately following India's independence, per capita output in Bihar stood at 80% of the country's mean. Since then, however, the state has had a chequered history. By the early 2000s, the state's per capita GDP had fallen to about a third of India's. The state was a prime example of all the things that had gone wrong: law and order problems, low human capital investments, agricultural and industrial stagnation—the list is endless. However, since then Bihar has, by all accounts, experienced a minor miracle: it has recorded some of the fastest growth rates in the country and law and order has drastically improved. While it is too early to officially call it a growth miracle, there is no doubt that things have begun to improve. Indeed, in a recent business climate survey, Patna was ranked above the neighbouring city of Kolkata in terms of providing a business-friendly environment.

While much has been written regarding Bihar's recent turnaround, this paper paints a more long-term picture of the landscape. In particular, it brings to bear recent contributions in the field of macroeconomics of growth and development. Over the past quarter of a century, research on long-run growth has experienced a renaissance, beginning with endogenous growth models from the mid-to-late 1980s. In this paper we examine Bihar based on some of the more influential developments in this field. In particular, we first revisit the issue of convergence (absolute versus divergence) relative to the rest of the country. We then move on to what has currently become the dominant framework of analysis: development accounting. The development accounting framework seeks to explain differences in levels of output per worker rather than growth rates (for a recent survey of development accounting and the major research questions, see Hsieh and Klenow (2010)). We look at the relative importance of efficiency (or total factor productivity (TFP), as it is popularly known) versus the role of factor accumulation. The development accounting literature at the cross-country level has come to the consensus view that it is the former which matters more in explaining country differences. We try to get a sense of whether this is also important at the state level in India and, if so, how Bihar fares relative to other states. Moving on, we look at the various sources of productivity differences that might be relevant for Bihar: intersectoral imbalances in productivity (i.e. dualism) and its causes, institutional problems (financial market development or the lack thereof, land reforms, labour market regulations, etc.). Finally, we briefly look at the linkages between economic growth, population growth and fertility rates based on the recent contributions of dynamic growth models that seek to explain all of these in a unifying framework. We conclude with some pointers for future research.

Before proceeding further, it is important to acknowledge the existing body of research on Bihar's economic performance. From a macroeconomic perspective, the literature on economic growth in Bihar is fairly limited. Nevertheless, Prasad

(1997), Prasad (2007) and World Bank (2005) exhaustively review the various socioeconomic indicators, growth trends, policies and failures of the past sixty years. At the microeconomic level, several studies have focused on issues of poverty and income distribution, lack of land reforms, industrial and agricultural stagnation, natural disasters (flooding), the failure of the state, public finances, etc. Instead of overloading the reader with a list of references at this juncture, we will refer to many of these contributions as the paper progresses.

2. Convergence versus Divergence

The fact that Bihar lagged behind most of the rest of India during the pre- and post-liberalization era is well accepted. In this section we revisit the well-developed literature on convergence to examine the specific extent to which this is true. Over the past quarter-century since the beginning of the resurgence of growth theory, the literature has oscillated from convergence scepticism to strong evidence of conditional convergence and back to convergence scepticism. The scepticism regarding convergence across countries was documented by Romer (1986), who showed that there was no evidence to suggest that initially poor countries had grown faster than initially richer countries during the post-Second World War period. Mankiw *et al*. (1992) argued that the Solow model on which the notion of convergence is based actually implies conditional convergence, i.e. among countries with similar investment and population growth rates, poorer countries should grow faster than rich ones. They went on to show that the results of the Solow model became stronger when further augmented with human capital. The ensuing proliferation of research at the cross-country level finally settled on a consensus that suggested that the results of Mankiw *et al*. were very specific to their human capital measure, and that convergence across the world was actually rather slow. This led the debate away from explaining growth rates to differences in levels of labour productivity (output per worker). Since the influential papers of Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999), research efforts have been focused on explaining productivity level differences rather than growth differences. Nevertheless, in the case of states within a country, one can make the case that convergence should exhibit stronger effects, especially given the free movement of goods and factors. Earlier studies such as those on US states (Barro and Sala-i-Martin 1991) indicate that there was indeed convergence, but it was not rapid. They also find similar results for seventy-three regions in Western Europe. Not surprisingly, a reasonably active literature on the issue of convergence across Indian states has also arisen over time. Without going into excessive detail regarding the body of literature on Indian states, we refer the reader to Purfield (2006) and Kochar *et al*. (2006).

Before running regressions testing convergence, one can get a direct sense of Bihar's performance simply by looking at figure 1, which shows Bihar's real net domestic product per capita relative to India's. The data for Bihar come mainly from the Economic and Political Weekly Research Foundation (EPWRF). Although Bihar and Jharkhand bifurcated in 1999, the EPWRF database has data for 'divided'

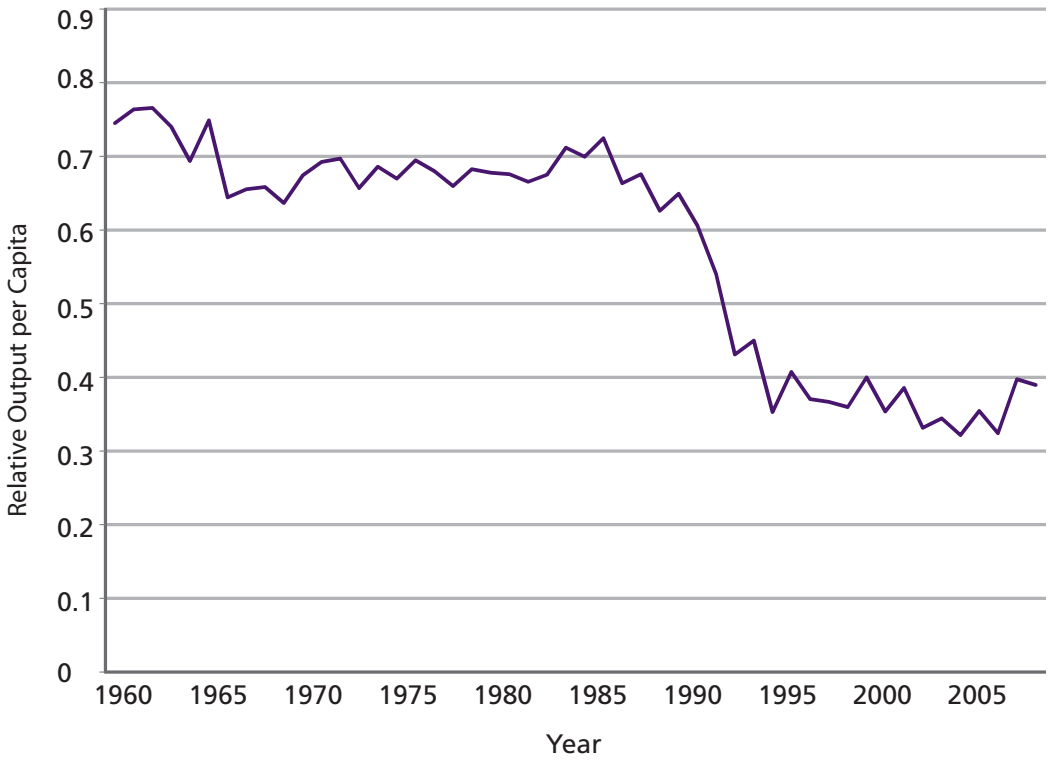


Figure 1. Bihar's NDP per capita relative to India's.

Bihar going back to 1993. The chart thus tracks divided Bihar from 1993. As stated in the introduction, Bihar's per capita GDP was quite high relative to India's in the early 1960s and, in fact, remained so well into the 1970s. It was during the 1980s that Bihar failed to grow fast enough to keep up with the rest of the country. During that decade, Bihar's rate of growth was 2.3%, while India's averaged 3.2%. In fact, it was actually during the second half of the decade, when the pre-liberalization era had begun in India, that Bihar fell dramatically behind. Its relative output per capita fell from 70% in 1985 to 54% by 1992. Once one takes into account the bifurcation and the subsequent decline in per capita output, the share falls further to 43%. Moreover, since 1993, which roughly coincides with the onset of the liberalized regime, Bihar continued to decline, bottoming out at 32% in 2005. Since then, there has been a recovery and in 2008 its share had risen to almost 40%. Thus, at least for Bihar, the story is mostly one of divergence. However, the bulk of the divergence happened in the 1980s with a continuing but less dramatic divergence in the past two decades.

Clearly, the Bihar case, although anecdotal, seems to challenge the belief that regions should converge within a country. However, it is important to ask whether Bihar simply reflects an exception or whether it is the norm, i.e. have Indian regions diverged or converged? The evidence from Purfield (2006) and Kochar *et al*. (2006) suggests that there has been divergence. We first revisit these results with updated data. The period is split into two parts, before and after economic liberalization. More precisely, we look at 1961–90 and 1993–2006. The latter period starts at 1993 rather than 1991 for the reason mentioned earlier: we

Table 1. Absolute and conditional convergence (dependent variable: growth rate in real SNDP per capita).

(a) Absolute convergence

	1961–90	1971–90	1993–2006	1971–2006
Log initial SNDP per capita	0.003 (0.004)	0.0008 (0.008)	0.01 (0.005)*	−0.002 (0.005)
R^2	0.03	0.00	0.07	0.00
N	12	23	31	20

(b) Conditional convergence

	1971–1990	1993–2006	1971–2006
Log initial SNDP per capita	−0.003 (−0.34)	0.003 (0.008)	−0.012 (0.008)
Population growth rate	0.281 (0.44)	−0.632 (0.302)**	0.25 (0.28)
Initial literacy rate	0.0001 (0.0002)	0.0004 (0.0002)**	0.0003 (0.0001)**
R^2	0.04	0.33	0.23
N	23	28	20

*Notes. Robust standard errors are in parentheses. *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively.*

have data on bifurcated Bihar from 1993 for output. Nevertheless, for other controls such as initial measures of education, we are forced to use data on the undivided Bihar. Part (a) of table 1 presents the regression results for absolute convergence, i.e. with no controls other than the initial state net domestic product (SNDP) per capita. We examine four phases: 1961–90, 1971–90, 1993–2006 and also a longer phase 1971–2006. The first two are undertaken since the sample increases considerably from 1971 onwards. The longer phase of 1971–2006 is undertaken purely out of curiosity, although, ironically, we have had to drop the three largest states, Uttar Pradesh, Madhya Pradesh and Bihar, due to their respective bifurcations in the late 1990s. Part (b) of table 1 presents the results of conditional convergence. As argued by Mankiw *et al*. (1992), the true test of the Solow model requires us to control for differences in population growth rates and investment rates. Furthermore, their results were stronger at the cross-country level, when human capital investment rates were included as well. Since figures for physical capital investment rates are not available at the state level, we have to make do with population growth rates and an initial measure of human capital attainment—the literacy rate. Ideally, we need to use human capital investment rates (which is not the same as enrolment rates), but they are difficult to come by for countries, let alone for regions within a country.

We can see from part (a) of table 1 that there is no evidence of absolute convergence. While the sample for 1961–90 is much too small, there is nothing to suggest convergence during the 1971–90 period. For 1993–2006, which is admittedly a rather short period, we see evidence of absolute divergence. Thus Bihar's decline in relative terms is not unusual and must be true for some other states

that have fallen behind over time. When we repeat the exercise for the longer time period of 1971–2006, the results are again inconclusive.

Part (b) of table 1 lists the results of conditional convergence exercises. To save space, we drop the 1961–90 period from the analysis since the sample size is too small. The two included variables are population growth rates and literacy rates. For 1971–90, the results are again inconclusive. There is no evidence of conditional convergence, nor is there any evidence that literacy rates or population growth rates matter. However, for 1993–2006, things are more interesting. We now see that initial SNDP per capita is no longer significant. However, literacy rates have a strong significant effect on subsequent growth rates.[1] Clearly, the results seem to indicate that, in the post-reform period, being poor is not in itself what causes states to lag behind: it is low human capital that seems to matter. We also experimented with dropping the literacy rate variable, which leads to the initial GDP per capita having a significant positive effect once again. Although these regressions do not include a whole array of controls and the sample size itself is small, these results are more supportive of the Nelson and Phelps (1966) catch-up concept than of convergence due to differences in marginal product of capital (which is what the Solow model relies on to generate convergence). Nelson and Phelps argued that it is not sufficient to view human capital simply as a factor of production. Human capital also plays a role in facilitating technology adoption and, thus, TFP growth. In other words, there is a human capital externality that a standard production function-based estimation would overlook. We discuss this more in the section on factor accumulation.

3. Development Accounting

Over the past decade, development accounting exercises have increasingly provided evidence that differences in living standards can be overwhelmingly accounted for by differences in TFP, and not differences in the stocks of raw labour, human capital and physical capital. Klenow and Rodriguez-Clare (1997) and Hall and Jones (1999) were the initial studies suggesting that differences in TFP might account for more than 60% of the differences in output per worker. Not surprisingly, this has led to an increasing focus on explaining differences in TFP, which is often taken to mean technology or efficiency rather than factor accumulation.

Development accounting usually starts from a production function specification, where output can be decomposed into two parts: TFP and factors of production. The main question that this line of research asks is to what extent the variation in output is due to TFP and to what extent it is due to factors of production. One of the more popular specifications starts with a Cobb–Douglas production function

$$Y = K^{\alpha}(AhL)^{1-\alpha},$$

1 We have confirmed that this result is not due to the slightly smaller sample size compared with the corresponding absolute convergence regression.

where A can be viewed as a TFP component, K is the physical capital stock, h is the human capital per worker and L is the number of workers. While this is the underlying production function, for a proper development accounting exercise we need to rewrite this in terms of labour productivity (Y/L). Since development accounting exercises need to explain the role of factors versus TFP, there needs to be a way of minimizing the covariance between the two. Of course, how much covariance exists is an empirical question. In practice, it is very likely that human capital influences TFP (Nelson and Phelps 1966) or TFP affects physical capital stock. For example, the latter is a straightforward consequence of growth in a Solow model: increases in efficiency will lead to increases in output, which in turn will lead to more capital accumulation. To get around the latter, the accounting exercise involves a rearrangement of the above production function such that

$$\frac{Y}{L} = A\left(\frac{K}{Y}\right)^{\alpha/(1-\alpha)} h. \tag{1}$$

The rearrangement leads to the traditional capital labour ratio being replaced by the capital output ratio. Thus, any TFP increase that leads to an increase in K via an increase in Y will no longer lead to capital accumulation incorrectly playing a higher role in the accounting analysis. The usual decomposition analysis that follows involves the following identity:

$$\text{var}[\ln(Y/L)] = \text{var}[\ln(A)] + \text{var}([\ln(X)]) + 2\,\text{cov}([\ln(A), \ln(X)]),$$

where $X = (K/Y)^{\alpha/(1-\alpha)} h$. The common practice is to allocate the covariance equally to TFP and factors of accumulation, i.e. in terms of shares, we can rewrite this as

$$1 = \frac{\text{var}[\ln(A)] + \text{cov}([\ln(A), \ln(X)])}{\text{var}[\ln(Y/L)]} + \frac{\text{var}([\ln(X)]) + \text{cov}([\ln(A), \ln(X)])}{\text{var}[\ln(Y/L)]}. \tag{2}$$

It is important to note that if the covariance is too high, then such decompositions might have limited value. One could think of any number of reasons as to why the covariance should not be zero. For example, high levels of human capital may facilitate the adoption of new technologies. In such a scenario the covariance should rightly be attributed to human capital. However, one can think of a relationship in the opposite direction. For example, the presence of skill-biased technologies may encourage investment in human capital, in which case the covariance should be attributed to A and not X. This bidirectionality can also be true for capital and technology. For example, to the extent that technology might be embodied in equipment, such a decomposition becomes less meaningful. In our exercise we will present the covariance results explicitly.

Before conducting the exercise, it is important to understand the role of development accounting exercises. Caselli (2005) rightfully notes that they should be

> understood as a diagnostic tool, just as medical tests can tell one whether or not he [a patient] is suffering from a certain ailment, but cannot reveal the causes of it. This does not make the test any less useful.

Thus, they do not reveal the fundamental sources of differences in labour productivity. We will discuss this issue further later.

A second issue pertains to the relevance of conducting an exercise like this for states within an economy. As argued earlier, if there is a free flow of factors of accumulation, there is little reason to expect capital accumulation or human capital accumulation to be different across states. However, the fact that Bihar's productivity is a third of India's suggests that the forces of convergence are not working as they should. India is not the only developing country that exhibits wide regional differences. Acemoglu and Dell (2010) also note the importance of regional differences in the Americas. In their research among eleven Latin American countries for which they have municipality-level data, the between-municipality differences in individual labour income are about twice the size of between-country differences (when the United States is included, this ratio is reversed). About half of the between-country and between-municipality differences are explained by observed human capital, the remainder being due to 'residual' factors. They propose a framework that emphasizes

> the importance of local differences in the efficiency of production. More specifically, within countries, productive efficiency is determined, among other things, by local institutions. Local institutions influence how local and regional collective decisions are made, how lower levels of government interact with the national government, and how political power is distributed at the local level.

Needless to say, such factors would be germane to the case of Bihar.

A pressing data concern is calculating capital stocks since they are not available at the state level and neither is investment. To get around this problem, we assume that national-level capital stocks for broad sectors of the economy are allocated to each state based on its share of national output in that sector. This is also the strategy used in the literature on US states (Garofalo and Yamarik 2002; Turner *et al*. 2008). Lahiri and Yi (2009) also do the same in their comparison of West Bengal and Maharashtra.[2] However, this construction has its own limitations: it implies equality of marginal product of capital across states within sectors. As mentioned before, this is likely to be the case in the long run but it would certainly have been preferable to have had data to back this up.[3]

Moving on to human capital, the widely adopted practice is now to use micro-economic-based Mincerian returns and to combine them with estimates of schooling years. What this implies is that the average human capital per worker can be calculated using a formula such as

$$h = \exp(\phi_{\mathrm{p}} s_{\mathrm{p}} + \phi_{\mathrm{s}} s_{\mathrm{s}} + \phi_{\tau} s_{\tau}), \tag{3}$$

2 Chatterjee *et al*. (2007) also calculate state-level TFPs but in a calibrated model and only up to 1991.

3 Another data limitation is the number of workers for a given year. This is only available for census years. Therefore, to derive 2005 labour force numbers, we apply the labour force participation rates from the 2001 census to the 2005 populations.

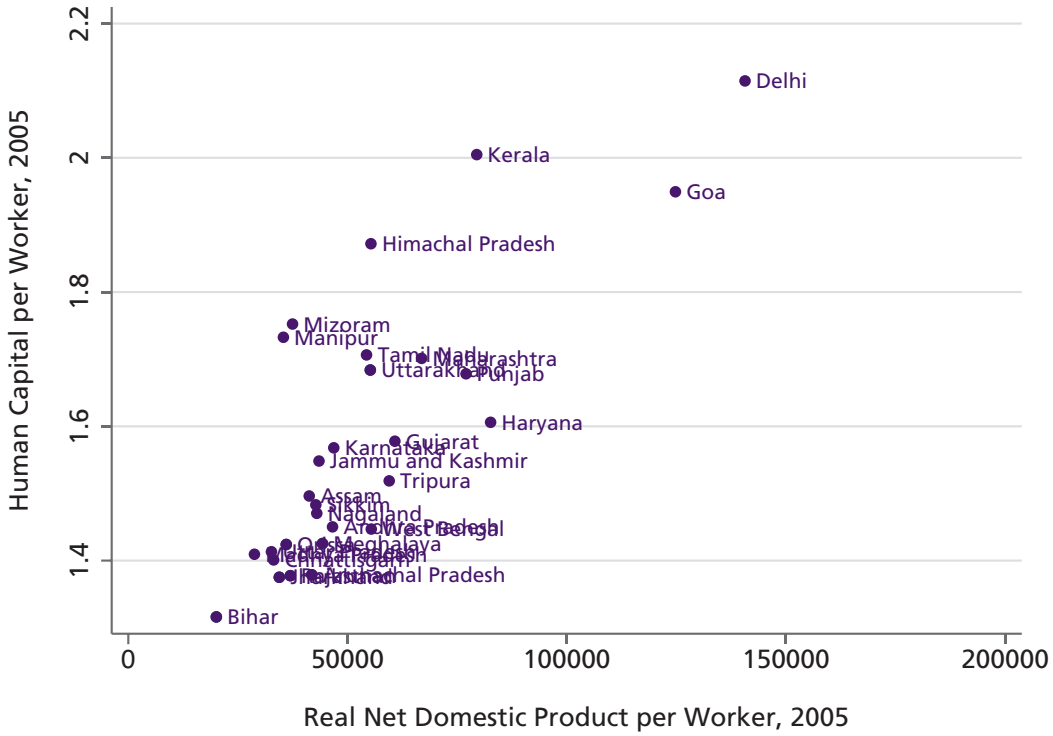


Figure 2. Human capital per worker, 2005.

where ϕ_p, ϕ_s and ϕ_τ are the Mincerian returns to an additional year of schooling at primary, secondary and higher levels, whereas s_p, s_s and s_τ represent the average years of schooling for each sector at each of these levels. To obtain measures of schooling, we follow the methodology of Lahiri and Yi (2008) and rely on Round 3 data from the National Family and Health Survey (2005). The National Family and Health Survey provides data on the share of the adult population for different levels of schooling. This allows us to calculate years of schooling by assigning the population shares of these rates. For the case of Bihar, 48% of the adult population has no education, 18.1% has fewer than five years, 19.5% has between five and nine years, 7.3% has ten or eleven years and 6.2% has twelve or more years. Using these shares and using the midpoint for each level of schooling, we calculate the average years of schooling in Bihar to be 3.5 years. This is the lowest number among the twenty-nine states and union territories for which the National Family and Health Survey provides data. Jharkhand is the second lowest, with 4.1 years of education. Delhi has the highest, with almost eight years. To calculate the Mincer-based measure of human capital per worker (equation (3)), we also need estimates of returns at various levels. We do not have returns to education at the state level. Therefore, we estimate returns at the national level from Duraiswamy (2000). The returns are 7.5% for primary education and 12.5% for secondary education. We define five years or fewer as primary education and six to twelve years as secondary education. Figure 2 plots human capital per worker against real net domestic product per worker. The correlation is clearly not strong and the variation in labour productivity is much larger than the variation in human capital.

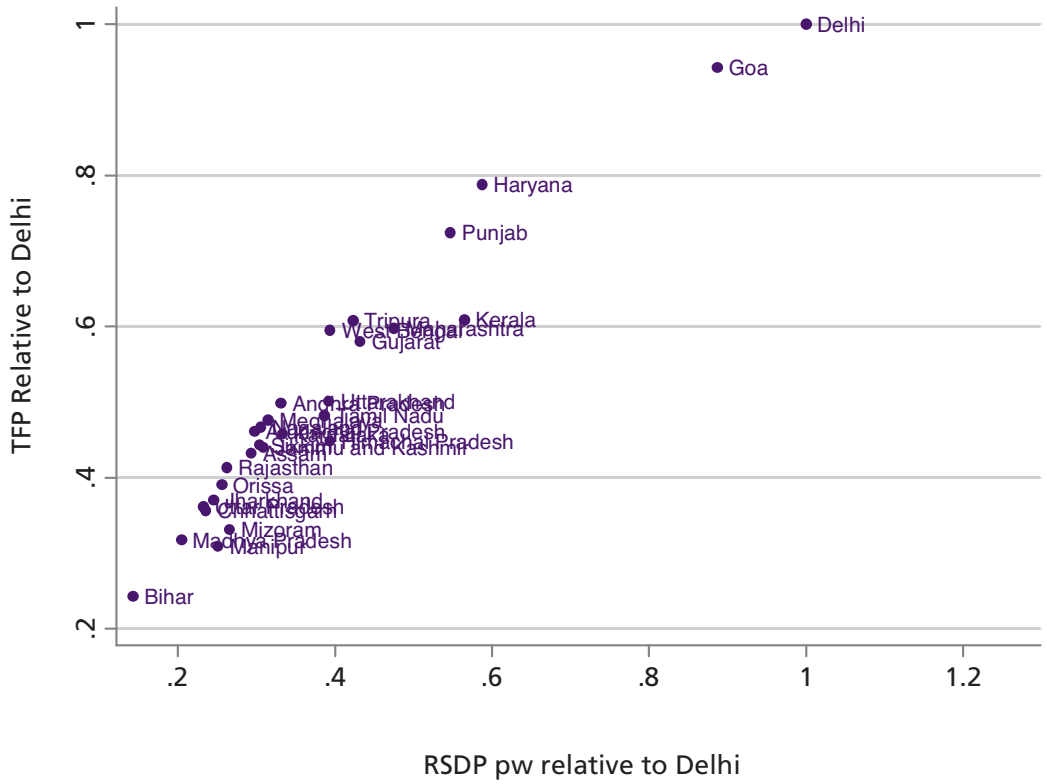


Figure 3. TFP differences across states, 2005.

With human capital numbers and capital output ratios in place, we can now go ahead and use equation (1) to back out TFP (A). The capital share in factor payments (α) is assumed to be $\frac{1}{3}$, which has become more or less the norm since Gollin (2002). Figure 3 plots TFP against labour productivity. Since the actual values of the TFP numbers are difficult to interpret, we have plotted the values relative to Delhi, which has both the highest TFP and the highest labour productivity in India. The strong correlation is abundantly clear. Labour productivity differences more or less reflect TFP differences. In table 2 we present the results of the variance decomposition based on equation (2). TFP differences account for 75% of the variation in labour productivity. The role played by factors is small. However, the covariance is 15%, suggesting that factor accumulation and TFP are not quite independent of each other: an unsurprising result given what we have found so far. Figure 4 plots human capital per worker against TFP. Unfortunately, the news is not good for Bihar. It brings up the rear for both variables. While the overall relationship across states is positive, there are some interesting deviations. For example, Kerala has high human capital but low TFP. This is not unsurprising given the state's excellent record on human capital but middling record on per capita output. Interestingly, West Bengal, which is the only other state that has been administered by the communist party for a long time, shows the same TFP but much lower levels of human capital. In the next few sections we will focus further on TFP and human capital.

Table 2. Development accounting, 2005.

var(A) share	var(X)	cov(A, X) share	Implied share of A	Implied share of X
0.60	0.10	0.15	0.75	0.25

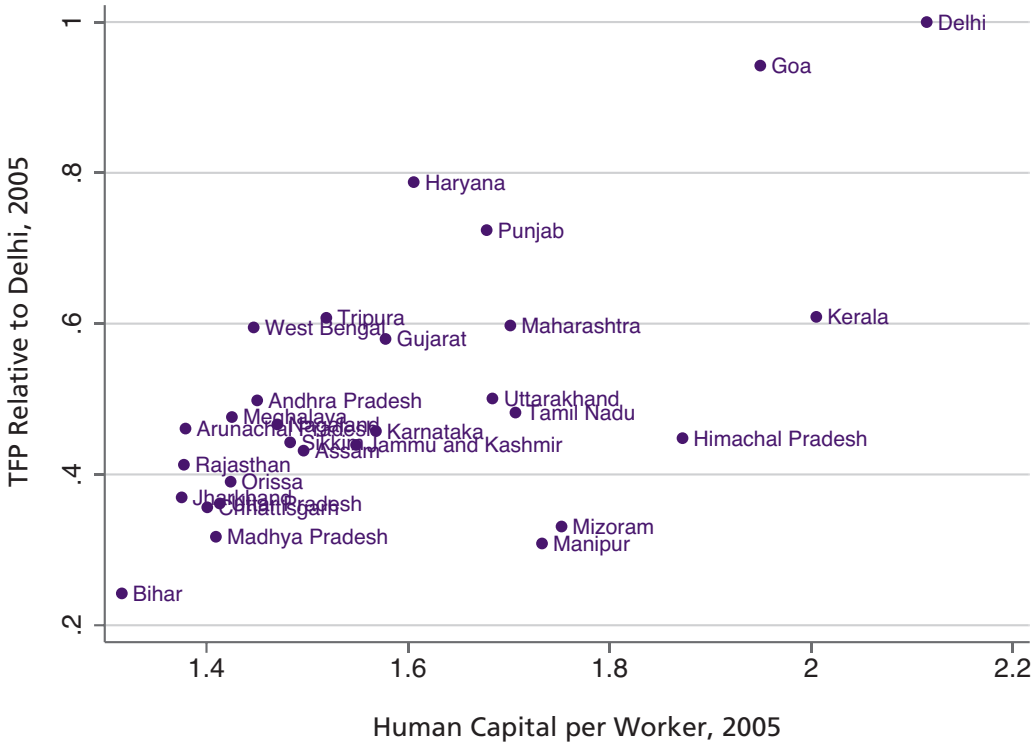


Figure 4. Human capital versus TFP, 2005.

4. Explaining TFP Differences

Within the growth and macro-development literature, the emerging consensus that TFP differences are key has paved the way for a large literature devoted to explaining these TFP differences. The literature focuses on a large number of possible explanations—intersectoral misallocation of resources, misallocation of resources across firms, endogeneity of TFP with respect to human capital, mismeasurement of human or physical capital, the role of various distortions (which in turn can lead to misallocations), credit market frictions, etc. It is impossible to do justice to the entire literature and the interested reader is encouraged to read Hsieh and Klenow (2010) and Caselli (2005) to get a sense of this work. Next, we focus on a few aspects that we feel are especially important for Bihar.

4.1. Sources of TFP Differences

4.1.1. *Dualism and TFP Accounting*

First, it is important to note that any development accounting exercise is obviously only as good as the data and the production function being used. In the

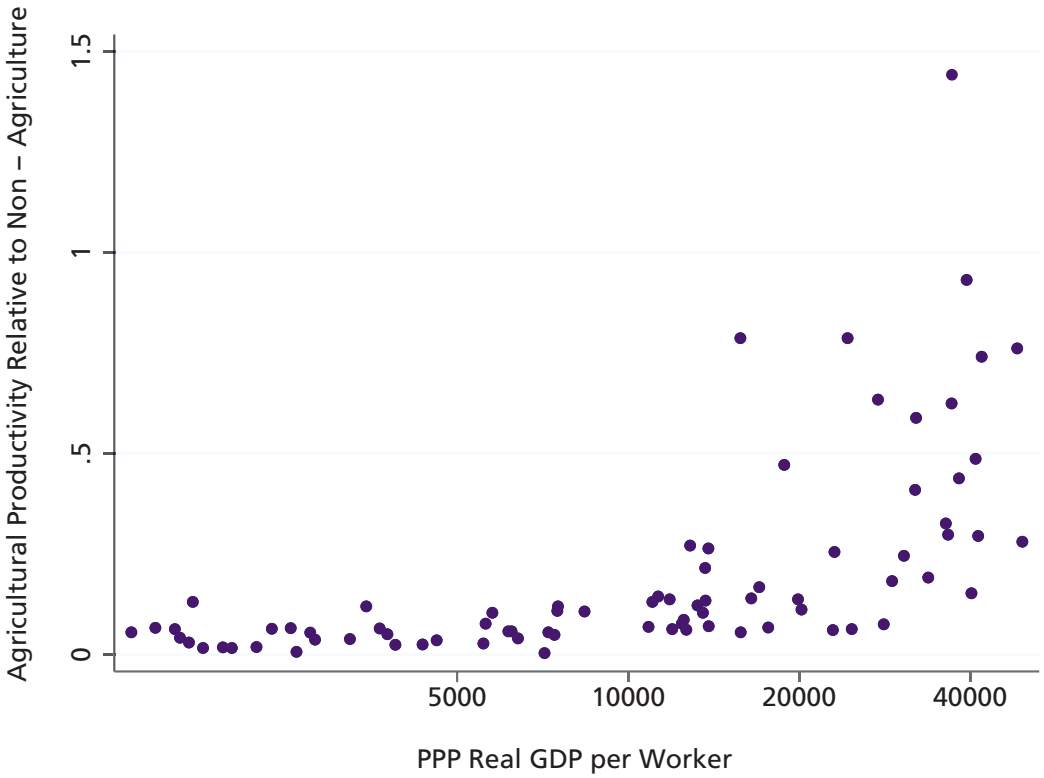


Figure 5. Relative productivity in agriculture and GDP per worker, 1985.

case of Bihar, this immediately raises the concern that an important factor of production, land, was ignored throughout the entire accounting analysis. For an agrarian economy like Bihar, this is presumably an important factor. Furthermore, the accounting analysis is based on a single aggregate production function. Given that Indian states exhibit radically different sectoral compositions of output, a single production function may be inadequate. This is also true for the cross-country literature. It is well known, from both the development accounting literature and the more classical dual economies literature, that there are large variations in productivity, both between sectors within one nation and within sectors across nations. To get a sense of the former, we reproduce a graph (figure 5) based on Chanda and Dalgaard (2008) that examines the relationship between agricultural labour productivity relative to productivity in the rest of the economy and aggregate labour productivity. With the exception of New Zealand, all countries have an agricultural productivity that is lower than the rest of the economy. Moreover, sixty out of these eighty have agricultural productivity that is less than 25% of the rest of the economy. What factors allow such large sectoral differences in labour productivity to persist is a question that is also relevant to the situation in Bihar. With regard to aggregate TFP differences, one might ask how important this is. Chanda and Dalgaard propose a methodology to examine the role of dual economies in aggregate TFP differences.

We begin by observing that GDP per worker, Y/L, can be written

$$\frac{Y}{L} = \left(\frac{Y/L}{Y_{\text{na}}/L_{\text{na}}}\right) \cdot \left(\frac{Y_{\text{na}}}{L_{\text{na}}}\right), \tag{4}$$

where $Y_{\text{na}}/L_{\text{na}}$ is labour productivity in the *non*-agricultural sector. The first term, $(Y/L)/(Y_{\text{na}}/L_{\text{na}})$, conveys information about *relative* efficiency between sectors. Obviously, if the agricultural sector and the non-agricultural sector are equally productive, then this term becomes 1. Now assume that the *non*-agricultural sector is characterized by a Cobb–Douglas constant returns to scale production function with capital-augmented labour and human-capital-augmented labour as inputs and a labour-augmenting TFP parameter,

$$\frac{Y_{\text{na}}}{L_{\text{na}}} = \left(\frac{K_{\text{na}}}{Y_{\text{na}}}\right)^{\alpha/(1-\alpha)} h_{\text{na}} A_{\text{na}}.$$

Upon substitution into equation (4) we can now express real GDP per worker as

$$\frac{Y}{L} = \left\{ \frac{\left[\frac{K_{\text{na}}}{Y_{\text{na}}} \Big/ \frac{K}{Y}\right]^{\alpha/(1-\alpha)} \frac{h_{\text{na}}}{h}}{\frac{Y_{\text{na}}}{L_{\text{na}}} \Big/ \frac{Y}{L}} \right\} A_{\text{na}} \left(\frac{K}{Y}\right)^{\alpha/(1-\alpha)} h. \tag{5}$$

Now recall the aggregate production function in equation (1). The correspondence between equation (5) and the aggregate TFP component is then obvious:

$$\text{TFP} = \left\{ \frac{\left[\frac{K_{\text{na}}}{Y_{\text{na}}} \Big/ \frac{K}{Y}\right]^{\alpha/(1-\alpha)} \frac{h_{\text{na}}}{h}}{\frac{Y_{\text{na}}}{L_{\text{na}}} \Big/ \frac{Y}{L}} \right\} A_{\text{na}}. \tag{6}$$

This suggests that the numbers calculated as A in the earlier section may confound the absolute level of efficiency in the economy, as represented by A_{na}, and relative efficiency across sectors, represented by the term in curly brackets. This allows us to split equation (6) into two parts:

$$\text{TFP} = \text{COMP} \cdot A_{\text{na}}, \tag{7}$$

where COMP, or what Chanda and Dalgaard (2008) refer to as the 'composition term', is given by

$$\text{COMP} = \left\{ \frac{\left[\frac{K_{\text{na}}}{Y_{\text{na}}} \Big/ \frac{K}{Y}\right]^{\alpha/(1-\alpha)} \frac{h_{\text{na}}}{h}}{\frac{Y_{\text{na}}}{L_{\text{na}}} \Big/ \frac{Y}{L}} \right\} \tag{8}$$

$$\iff \quad \text{COMP} = \left\{ \frac{\left[\frac{K_{\text{na}}}{Y_{\text{na}}} \Big/ \frac{K}{Y}\right]^{\alpha/(1-\alpha)} \frac{h_{\text{na}} L_{\text{na}}}{hL}}{\frac{Y_{\text{na}}}{Y}} \right\}. \tag{9}$$

Written this way, the numerator reflects the allocation of all factors, while the denominator reflects the relative output levels. Trivially, both the numerator and the denominator would collapse to 1 in a single-sector economy. Alternatively, it would also collapse to 1 if there are two sectors but the factor allocations and output composition are completely aligned (e.g. 20% of capital and labour is devoted to the sector that is responsible for 20% of the output). That is, if

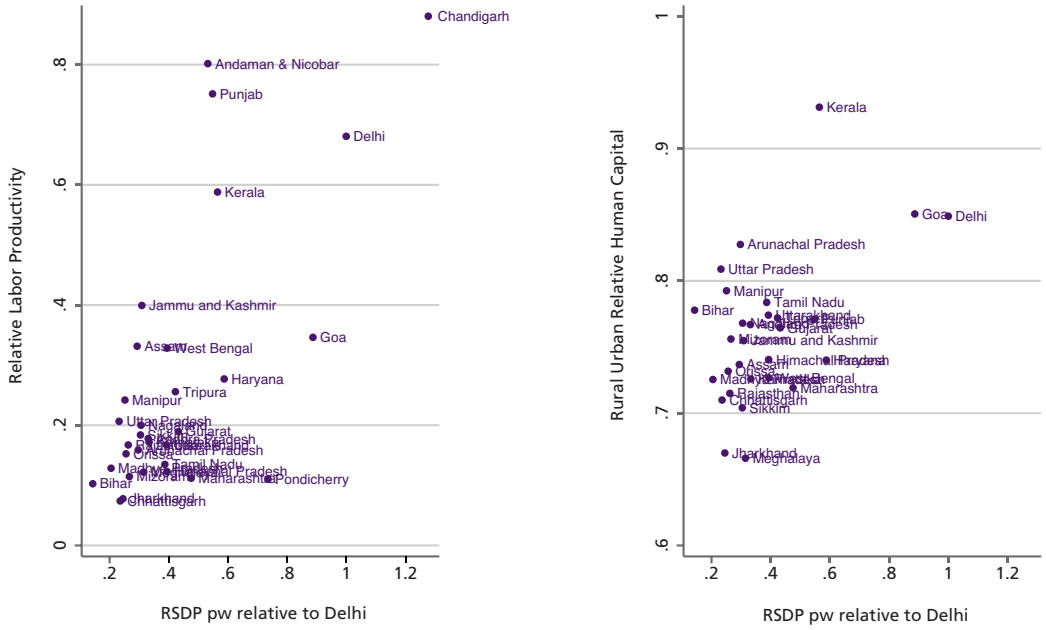


Figure 6. Components of the composition effect, 2005.

both sectors are equally efficient in converting physical inputs into output, COMP becomes 1. Thus, to the extent it deviates way from 1, it reflects the extent of *dualism*. An elegant feature of this exercise is that we do not need to make assumptions about the agricultural production function. This is an advantage since it helps us to avoid making dubious assumptions about the share of land income, etc., which is not available across countries, let alone across states.

To calculate COMP we need to know the relative sectoral labour productivities, relative capital output ratios and relative human capital measures. Relative sectoral labour productivities can be easily had but relative capital output ratios are unavailable. However, in the development accounting exercise we assumed that the capital output ratio of the economy for a sector applies for that sector in every state. Hence, to the extent that we are interested in explaining *variations* across states, the sectoral capital output ratios will not play a role. Finally, for relative human capital we use human capital numbers for rural versus urban sectors across states, which are available from the 2005 National Family and Health Survey. The underlying assumption is that rural human capital reflects agriculture and urban human capital reflects the non-agricultural sectors. While this may seem like a reasonable assumption, there is likely to be some measurement error, since not all rural labour is agricultural.[4]

Figure 6 provides an overview of the two components that make up the composition effect. The first sub-graph depicts relative labour productivity against real GDP per worker (relative to Delhi). Unsurprisingly, Bihar fares quite poorly. Bihar's agricultural labour productivity is only 10% of its non-agricultural sector. If we consider labour shares and GDP shares separately, the asymmetry is

4 According to Lanjouw and Murgai (2009), the rural non-farm sector has grown considerably over the past twenty years and some states like Kerala have 77% of their rural labour employed in the non-farm sector.

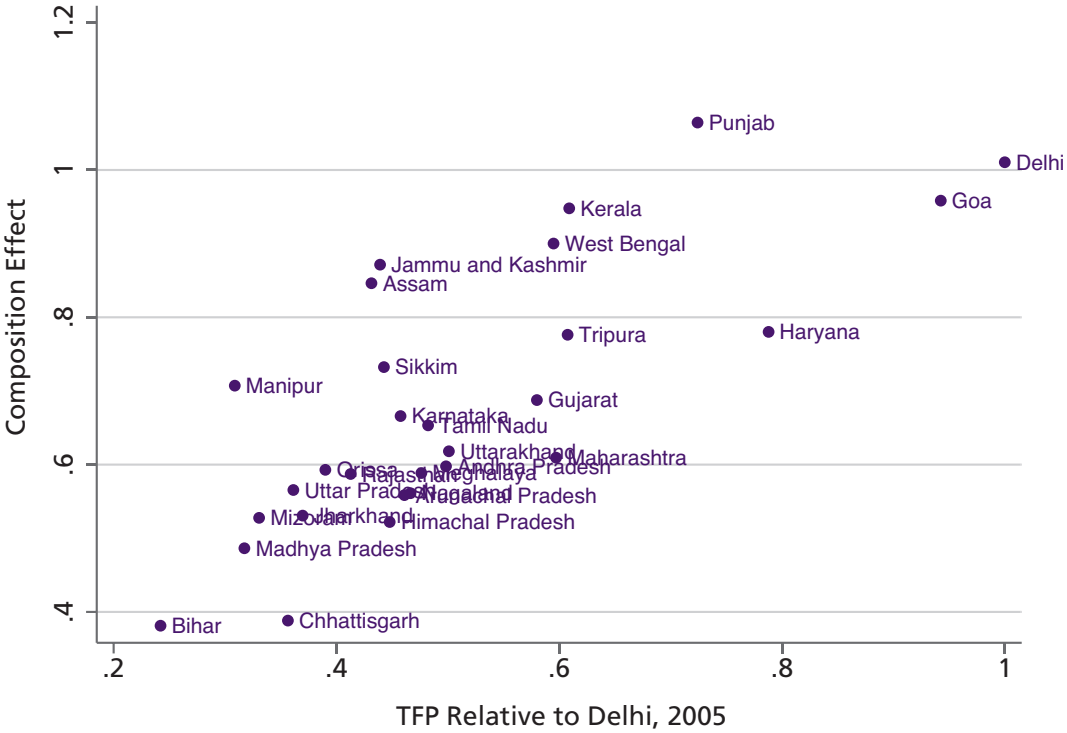


Figure 7. Intersectoral differences and aggregate TFP, 2005.

stark: only 25% of Bihar's output came from agriculture, yet the sector employed 77% of its workers. Unlike the case with many other variables, for urban–rural human capital gaps, Bihar does not perform poorly. At the same time, interpreting this variable is not straightforward. The gap in Bihar is low because we know that both the urban and the rural human capital levels are low. As an aside, an implication of the large intersectoral productivity gaps within states is the large interstate within-sector productivity gaps. This is especially true of agriculture: Punjab's GDP per worker in agriculture is INR64,000 while Bihar's is INR6,700, an almost tenfold difference.[5] However, this is not true of the non-agricultural sector, where Bihar's GDP per worker is INR65,000 while Punjab's is INR85,000. The non-agricultural gaps are nowhere near as high as those within agriculture.

Figure 7 depicts the relationship between COMP and aggregate TFP. As can be seen from the figure, there is a strong positive correlation. Note that equation (7) allows us to do a second round of decomposition: effectively a TFP accounting exercise. We find that the composition effect can explain about 62% of the variation in aggregate TFP differences. Combined with the result that 75% of labour productivity differences can be explained by TFP, this means that relative sectoral efficiencies can explain about 46% of variations in labour productivity. Thus, misallocation across sectors plays a large role in explaining differences in the productivity of states. At the same time, it does not explain everything. Thus, there are possibly sector-neutral factors that also play an important role.

5 In an earlier survey-based exercise, Chadha and Khurana (1989) find a similar asymmetry. Rural workers in Punjab worked 14% more in terms of man-days but produced 122% extra earnings compared with their counterparts in Bihar.

4.1.2. *Explaining Dualism*

Continuing the earlier use of the medical industry metaphor, the TFP accounting exercise carried out above is really a set of more intensive diagnostic tests to pinpoint the malady. However, it still does not tell us the source of these intersectoral differences. In this section we outline some of the possible explanations. At a broader level, it is important to realize that virtually any distortion that can result in low *aggregate* TFP can cause dualism. For example, if there is a distortion in financial markets for loans in industry, this would create a small but productive industrial sector, while forcing a large section of the labour force to remain employed in the unproductive agricultural sector. Similarly, a more aggregate variable like property rights enforcement can allow dualism to persist: the absence of property rights discourages industry and thus forces labourers to stay on in an unproductive agricultural sector. In both these cases, even if there is a small productive industrial sector, there is a large unproductive agricultural sector that results in a low overall TFP in the economy.

Another set of circumstances that might sustain a dual economy is a lack of technological innovation in the agricultural sector. However, a lack of productivity improvements in the agricultural sector cannot by itself explain dualism. The obvious reaction would be for workers to move out of an unproductive sector into a more productive sector. Therefore, it has to be something else that holds back workers from leaving the agricultural sector. This could be due to some sort of a barrier to labour mobility or it could be due to some other problem in the agricultural sector, such as a lack of land reforms or problems related to land ownership rights. We discuss these issues next.

In a well-known paper, Restuccia *et al*. (2008) explain low agricultural productivity in a general equilibrium model by introducing three elements: an economy-wide productivity parameter, a distortion in labour mobility and a distortion in the pricing of agricultural intermediate inputs (that are produced by the non-agricultural sector). In economies where the distortion in intermediate input pricing is high and the barriers to labour mobility are also high, the calibrated model can replicate the Schultzian food problem—an unproductive agricultural sector. The important feature here is that both a restriction on labour movement *and* a variable making agriculture unproductive are important. The existence of these distortions in input markets magnify differences in overall productivity in the economy. Thus, Restuccia *et al*. underscore the importance of a general equilibrium framework. While we do not have measures of how expensive input prices are in Bihar relative to the rest of India, we can discuss some indirect evidence. Consider, for example, the role of short-term credit in agriculture. These loans are usually provided to pay for input costs in the agricultural sector during the two crop seasons. If such loans are very expensive or unavailable, it effectively has the same effect as increasing the price of the intermediate input. For a long time the Indian government's various subsidized agricultural loan schemes were failures, partly due to excessive bureaucracy or ill-thought-out mechanisms of lending. However, in the late 1990s, in an effort to reduce red tape, the government intro-

duced the Kisan credit card (KCC) scheme.[6] The scheme has many advantages: in particular, there is no collateral requirement for credit up to INR100,000 (initially the figure was INR50,000) and the credit line is available for three years. Over the past decade, the scheme has become so popular that almost all short-term agricultural loans now take place exclusively through this scheme. Nevertheless, according to a survey (Sharma 2005), Bihar lagged behind significantly. Despite being the second-largest state, Bihar accounted for only 2% of KCC loans in 2005. Even compared with poor states like Orissa and Uttar Pradesh, Bihar's adoption rates were low. In terms of KCC accounts to landholdings, the ratios in these two states were 54% and 35% respectively, while for Bihar it was only 10% in the mid 2000s. There has not been sufficient research carried out to explain Bihar's lack of adoption. It could possibly be a worsening law and order situation, or it could simply be that it reflects Bihar's lack of financial development. These loans are intermediated through nationalized banks, regional rural banks, etc. If the extent of such banking in Bihar was already poor, the lack of adoption of this scheme would be unsurprising.

An alternative take on explaining intersectoral productivity differences focuses on home production. Gollin *et al*. (2004) construct a model that allows for a distortion that discourages capital accumulation by making investment goods relatively more expensive than consumption goods. By discouraging capital accumulation, this distortion encourages individuals to remain in the rural/agricultural sector. In their model, the rural/agricultural sector allows more home production opportunities. Therefore, workers spend less time working in the agricultural sector and spend more hours engaged in home production to satisfy all their consumption needs (in the Gollin *et al*. model, non-agricultural consumption goods can come either from the manufacturing sector or from home production). One of the advantages of their model is that it allows for free labour mobility between agriculture and manufacturing and yet generates a large unproductive agricultural sector. Clearly, this model is more in line with our earlier observation that distortions in the non-agricultural sector of the economy can generate a large unproductive agricultural sector. However, the model also suggests that we should observe the larger share of time that is devoted to home production in poorer countries. Their own calibrated results replicate this. However, we do not have data on Bihar to see whether this is actually the case.

While home production hours are unavailable, we do have data on rural non-farm activities. In the context of India, this can represent a substantial chunk of the rural sector. Non-farm rural activities are not, however, the same as home production. On the contrary, in India the share of non-farm rural activities is highly correlated with labour productivity across states. Based on National Sample Survey (NSS) data compiled by Lanjow and Shariff (2004), we found the correlation between labour productivity and the share of the non-farm rural sector to be 0.62. Bihar's share is only 25%. According to their findings, non-farm rural activity is tied strongly to education and social status. The exception is casual non-farm

6 Despite its name, there is no actual credit card. However, it conveys the concept of a revolving credit line.

labour. However, in Bihar, this is almost insignificant: about 2.5% of the rural labour force. Thus, the extent to which home production leads to an underestimation of GDP in Bihar (and India generally) is an open research question.

An important factor that we have not discussed so far is the role of land in understanding dualism. In particular, there are two aspects that are likely to be relevant. First, land fragmentation might make agriculture extremely unproductive. Second, in the absence of land reforms, ownership of land may not be well defined. In theory this could make it difficult for workers to migrate from agriculture to more productive sectors and may also allow market failures to persist, thereby reducing productivity in the agricultural sector. The issue of land reforms has been studied extensively in the Indian context and for Bihar as well. One of the most widely cited works on land reforms and poverty in India is Besley and Burgess (2000). They looked at four types of land reforms: tenancy reforms, abolition of intermediaries, ceilings on landholdings and consolidation of landholdings. Based on their coding, by 1992 Bihar ranked fourth in terms of the number of land reforms enacted (Bengal ranked first and Punjab and Rajasthan ranked lowest). The study documents *de jure* land reforms and not *de facto* ones. More recently, Ghatak and Roy (2007) further investigated the efficacy of land reforms using the Besley and Burgess index. They note that, when using alternative dependent variables (and not agricultural output per capita as is used in Besley and Burgess (2000)), the effect of cumulative land reforms on Bihar's yields is actually negative and significant at the 1% level.

Within the context of Bihar, the lack of land reforms has been extensively studied by Rouyer (1994), Bharati (1992) and Prasad (2007), to name just a few. Rouyer undertakes a long-term study of weak state capability in Bihar, attributing it to political fragmentation at the local level. He argues that land reforms, which could potentially have addressed some of these problems, failed to happen. This, he goes on to argue, was because of the emergence of a political leadership, following independence in 1947, that had vested interests in maintaining the zamindari system that was formalized and reinforced by colonial institutions such as the Act of Permanent Settlement in 1793. The case of Bihar highlights the problems with using *de jure* measures of reforms. On paper, Bihar was the first state in India to enact land reforms (1950). The motivation behind enacting land reforms in the post-independence era can be traced back to the exploitative land tenure systems that were established during colonial times. In most cases, land reforms were enacted to abolish landlords and remove other intermediaries, establish tenancy reform, land consolidation and ceilings on landholdings. However, Rouyer observes that Bihar was the least successful state in implementing reforms. Januzzi (1977) notes that nowhere was the gulf between articulation of ideals and accomplishment of results more conspicuous than in Bihar. Banerjee and Iyer (2003, 2009) exploit variations in the rights to land ownership instituted by the British to explain the performance of the agricultural sector and the provision of public goods. Thus, their findings are very much in the spirit of the now formidable literature that documents the long reach of colonial and pre-colonial institutions on current productivity differences. They show that, despite

the enactment of land reforms shortly after independence, states that were subject to the landlord-based land tenure systems continue to perform poorly in several measures. This is particularly germane to Bihar, which, in their sample, is considered to be completely characterized by a landlord-based tenure system.[7]

One of the more traditional measures that is used to explain lack of productivity in the agricultural sector is farm size.[8] Monchuk *et al*. (2010) have constructed measures of land fragmentation across states.[9] Drawing on a 2005 sample of 9,000 households in India, the average number of fragments is 3.17. Bihar has the highest degree of land fragmentation at 4.91. Gujarat has the lowest at 1.26. *Ex ante*, it would seem that such a high degree of land fragmentation would lead to low agricultural productivity. Figure 8 depicts the relationship between land fragmentation and agricultural GDP per worker. While Bihar is at the unenviable top left corner of the graph, surprisingly, there is no strong negative correlation (only −0.12). Therefore, the data on both *de jure* land reforms and land fragmentation seem to provide no direct answers to Bihar's 'agriculture' problem. The more likely channel seems to be the role of long-run institutions.

4.1.3. *Non-Agricultural Sources of TFP Differences*

So far, we have focused exclusively on dualism and agricultural issues as the main sources of TFP differences. We now move on to other factors that might play an important role in understanding TFP differences and, more generally, differences in overall labour productivity. An emerging consensus from the cross-country regression explaining long-term productivity differences is the primacy of 'institutional quality'. Building upon the insights of North (1990) and Engerman and Sokoloff (1997, 2000), the empirical work of Hall and Jones (1999), Acemoglu *et al*. (2001, 2002) and Easterly and Levine (2003) provide evidence supporting the importance of property rights institutions. That is, the underlying structures that form the legal and political rules of the game for activities within society are central to aggregate productivity. Indeed, with better established property rights and a well-functioning state (in short, 'strong institutions'), one would expect to find agents faced with incentives for productive effort rather than socially costly rent-seeking activities or predation. However, property rights institutions are only one of a set of institutions that might matter for differences in economic development. Indeed, the number of variables capturing different aspects of institutional quality has proliferated over the past few years in tandem with the rising interest in explaining development via institutions. In an effort to distinguish the proliferating measures of institutional quality, Acemoglu and Johnson (2005) create

7 It is important to note that their sample does not necessarily include every district in the included states. The other two land tenure systems are the cultivator-owned system and the village-based system (see table 1 in Banerjee and Iyer (2003) and the accompanying discussion).

8 Adamopoulos and Restuccia (2011) emphasized the role of farm size in explaining international productivity differences.

9 Land fragmentation is not necessarily a consequence of land transfers. It is said to exist when a household operates on more than one separate piece of land. Monchuk *et al*. define a land fragment as a contiguous piece of land on which the household engages in production.

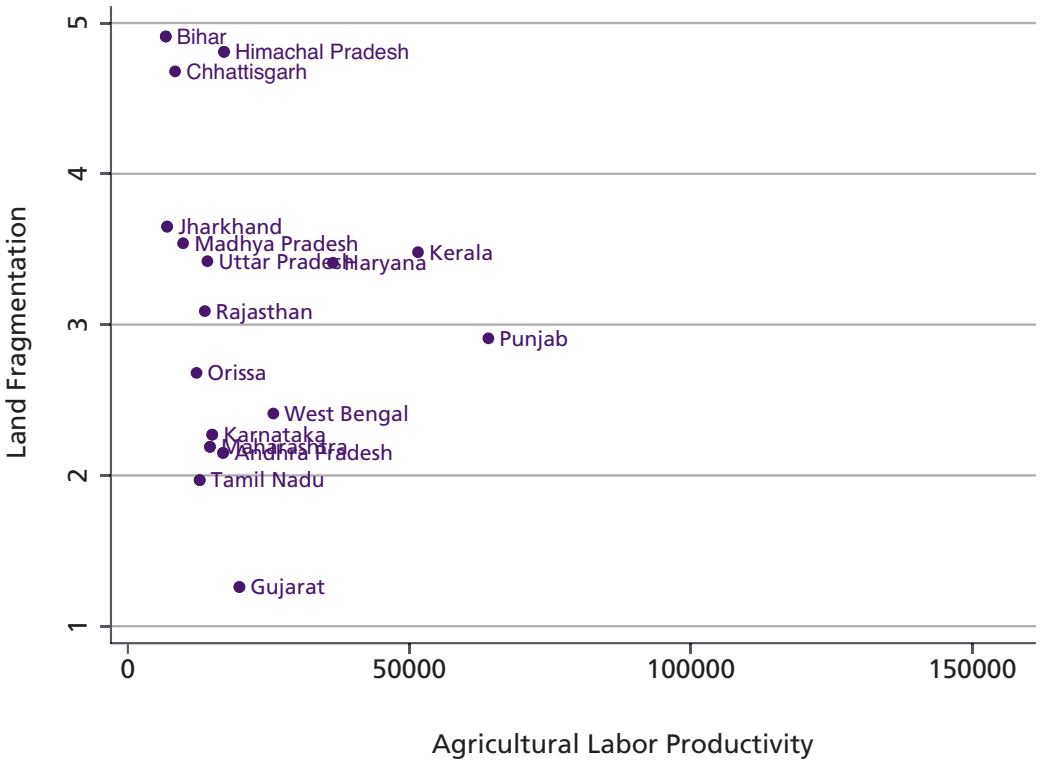


Figure 8. Land fragmentation and agricultural output per worker, 2005.

three categories: they distinguish between 'property rights' institutions and 'contracting' institutions and they examine the role of financial development. Beck *et al*. (2000) make the empirical case for the role of financial market institutions. Furthermore, the theoretical literature on growth and the role of imperfect credit markets is sizeable (see Banerjee and Newman 1993; Galor and Zeira 1993; Buera and Shin 2008). In the cross-country literature, in order to capture the protection of property rights, a measure of the 'risk of expropriation' is usually employed. This comes from *Political Risk Services*. To measure the quality of contracting institutions, Acemoglu and Johnson (2005) use an index for legal complexity, compiled by Djankov *et al*. (2003). The basic idea is that greater legal complexity introduces transaction costs, making it harder to enforce contracts. Their index looks at the legal complexity involved in resolving relatively simple disputes such as a bounced cheque or eviction of defaulting residential tenants. Finally, Beck *et al*. (2003) created various measures of financial market development such as private credit as a fraction of GDP.

We start with financial development, since we have mentioned the role of credit markets already in the context of dualism. To compare Bihar with other states, we constructed a measure of credit-to-GDP ratio. This is similar to the measure created by Beck *et al*., but is based on scheduled commercial banks as opposed to all banks. Hence, it is not 'private' credit but rather credit through public sector banks. Nevertheless, given the important role of scheduled commercial banks, the variable is likely to be able to capture useful information. Figure 9 depicts the relationship between the logarithm of the credit-to-GDP ratio and the

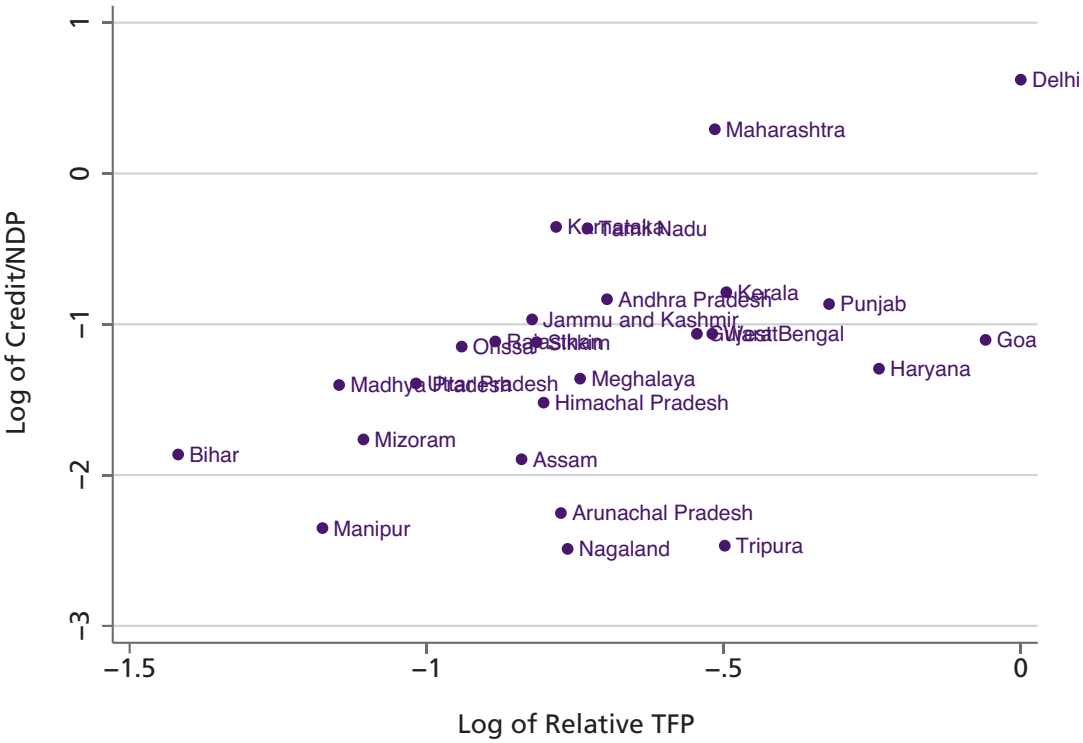


Figure 9. Financial market development and TFP differences, 2005.

logarithm of relative TFP. The strong relationship is obvious.[10] While we already know that Bihar has the lowest TFP, it fares less badly in terms of financial market development.

Labour market regulations are another institution receiving a lot of attention in the academic and policy debates on the dismal performance of the Indian manufacturing sector. Besley and Burgess (2004) highlight the role of labour market regulations by constructing an index for Indian states and showing the deleterious effects of pro-worker legislation on output, employment, investment and productivity in formal manufacturing. Although this index has been subject to some criticism (Bhattacharjea 2009), subsequent modifications by Gupta (2009) have not changed the basic result. Furthermore, Aghion *et al*. (2008) find that states with more stringent labour laws reaped fewer benefits during the post-reform period. Regarding the question of where Bihar stands when measured against these indices, the results are very mixed. According to the Burgess and Besley index, Bihar falls under the category of neutral labour laws (neither pro-employer nor pro-labour). On the other hand, the OECD (2007) data, which Gupta draws upon, place Bihar under the inflexible labour laws category.

In addition to labour market regulations, one can also consider product market regulations. Conway and Herd (2008) apply the OECD methodology for measuring product market regulations. The regulatory areas covered by the product market regulations indicators can be classified into three broad groups: the extent of state control in the economy, the degree to which regulation acts a barrier to

10 The graph for credit-to-GDP ratio and labour productivity looks very similar.

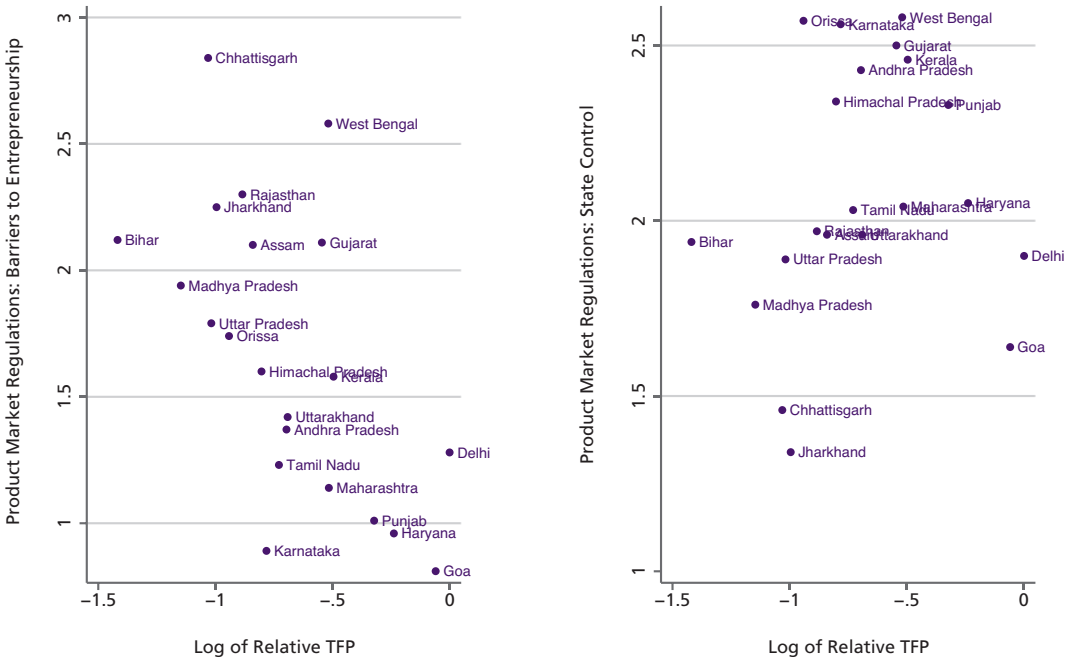


Figure 10. Product market regulations and TFP differences.

entrepreneurship, and the existence of regulatory barriers to international trade and investment. Obviously, only the first two are relevant when looking at states rather than countries. The advantage of these indicators is that, unlike business climate indicators, they reflect objective rules rather than perceptions and opinions. Overall, the regulatory environment in India is much more restrictive than it is in all other regions in the world for which such data have been constructed (Africa is the only major world region that is missing). However, within India, it turns out that Bihar is less restrictive than the Indian average in terms of both state control and barriers to entrepreneurship. Thus, the perception that Bihar is business unfriendly may have less to do with rules and regulations and more to do with risk of expropriation. Figure 10 depicts the relationship between TFP and the two major components of these regulations. The overall correlation between the state control measure and TFP is weak, and Bihar itself does not have high levels of state control. The relationship is much stronger between TFP and barriers to entrepreneurship. While Bihar's value is high, it is actually similar to that of Gujarat and lower than some other states.

We conclude this section with table 3, which lists correlations among various variables: TFP, labour productivity, the composition effect, land fragmentation, financial sector development, labour market regulations and product market regulations (that is, the overall level of state control and barriers to entrepreneurship). We find the composition effect, land fragmentation, financial market development (credit) and barriers to entrepreneurship to be highly correlated with both TFP and labour productivity. Of course, correlation does not imply causation.[11]

11 We also ran some ordinary least-squares 'horse race' regressions. In general, we found that composition effect, barriers to entrepreneurship and land fragmentation were significant. However, given the fragile nature of the regressions and the high degree of reverse causality, we have not listed them here.

Table 3. Output, TFP and institutions (correlations).

	Log relative TFP	Log Y/L	Log COMP	Land fragmentation	Credit	Labour regulations	Product-market regulations: overall	Product-market regulations: state	Product-market regulations: barriers
Log relative TFP	1 29								
Log Y/L	0.9677 29	1 32							
Log COMP	0.765 29	0.7641 29	1 29						
Land fragmentation	−0.5209 17	−0.4492 17	−0.5347 17	1 18					
Credit	0.4842 26	0.5445 29	0.3464 26	−0.6761 15	1 29				
Labour regulations	0.2343 16	0.1444 16	0.2163 16	−0.2255 14	0.0632 16	1 16			
Product-market regulations: overall	−0.4469 21	−0.4895 21	−0.2466 21	0.007 17	−0.3657 18	0.5801 15	1 21		
Product-market regulations: state	0.1855 21	0.1627 21	0.3415 21	−0.5133 17	0.0784 18	0.4471 15	0.3837 21	1 21	
Product-market regulations: barriers	−0.5926 21	−0.6235 21	−0.4786 21	0.3411 17	−0.4938 18	0.3841 15	0.8162 21	−0.2201 21	1 21

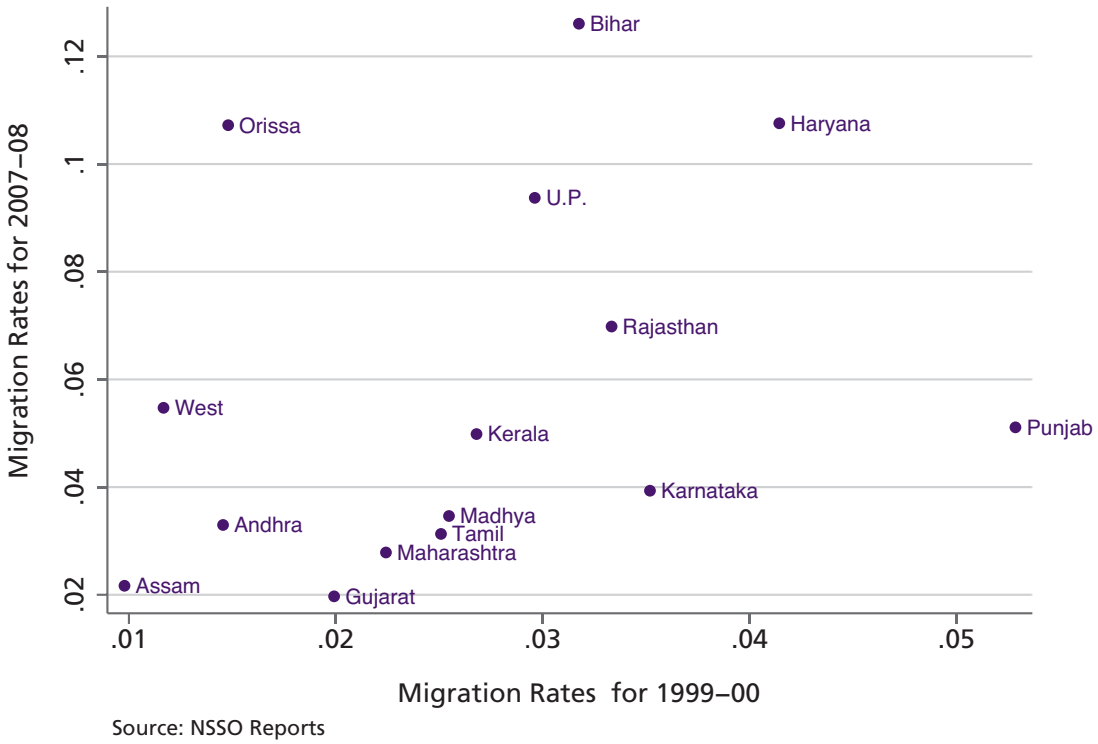
5. Factor Accumulation

In open economies, closed neoclassical models such as the canonical Solow model become less relevant. Since capital, in theory, can freely flow from one state to another, one would expect marginal products to equalize. Indeed, the evidence put forward by Foster and Rosenzweig (2004) suggests that capital is quite mobile across districts in India. Similarly, frictionless labour markets would imply that marginal products of labour should also equalize across states. To what extent this is actually true for Bihar, and India in general, is an empirical question. On the one hand, anecdotal evidence suggests that a large amount of migration takes place across state borders. In particular, the 'migrant' Bihari represents a cliché in this discourse. If migration was commonplace, then the entire convergence and development accounting exercise would, *ex ante*, be unnecessary. With the equalization of marginal products, we should see equality across states in terms of average productivity. Obviously, this is not what we observe. Instead, the data suggest that Bihar has lagged behind for a substantial period of time, with only some evidence of convergence in the past few years. This persistent gap perhaps suggests that states in India are not as 'open' or that there is some other factor preventing workers from freely migrating to other states.[12]

To gauge the extent of migration, we collected some data from NSS reports on interstate migration. Figure 11 presents out-migration rates across states based on surveys in 1999–2000 and 2007–8. There are two interesting observations that one can make about Bihar. First, in 1999–2000, Bihar's out-migration rate is not significantly different from that of other states. At a little more than 3% of the population, it is still lower than that of Haryana, Punjab and Karnataka. Interestingly, these states have considerably higher per capita GDP than Bihar. One possibility is that a lot of the migration from these states could be taking place to nearby urban centres (for example, from Haryana and Punjab to Delhi and Chandigarh). Nevertheless, among the low-income states Bihar still has the highest out-migration rate, followed closely by Uttar Pradesh.

Between 1999–2000 and 2007–8, however, we see a dramatic change in migration rates from Bihar. According to our calculations, migration rates now stand at around 12% of the population—a dramatic increase. The 2007–8 data reinforces some of our prior assumptions regarding out-migration. Out-migration rates are highest for the poorest states (Bihar, Uttar Pradesh and Orissa), although Haryana also has a high out-migration rate (which could be attributed to the Delhi effect). Out-migration rates are lowest for states that have done well in the post-reform era (Maharashtra, Gujarat, Karnataka, etc.). Interestingly, although Karnataka had a relatively high out-migration rate in 1999–2000, we find that there has been virtually no increase since then. This is not surprising given the booming high-tech sector there. What are the implications of the huge increase in out-migration

12 Gill (1984) surveys villages in Jullunder (Punjab) and East Champaran (Bihar) to better understand the causes and patterns of migration. The main findings are that, while elements of migration are seasonal (different planting and harvesting seasons), the overriding factor seems to be higher wages in Punjab, for both agriculture and the non-seasonal construction industry.



Source: NSSO Reports

Figure 11. Changes in migration rates.

rate for Bihar? Given that Bihar has seen 9% of its population leave over a ten-year period, economic theory would suggest two effects. First, the marginal product of labour should increase and, thus, average wages and labour productivity should go up. Second, since out-migrants usually leave family behind to whom they send remittances, there might be large capital flows into the state (further increasing the marginal product of labour). Figure 12 presents data on remittances as a share of GDP. For Bihar, remittances in 2007–8 accounted for approximately 5.5% of GDP. The only state with a higher figure for remittances than Bihar is Kerala, which receives large remittances from migrant workers in the Middle East.

The data and the high level of remittances suggest that, unlike the convergence found in the traditional Solow model, open economy convergence factors might have been at work over the last decade. While a lot of the growth in Bihar has been attributed to construction spending, it is important not to discount the simple economic forces at work. Furthermore, the high level of remittances can help to solve another puzzle of the recent Bihar growth story: the fact that a lot of growth has taken place in construction and non-tradeable services, such as hotels/restaurants and telecommunications. The traditional explanation has been that the construction boom funded by central government has led to pecuniary externalities for hotels and restaurants (more contractors and engineers visiting the state). However, an argument can be made that remittances have financed a consumption boom. This has led to a spike in the number of hotels, restaurants and telecommunication services. For growth pessimists this might be worrisome, as it implies that remittance inflows are not financing investment so much as they are financing imported consumption goods from the rest of the

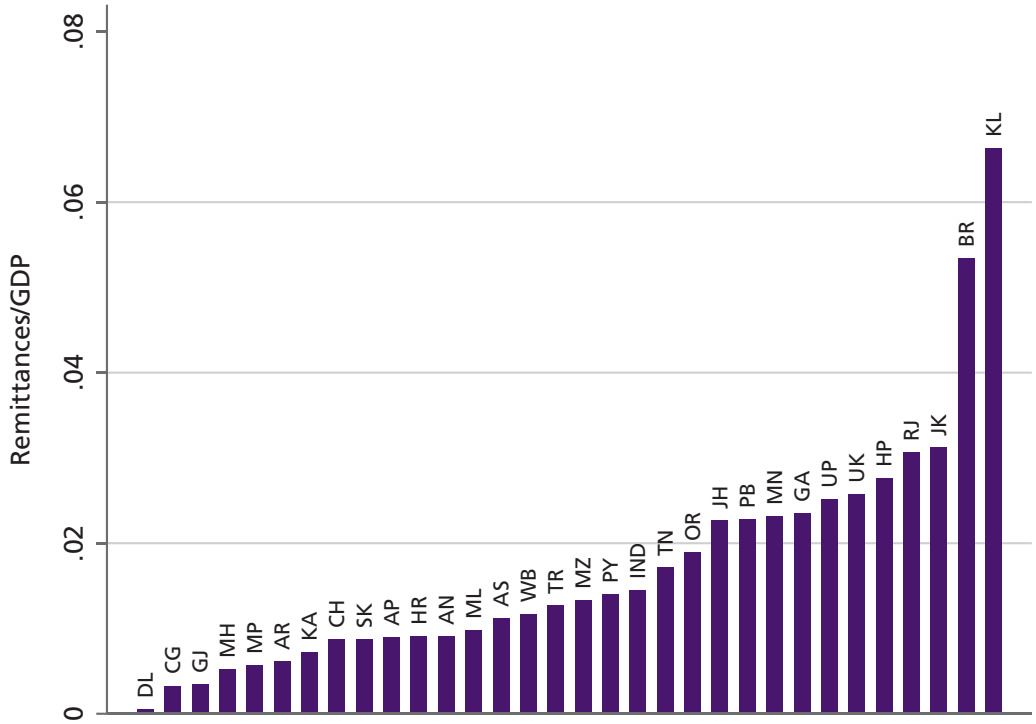


Figure 12. Remittances as a share of state NDP, 2007–8.

country.[13] It may therefore have led to service sector growth rather than contributing to any manufacturing growth.[14]

5.1. Human Capital and Population Growth

One of the central contributions of growth theory over the past couple of decades has been the integration of human capital into the debate. The literature is now so large that it is impossible to do it justice with a brief discussion. Here, I will briefly review three areas of advancement that are more relevant in the context of Bihar. First is the vexing issue of causality. While early papers such as Mankiw *et al*. (1992) seemed to provide evidence of both economically and statistically significant effects of investment in human capital on economic growth, this finding was quickly called into question. Indeed, the effects of schooling on growth turned out to be one of the most fragile relationships in the growth regression literature. This led to two strands of thought.

The first strand is exemplified by the work of Bils and Klenow, who suggest that it is growth that causes schooling rather than the other way round. From a theoretical standpoint, this makes intuitive sense: the prospect of higher growth in wages would lead forward-looking agents to invest more in human capital.

13 For some sceptical views on Bihar's recent growth resurgence, see Das Gupta (2010) and Nagaraj and Rahman (2010).

14 In terms of magnitude, a more important source of inflows is expenditure by the central government. Pinaki (2010) notes that the central government finances 70% of the state government's expenditures. There is considerable debate on the 'fairness' in central government allocations (see Pinaki (2010) and Guruswamy *et al*. (2006) for more on this subject).

This, in turn, might also have an effect on savings. From a general equilibrium standpoint, the overall effect on savings is unclear and depends, to a large extent, on the development of credit markets. In advanced countries, where it is easier to borrow for education, it might lead to a decline in the savings rate (as measured in national income accounts).[15] On the other hand, in developing countries, where credit markets for education do not exist, this would encourage parents to save more for their children's education. There is some evidence supporting this kind of behaviour in China (Prasad and Chamon 2010). Again, in the context of a state, it is important to be cognizant of open economy issues. The incentive to invest in human capital may have little to do with the state's own growth prospects if it is easy to migrate to other areas of the country. In the case of Bihar, anecdotal evidence suggests that this brain drain might be significant. To a large extent, in the presence of imperfect credit markets this is also a function of income inequality: richer individuals have the resources to invest in human capital and then migrate from the state, while poor individuals cannot invest in human capital (Galor and Zeira 1993). Of course, poor individuals may simply migrate without investing in human capital as long as the returns to unskilled labour are high elsewhere. As those familiar with Bihar know, this, too, is very much a part of the Bihar story. Whether human capital affects growth or is affected by growth is obviously an interesting research question that has not yet been adequately pursued for India, let alone for Bihar. The fact that growth can lead to more schooling is also apparent in some of the findings of a recent report on elementary education (Ghosh and Rana 2011), which argues that the rise in private tuition reflects the 'elevated aspiration of the parents to acquire quality education'. Nevertheless, this is only suggestive and more research needs to be done. Perhaps it would be possible to identify growth shocks and human capital shocks in various regions in order to disentangle these effects.

The second aspect of the ambiguous human capital–growth relationship pertains to the poor measures of quality of education. Within the cross-country framework, this has been very difficult to disentangle. One strategy has been to look at the returns to human capital for different immigrant groups in a host country such as the US after controlling for other factors (see, for example, Schoelman 2010). Applying the results to a development accounting exercise, Schoelman finds that the contribution of education doubles its role by explaining output per worker differences. An alternative strategy is to look at international test-score variations. Hanushek and Woessman (2009) note that differences in quality as measured by standardized test scores do a much better job of explaining variations in growth compared with years of schooling. The results themselves are quite surprising, although, again, one must be aware of issues of endogeneity—poorer areas are less likely to be able to match the quality of education provided in richer areas.

Within Bihar, educational attainment has increased significantly, particularly in the past few years. Enrolment rates in elementary education are now at 98%

15 See, for example, Chanda (2008), where it is argued that higher returns to education can partially explain lower savings in the US.

(Ghosh and Rana 2011). Nevertheless, quality remains a challenge. To compare Bihar with the rest of India, one can look at an outcome-based measure of quality (e.g. results in high school national board exams) or an input-related measure. One input-related measure that has been the subject of intense study is teacher absenteeism. Drawing on a nationally representative sample of 3,700 schools, Kremer *et al*. (2005) find that Bihar has the second-highest rate of teacher absenteeism, at 37% around 2003.[16] Absenteeism, though, is a (negative) input and not an output. Moreover, one has to be mindful of the period of measurement used. Absenteeism today is likely to have deleterious effects on productivity in the future, but not on productivity today. Thus, the high rate of absenteeism is a leading indicator of future human capital quality. Another leading indicator of educational attainment is dropout rates. While enrolment rates have risen in Bihar, the dropout rate was still high in 2001: 75% for grades 1–8, compared with 41% for the whole of India.

A third important aspect of the human capital–growth relationship that we would like to draw attention to is the role of human capital in facilitating technology adoption. The argument goes back at least as far as Nelson and Phelps (1966), who postulated that simply viewing human capital as a factor of production is not enough. Human capital also plays a role in facilitating technology adoption and thus TFP growth. The Nelson and Phelps idea has been empirically tested by Benhabib and Spiegel (2005) using the following specification:

$$\frac{\dot{A}_i(t)}{A_i(t)} = g_i(h_i(t)) + c(h_i(t))\left(1 - \frac{A_i(t)}{A_F(t)}\right),$$

where $\dot{A}_i(t)/A_i(t)$ refers to TFP (or technological growth) in the country of interest and $g_i(h_i(t))$ represents the direct effect of human capital on the rate of innovation. $c(h_i(t))(1 - A_i(t)/A_F(t))$ captures catch-up effects and depends on two things: human capital and the initial gap between country i and the country at the frontier. The idea here is that, for two countries that have the same gap relative to the frontier country, the one with the human capital will experience faster rates of growth in TFP. In addition to Benhabib and Spiegel finding this effect to be true at the cross-country level, Foster and Rosenzweig (1996) have also provided convincing evidence that, during the green revolution in India, farmers with higher levels of education benefitted more from new technologies. More evidence supporting human capital's facilitating role comes from Borenzstein *et al*. (1998), who show that countries with higher levels of human capital tend to benefit more from foreign direct investment (in terms of higher growth rates). In the context of Bihar, relative to India, there is no doubt that the lack of human capital would then create an additional disadvantage. Unfortunately, it is difficult to know to what extent this is a problem, since we do not have measures of TFP growth in Bihar.

Finally, an important area in which research on human capital and growth has broken new ground is in understanding the long-term simultaneous evolution

16 Ironically, this is a case where the bifurcation of Bihar has been good for the state: the highest rate of absenteeism is in Jharkhand with 41%.

of both variables along with fertility choice (and thus population growth). The seminal work in this area by Galor and Weil (1996, 2000) involves sophisticated theoretical models that are capable of reproducing the transition from the Malthusian regime to the industrial revolution and modern economic growth. In the process, they can also explain the evolution of investments in human capital and fertility rates. While it would be a stretch to apply these specific models to Bihar, one could certainly draw on some of the fundamental concepts and the subsequent literature. Most of this work incorporates fertility choice based on income versus substitution effects or Becker's quality versus quantity trade-offs. In the former case, children are viewed as normal goods, but higher incomes also lead to rising opportunity costs from having children. When the latter offsets the former, fertility begins to decline. In the quality–quantity model, rising returns to human capital (due to economic growth) lead parents to invest in fewer children while investing more in each child's education. Given that there are possibly other reasons why fertility might decline (e.g. declining mortality, which is also a function of economic growth), it is difficult to conduct rigorous econometric tests. As a rough exercise, we look at the orthogonal relationship between declines in fertility rates and increases in literacy rates after conditioning for initial income. Initial income is added as a 'catch-all' control for other possible determinants: mortality, general convergence behaviour, etc. We ran the regression for two subperiods, 1971–2005 and 1993–2005. For both periods, declines in fertility rates exert a strong positive effect on literacy rates. The results are displayed in table 4. Initial income also exerts an independent negative effect, no doubt picking up some convergence dynamics. Nonetheless, these regressions are suggestive at best—the sample is too small for the results to be conclusive. Figure 13 shows the orthogonalized plots from the second regression in table 4. The negative relationship is clearly present. However, compared with other states Bihar seems to have gained less in terms of literacy for similar declines in fertility.[17]

6. Concluding Thoughts

This paper has tried to present an overview of Bihar's productivity challenges within the framework of recent developments in growth theory. The research on economic growth is so vast, and the experience of Bihar involves so many variables, that it is impossible to cover all the bases. We have focused on certain elements that draw upon the recent consensus in the growth literature on the importance of TFP relative to physical capital accumulation, and the role of institutional quality and misallocation of resources in driving low TFP and low overall productivity. The paper combined this with particular elements that have been problematic in Bihar: dualism, land fragmentation and low levels of human capital. As the paper has highlighted, Bihar clearly has a TFP problem. This is tied, to a large extent, to its extremely low agricultural productivity and, to a

17 Note that the plot reflects residuals and not actual values. During this period Bihar experienced a 0.4 point decrease in fertility and a 13 point increase in literacy rates. Also, during this period, Kerala experienced a slight increase in fertility. Finally, the fact that Bihar lagged behind in literacy gains can obviously reflect an omitted variable problem in the regression.

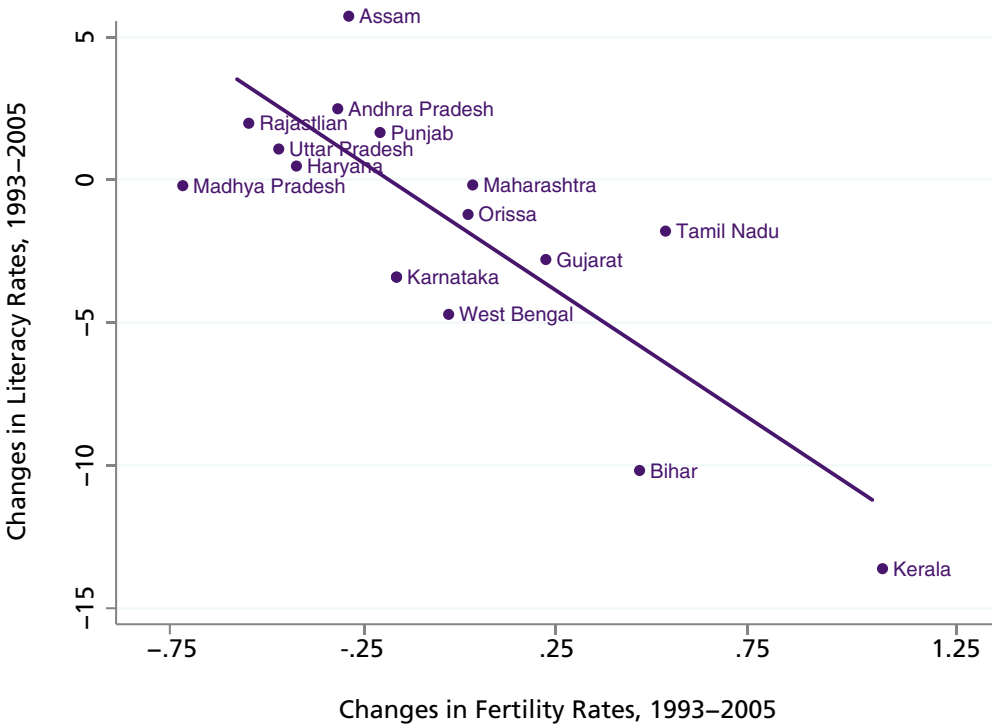


Figure 13. Changes in the literacy rate versus the fertility rate: orthogonal relationship (1993–2005).

Table 4. Fertility and education (dependent variable: changes in literacy rates).

	1993–2005	1971–2005
Change in fertility	−9.27 (1.90)	−6.99 (1.91)
Initial log GDP per capita	−3.65 (1.21)	−13.31 (5.05)
R^2	0.70	0.62
N	15	12

lesser extent, its poor financial development. Bihar does not fare poorly in some other areas, such as product and labour market regulations. Furthermore, over the past thirteen years, it is obvious that the trade-off of declining fertility and increasing educational attainment has been strong for Indian states. However, Bihar has lagged behind in terms of gains as measured by increases in literacy rates.

There are still other areas in which this research needs to be extended. The paper suggests that the role of education quality is important but that we do not have a good indicator with which to incorporate it into our analysis. In terms of the development accounting exercise earlier, this would increase Bihar's TFP but lower its human capital per worker. Finally, for future research, it may be worthwhile to consider building general equilibrium models with distortions explicitly built in to understand the relative importance of various distortions. For example, one could envision a unifying general equilibrium model with credit market frictions, land

as an endowment, and endogenous fertility and education choices.[18] With the correctly calibrated parameters, it need not be difficult to replicate Bihar's problems of land fragmentation, unproductive agriculture and low levels of human capital accompanied by low growth.

At the same time, one should not ignore the deep determinants of economic performance. In the case of Bihar, the role of feudal systems, colonial institutions and geographic factors all play an important role. We briefly highlighted the work of Banerjee and Iyer (2005, 2009) at the national level, in conjunction with the work on Bihar by Rouyer (1994). However, a more rigorous district-level analysis for Bihar might provide interesting insights. In addition to historical institutions, research on long-run economic growth has come to recognize the importance of geography. While most of this focuses on variables such as access to the coast, soil suitability for agriculture, etc., there is also an increasing interest in the role of natural disasters. Kahn (2005) finds that the death toll from natural disasters is greater in poorer countries and in countries that have higher income inequality and are less democratic.[19] Such research is important for Bihar given the frequent flooding of the Kosi river (see Rourbacher (2008) and Mishra (2008) for more on the effects of floods on Bihar's proposed solutions). Flooding itself—and particularly repeated flooding, as has been the case in Bihar—is, of course, not entirely exogenous. Finally, with the bifurcation of Bihar in 1999, the state lost access to an abundant supply of natural resources. While it was initially claimed that this would hurt Bihar, the state has clearly experienced comparatively higher growth rates since bifurcation. Clearly, the improving law and order situation has played an important role. However, growth theory suggests some other possible channels. For example, Sachs and Warner (1995) have found that, at the cross-country level, natural resource abundance can be detrimental to economic growth. Lane and Tornell (1996) provide a rationale for this outcome. They show that in an economy where there are many powerful groups and institutions are poor, the gains from natural resource prices are more than offset by the redistribution of such gains to these groups. In the context of Bihar, the possibility that bifurcation might have actually been beneficial has not gone unnoticed. For example, Bhattacharya (2000), while mostly remaining cautious about Bihar's post-bifurcation potential, notes that it might actually reduce corruption due to the loss of a celebrated 'scam route' that originated in Jharkhand's more lenient administrative regime.

Before finishing, we should point out that this paper has focused on analysing the sources of economic growth. We have not devoted attention to the implications of economic growth. In the academic and policy environment, a lot of the discussion seems to surround the effect of growth on poverty and inequality. The cross-country work seems to find that the incomes of the poorest rise proportionately to the average income of the population (Dollar and Kraay 2002).

18 This might sound overly ambitious, but de la Croix and Doepke (2003) cover similar ground, although they do not explicitly consider land.

19 In a similar vein, Strobl (2008) finds that hurricanes along the US coast have negligible long-run growth effects, which is unsurprising given Kahn's findings regarding the role of development and institutional quality in mitigating the effects of disasters.

However, the evidence is not clear for India as a whole and has been subject to vigorous debate, largely centring around sampling techniques (see, for example, Lal *et al*. 2001). Nevertheless, the data seem to indicate that Bihar has experienced poverty reduction more or less at the same pace as the nation as a whole, but, in terms of absolute levels, it still remains among the poorest states.[20] As far as inequality is concerned, in 2004–5, Bihar registered slightly lower Gini coefficient compared with all of India for both urban and rural areas. Overall, over the period from 1973 to 2005, Bihar saw a fairly large decline in rural inequality and an equally large increase in urban inequality.[21] In any case, for a poor state such as Bihar, there is little to redistribute, and sustaining the recent increase in growth is of paramount importance.

20 See Himanshu (2007, 2010) for recent trends and estimates of poverty rates using NSS data. For Bihar, the rural and urban poverty rates in 2004–5 were 56% and 44%, respectively, while for India as a whole they were 41.8% and 25%.

21 In 1970, Bihar's rural and urban Gini coefficients were 0.27 and 0.26, respectively. In 2004–5 these were 0.20 and 0.33. The four corresponding numbers for India as a whole were 0.28, 0.30, 0.30 and 0.37 (Planning Commission 2010, table 21).

Table 5. Data appendix.

Variable	Data source
State Net Domestic Product (SNDP) and population	Economic and Political Weekly Research (EPWRF) database (1960–2006), Reserve Bank of India, Handbook of Statistics on the Indian Economy (www.rbi.org.in/scripts/AnnualPublications.aspx?head=Handbook%20of%20Statistics%20on%20Indian%20Economy)
Literacy rates (1961, 1971, 1991, 2001)	Planning Commission, (Government of India), Data tables, table 112 (http://planningcommission.gov.in/data/datatable/index.php?data=datatab)
Adult population shares by education level (total, rural and urban), to calculate state human capital	National Family and Health Survey (2005), data compiled from various state reports (www.nfhsindia.org/report.shtml)
Labour force (to calculate SNDP per worker), 2005	Labour force participation rates from 2001 census were applied to population data for 2005 (www.censusindia.gov.in/Census_Data_2001/Census_Data_Online/Economic_Data/Work_Participation_rate.aspx)
Capital stock by state, 2005	Output shares of various sectors from EPWRF for 2005 used to allocate aggregate capital stocks by state (see text for details). Aggregate capital stocks come from National Accounts Statistics (http://mospi.nic.in/dwh/index.htm)
Returns to education	Duraiswamy (2000)
Sectoral labour force by state, 2005	Agricultural labour force shares for 2001 from Government of India Agricultural Statistics at a Glance (table 2.3b). These were applied to state labour force numbers for 2005. Non-agricultural labour force shares $\equiv 1-$ agricultural labour force shares
Land fragmentation	Monchuk *et al*. (2010)
Credit of scheduled commercial banks (used for credit/GDP ratio)	Reserve Bank of India, statistical tables related to banking in India, table 2.3. State-wise distribution of deposits and credit of scheduled commercial banks In India, 2004 and 2005 (www.rbi.org.in/scripts/AnnualPublications.aspx?head=Statistical+Tables+Relating+to+Banks+of+India)
Product market regulations (state control and barriers to entrepreneurship)	Conway and Herd (2008)
Labour market regulations	Besley and Burgess (2000)
Migration rates, 1999–2000	National Sample Survey Organisation, Government of India, 2001. Migration in India, 1999–2000, Report 470, table 4.1 (p. 47)
Migration rates, 2007–8	National Sample Survey Organisation, Government of India, 2010, Migration in India, 2007–8, Report 533, tables 4.1.1 and 6.2.1
Remittances, 2007–8	National Sample Survey Organisation, Government of India, 2010, Migration in India, 2007–8, Report 533, Statement 6.7.1
Literacy rates and fertility rates for 2005	National Family and Health Surveys, 2005, Data compiled from various state reports (www.nfhsindia.org/report.shtml)

References

Acemoglu, D., and Dell, M. 2010. Productivity differences between and within countries. *American Economic Journal: Macroeconomics* **2**(1), 169–88.

Acemoglu, D., and Johnson, S. 2005. Unbundling institutions. *Journal of Political Economy* **113**, 949–95.

Acemoglu, D., Johnson, S., and Robinson, J. A. 2001. The colonial origins of comparative development: an empirical investigation. *American Economic Review* **91**, 1369–401.

Acemoglu, D., Johnson, S., and Robinson, J. A. 2002. Reversal of fortune: geography and institutions in the making of the modern world income distribution. *Quarterly Journal of Economics* **117**(4), 1231–94.

Adamopoulos, T., and Restuccia, D. 2011. The size distribution of farms and international productivity differences. Mimeo, University of Toronto.

Aghion, P., Burgess, R., Redding, S. J., and Zilibotti, F. 2008. The unequal effects of liberalization: evidence from dismantling the license Raj in India. *American Economic Review* **98**(4), 1397–412.

Banerjee, A. V., and Iyer, L. 2005. History, institutions, and economic performance: the legacy of colonial land tenure systems in India. *American Economic Review* **95**(4), 1190–213.

Banerjee, A. V., and Iyer, L. 2009. Colonial land tenure, electoral competition, and public goods in India. In *Natural Experiments in History* (ed. J. Diamond and J. Robinson). Cambridge, MA: Harvard University Press.

Banerjee, A. V., and Newman, A. F. 1993. Occupational choice and the process of development. *Journal of Political Economy* **101**(2), 274–98.

Barro, R. J., and Sala-i-Martin, X. 1991. Convergence across states and regions. *Brookings Papers on Economic Activity* **22**(1), 107–82.

Beck, T., Demirgüc-Kunt, A., and Levine, R. 2003. Law, endowments, and finance. *Journal of Financial Economics* **70**, 137–81.

Beck, T., Levine, R., and Loayza, N. 2000. Finance and the sources of growth. *Journal of Financial Economics* **58**(1), 261–300.

Benhabib, J., and Spiegel, M. M. 2005. Human capital and technology diffusion. In *Handbook of Economic Growth* (ed. P. Aghion and S. Durlauf), 1st edition. pp. 935–66. Elsevier.

Besley, T., and Burgess, R. 2000. Land reform, poverty reduction, and growth: evidence from India. *Quarterly Journal of Economics* **115**(2), 389–430.

Besley, T., and Burgess, R. 2004. Can labor regulation hinder economic performance? Evidence from India. *Quarterly Journal of Economics* **119**(1), 91–134.

Bharti, I. 1992. Bihar's bane: slow progress on land reforms. *Economic and Political Weekly* **27**(13), 628–30.

Bhattacharjea, A. 2009. The effects of employment protection legislation on Indian manufacturing. Working Paper 96, Center on Democracy, Development, and the Rule of Law. Freeman Spogli Institute for International Studies.

Bils, M., and Klenow, P. J. 2000. Does schooling cause growth? *American Economic Review* **90**, 1160–82.

Borensztein, E., De Gregorio, J., and Lee, J.-W. 1998. How does foreign direct investment affect economic growth? *Journal of International Economics* **45**, 115–35.

Buera, F. J., and Shin, Y. 2010. Financial frictions and the persistence of history: a quantitative exploration. Mimeo, Washington University, St. Louis.

Caselli, F. 2005. Accounting for cross-country income differences. In *Handbook of Economic Growth* (ed. P. Aghion and S. Durlauf), volume 1A. Amsterdam: North-Holland.

Chadha, G. K., and Khurana, M. R. 1989. Backward agriculture, unrewarded labour and economic deprivation: Bihar's contrast with Punjab. *Economic and Political Weekly* **24**(47), 2617–23.

Chakraborty, P. 2010. Recommendations for the thirteenth finance commission: recommendations for Bihar. Mimeo.

Chanda, A. 2008. The rise in returns to education and the decline in household savings. *Journal of Economic Dynamics and Control* **32**(2), 436–69.

Chanda, A., and Dalgaard, C.-J. 2008. Dual economies and international total factor productivity differences: channelling the impact from institutions, trade, and geography. *Economica* **75**, 629–61.

Chatterjee, S., Lahiri, A., and Yi, K.-M. 2007. Income disparities across Indian States. Presentation at Society of Economic Dynamics Annual Conference.

Conway, P., and Herd, R. 2008. Improving product market regulation in India: an international and cross-state comparison. Working Paper 599, OECD Economics Department.

Das Gupta, C. 2010. Unravelling Bihar's 'growth miracle'. *Economic and Political Weekly* **45**(52), 50–62.

Djankov, S., La Porta, R., Lopez-de-Silanes, F., and Shleifer, A. 2003. Courts. *Quarterly Journal of Economics* **118**, 453–517.

Dollar, D., and Kraay, A. 2002. Growth is good for the poor. *Journal of Economic Growth* **7**(3), 195–225.

Duraiswamy, P. 2000. Changes in returns to education in India 1983–94 by gender, age, cohort and location. Discussion Paper 815, Economic Growth Center, Yale University.

Easterly, W., and Levine, R. 2003. Tropics, germs, and crops: the role of endowments in economic development. *Journal of Monetary Economics* **50**, 3–39.

Economic and Political Weekly Research Foundation. 2009. *Domestic Product of States of India 1960–61 to 2006–07*, 2nd updated edition. Mumbai: EPWRF.

Engerman, S. L., and Sokoloff, K. L. 1997. Factor endowments, institutions, and differential paths of growth among new world economies. In *How Latin America Fell Behind* (ed. S. H. Haber). Stanford University Press.

Engerman, S. L., and Sokoloff, K. L. 2000. Institutions, factor endowments, and paths of development in the new world. *Journal of Economic Perspectives* **14**, 217–32.

Foster, A. D., and Rosenzweig, M. R. 1996. Technical change and human-capital returns and investments: evidence from the green revolution. *American Economic Review* **86**(4), 931–53.

Foster, A. D, and Rosenzweig, M. R. 2004. Agricultural productivity growth, rural economic diversity, and economic reforms: India, 1970–2000. *Economic Development and Cultural Change* **52**(3), 509–42.

Galor, O., and Weil, D. N. 1996. The gender gap, fertility, and growth. *American Economic Review* **86**(3), 374–87.

Galor, O., and Weil, D. N. 2000. Population, technology and growth: from Malthusian stagnation to the demographic transition and beyond. *American Economic Review* **90**, 806–28.

Galor, O., and Zeira, J. 1993. Income distribution and macroeconomics. *Review of Economics Studies* **60**, 35–52.

Garofalo, G. A., and Yamarik, S. 2002. Regional convergence: evidence from a new state-by-state capital stock series. *Review of Economics and Statistics* **84**(2), 316–23.

Ghatak, M., and Roy, S. 2007. Land reform and agricultural productivity in India: a review of the evidence. *Oxford Review of Economic Policy* **23**(2), 251–69.

Ghosh, P., and Rana, K. 2011. *First Report on Elementary Education in Bihar: Progress and Challenges*. Pratichi (India) Trust/Centre for Economic Policy and Public Finance, ADRI Patna.

Gill, I. 1984. Migrant labour: a mirror survey of Jullunder and East Champaran. *Economic and Political Weekly* **19**, 961–4.

Gollin, D. 2002. Getting income shares right. *Journal of Political Economy* **110**(2), 458–74.

Gollin, D., Parente, S., and Rogerson, R. 2004. Farm work, home work and international productivity differences. *Review of Economic Dynamics* **7**, 827–50.

Gupta, P., Hasan, R., and Kumar, U. 2009. Big reforms but small payoffs: explaining the weak record of growth in Indian manufacturing. *India Policy Forum* **5**(1), 59–123.

Guruswamy, M., Baitha, R. A., and Mohanty, J. P. 2006. Centrally planned inequality: the tale of two states: Punjab and Bihar. In *India, Issues in Development* (ed. M. Guruswamy). Gurgaon: Hope India.

Hall, R., and Jones, C. I. 1999. Why do some countries produce so much more output per worker? *Quarterly Journal of Economics* **114**, 83–116.

Hanushek, E. A., and Woessmann, L. 2009. Do better schools lead to more growth? Cognitive skills, economic outcomes, and causation. Working Paper 14633, National Bureau of Economic Research.

Himanshu. 2007. Recent trends in poverty and inequality: some preliminary results. *Economic and Political Weekly* **42**(6), 497–508.

Himanshu. 2010. Towards new poverty lines for India. *Economic and Political Weekly* **45**(1), 38–48.

Houlton, J. 1949. *Bihar: The Heart of India*. Kolkata: Orient Longman.

Hsieh, C.-T., and Klenow, P. J. 2010. Development accounting. *American Economic Journal: Macroeconomics* **2**(1), 207–23.

International Institute for Population Sciences and Macro International. 2008. *National Family Health Survey (NFHS-3), India, 2005–06: Bihar*. Mumbai: International Institute for Population Sciences.

Januzzi, T. F. 1977. An account of the failure of agrarian reforms and the growth of agrarian tensions in Bihar: 1949–1970. In *Land Tenure and Peasant in South Asia* (ed. R. E. Frykenber), pp. 211–212. New Delhi: Orient Longman.

Kahn, M. A. 2005. The death toll from natural disasters: the role of income, geography, and institutions. *Review of Economic Statistics* **87**(2), 271–84.

Kochhar, K., Kumar, U., Rajan, R., Subramanian, A., and Tokatlidis, I. 2006. India's pattern of development: what happened, what follows? *Journal of Monetary Economics* **53**(5), 981–1019.

Klenow, P. J., and Rodriguez-Clare, A. 1997. The neoclassical revival in growth economics: has it gone too far? In *NBER Macroeconomics Annual* (ed. B. Bernanke and J. J. Rotemberg), pp. 73–103. Cambridge, MA: MIT Press.

Kremer, M., Chaudhury, N., Hammer, J., Muralidharan, K., and Rogers, H. 2005. Teacher absence in India: a snapshot. *Journal of the European Economic Association* **3**, 658–67.

Lahiri, A., and Yi, K.-M. 2009. A tale of two states: Maharashtra and West Bengal. *Review of Economic Dynamics* **12**(3), 523–42.

Lal, D., Mohan, R., and Natarajan, I. 2001. Economic reforms and poverty alleviation: a tale of two surveys. *Economic and Political Weekly* **36**(12), 1017–28.

Lane, P. R., and Tornell, A. 1996. Power, growth, and the voracity effect. *Journal of Economic Growth* **1**(2), 213–241.

Lanjouw, P., and Shariff, A. 2004. Rural non-farm employment in India: access, incomes and poverty impact. *Economic and Political Weekly* **39**(40), 4429–46.

Mankiw, G. N., Romer, D., and Weil, D. N. 1992. A contribution to the empirics of economic growth. *Quarterly Journal of Economics* **107**(2), 407–37.

Mishra, D. K. 2008. Bihar floods: the inevitable has happened. *Economic and Political Weekly* **43**(8), 8–12.

Monchuk, D., Deninger, K., and Nagarajan, H. 2010. Does land fragmentation reduce efficiency? Micro evidence from India. Paper presented at the Agricultural and Applied Economics Association 2010 AAEA, CAES, and WAEA Joint Annual Meeting, Denver, CO, 25–27 July 2010.

Nagaraj, R., and Rahman, A. 2010. Booming Bihar: fact or fiction? *Economic and Political Weekly* **45**(8), 10–11.

Nayyar, R. 1979. Rural poverty in Bihar 1961–62 to 1970–71. *Journal of Development Studies* **15**(2), 194–201.

Nelson, R., and Phelps, E. 1966. Investment in humans, technological diffusion, and economic growth. *American Economic Review* **56**, 69–75.

North, D. C. 1990. *Institutions, Institutional Change and Economic Performance*. Cambridge University Press.

Organization for Economic Co-operation and Development. 2007. *OECD Economic Surveys: India* **2007**(14), 1–246.

Planning Commission. 2010. Data for use of Deputy Chairman, Planning Commission, Government of India.

Prasad, J. 2007. *Bihar: dynamics of development*. New Delhi: Mittal.

Prasad, K. N. 1997. *Bihar Economy Through the Plans: In Comparison with All-India and Other States*. New Delhi: Northern Book Center.

Purfield, C. 2006. Mind the gap: is economic growth in India leaving some states behind? Working Paper WP/06/103, International Monetary Fund, Washington, DC.

Restuccia, D. 2004. Barriers to capital accumulation and aggregate total factor productivity. *International Economic Review* **45**, 225–38.

Romer, P. M. 1986. Increasing returns and long-run growth. *Journal of Political Economy* **94**(5), 1002–37.

Rorabacher, J. A. 2008. Gerrymandering, poverty and flooding: a perennial story of Bihar. *Economic and Political Weekly* **43**(7), 45–53.

Rouyer, A. R. 1994. Explaining economic backwardness and weak governing capability in Bihar state in India. *South Asia: Journal of South Asian Studies* **17**(2), 63–89.

Sachs, J. D., and Warner, A. M. 1995. Natural resource abundance and economic growth. Working Paper 5398, National Bureau of Economic Research.

Schoelman, T. 2010. Education quality and development accounting. Mimeo, Arizona State University.

Sharma, A. 2005. *Kisan Credit Card Scheme: Impact, Weaknesses and Further Reforms*. New Delhi: National Council of Applied Economics and Research.

Strobl, E. 2008. The economic growth impact of hurricanes: evidence from US coastal counties. Discussion Paper 3619, IZA.

Turner, C., Tamura, R., and Mulholland, S. E. 2008. How important are human capital, physical capital and total factor productivity for determining state economic growth in the United States, 1840–2000? Paper 7715, Munich Personal RePEc Archive.

World Bank. 2005. Bihar: towards a development strategy. Report, World Bank, Washington, DC.

The International Growth Centre (IGC) aims to promote sustainable growth in developing countries by providing demand-led policy advice based on frontier research.

Find out more about
our work on our website
www.theigc.org

For media or communications
enquiries, please contact
mail@theigc.org

Subscribe to our newsletter
and topic updates
www.theigc.org/newsletter

Follow us on Twitter
@the_igc

Contact us
International Growth Centre,
London School of Economic
and Political Science,
Houghton Street,
London WC2A 2AE

IGC
International
Growth Centre

DIRECTED BY
LSE
UNIVERSITY OF OXFORD

FUNDED BY
UKaid
from the British people

Designed by soapbox.co.uk